TEACHERS THINKING CRITICALLY TO INCREASE
CRITICAL THINKING AWARENESS AND INTENTION

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INCREASING CT AWARENESS AND INTENTION

ABSTRACT

Critical thinking, the ability to analyze, synthesize, and evaluate information, is a necessary skill for success in the 21st century. Yet, many students across the United States are graduating high school without these skills. One possible reason that critical thinking seems to be lacking in high school classrooms is that secondary educators do not know how to inherently infuse their lessons with critical thinking opportunities. Improving students’ ability to think critically requires educators who are not only aware of their critical thinking practices but are also intentional in how they encourage their students to think critically.

Teachers can improve their critical thinking practices by participating in training that encourages the clear and purposeful infusion of critical thinking. However, studies outlining and examining how to improve teachers’ critical thinking practices are scarce. Therefore, the purpose of this qualitative study was to create, pilot, and evaluate an 8-week professional development designed to increase secondary educators’ critical thinking awareness and intention. Participants analyzed their practices and tried out new practices while working in a cross-curricular group. The goal was that increased awareness and intention would lead to improved practices. Additionally, participants shared their perception of the intervention so that necessary improvements could be made in the future. Qualitative methods allowed participants' critical thinking knowledge, beliefs, and practices to be assessed before, during, and after the intervention. The researcher determined that the participants’ critical thinking awareness and intention were increased by the opportunities provided to the participants to think critically about critical thinking within their cross-curricular group.

Keywords: critical thinking, professional development, cross-curricular professional development, awareness, and intention.
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“It always seems impossible, until it is done.” – Nelson Mandela
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CHAPTER 1: INTRODUCTION

Analyzing, synthesizing, and evaluating information, classified as the ability to think critically, are necessary skills for success in the 21st century. Today information is often disseminated at the speed of a 140 character tweet. The ability for any and all to provide information across the internet requires a population that can quickly and effectively assess the source, purpose, and content of the information presented. The democratization of information caused by social media requires that humans today can think critically about the information that is constantly available at our fingertips. Additionally, companies such as Google state that soft skills such as critical thinking (CT) improve their employees’ effectiveness (Strauss, 2017). Unfortunately, while companies desire employees with these skills and society needs people with the ability to think critically, an analysis of assessment data and classroom observations show that many students are graduating high school without the ability to think critically (Burris & Garton, 2007; Dam & Volman, 2004; Marshall & Horton, 2011; Raudenbush, Rwaon, & Cheong, 1992). The organization of schooling, the drive to cover content, and teachers’ lack of pedagogical knowledge to purposefully infuse critical thinking skills (CTS) into their classes, negatively influences the improvement of students’ ability to think critically. While research exists that addresses barriers to the improvement of CT as well as the effects of professional development (PD) on teacher practice, there is a lack of research on the type of PD that will best encourage teachers to infuse CT into their practice. Therefore, the goal of this intervention study was to develop, implement, and assess professional development specifically designed to increase teachers’ awareness and intention regarding their CT practices.
Problem Statement

Critical thinking has never truly been a goal of the American education system and so it should come as no surprise that our students are delinquent in the skill. John Dewey, a leading 20th century Progressive educator, argued that school should be a child-centered experience offering students active opportunities to search for ways to erase doubt they encountered (Gersten, 2003). Focusing on active learning experiences, as discussed by Dewey, could have led to schools that built students’ ability to think critically. However, he ultimately was not the dominant shaper of mainstream education and most schools were not set-up according to his model. Instead, schools were organized to mirror the industrial expectations of society and students were taught to produce routine tasks with minimal errors (Wagner & Dintersmith, 2015). In this system, teachers were situated as knowledge-givers and students as passive knowledge-receivers (Onosko, 1990); students were not required to think reflexively or learn through experience as suggested by Dewey (1938). This organizational structure has continued through to the present. In his seminal work *How Teachers Teach*, Cuban (1993) discovered that in an almost 100 year span, teachers’ classroom practices shifted very little and that the most common delivery of instruction in those almost 100 years was teacher-centered lessons. More recently, a study of students in a teacher preparation program discovered that rote learning and memorization continue to be the prevalent method of instruction (Allamnakhrah, 2013). Improving CT requires students to participate and engage with material, activities that are often lacking in teacher-centered classrooms.

While the persistence of teacher-centered classrooms has limited student CT growth, so too has the necessity to cover the curriculum. In 1983, *A Nation at Risk* (1983) was published and stated that America’s economic dominance was in danger because our students were falling
behind their international counterparts. Hence, public education became the focus of multiple reforms, including the “excellence movement” in which standards were written, graduation requirements were increased, more student assessments were instituted, and teacher certification requirements were tightened (Gordon, 2003). These changes did not encourage educators to develop programs that assisted students in developing skills to solve the world’s most pressing problems, but instead emphasized knowledge acquisition; knowledge that could be assessed using standardized tests. Standardized testing became even more important in the early 2000s with the adoption of the No Child Left Behind (NCLB) legislation. At this juncture, the federal government attempted to ensure educational equity by connecting funding to standards and having those standards measured through standardized assessments (Gordon, 2003). Focusing on standardized testing has not improved the equity of education in America but it has further relegated CT to the background as teachers feel the pressure to cover content and teach to the test (Baildon & Sim, 2009; Fisher, Bol, & Pribesh, 2011).

Concurrently, the 21st century has ushered in a technological boom that now has smartphones and social media being the main sources of communication. Today, news is often provided through headlines and blurbs not much longer than 140 characters. This oversaturation of information requires a society that can quickly and effectively analyze information to determine source, purpose, and viewpoint. Therefore, although the history and reform of the American education system has worked against the infusion of critical thinking, the needs of the 21st century student demand opportunities for teachers to improve their pedagogy so that they may increase their students’ ability to think critically.

Today, students need to learn how to quickly and effectively process and analyze data to create new information (Allamnakah, 2013; Halpern, 1998). At this point, the reasons why
critical thinking is not taught can no longer be the central focus of research and instead the gap
between what our students need and what our system provides should be addressed. Teachers
possess both the responsibility and the greatest likelihood of helping students improve their
ability to think critically. However, while teachers state CTS are important, they are unsure how
to increase these skills in the classroom (Barak & Shakhman, 2007; Stapleton, 2011). Seemingly,
there is a belief that teachers inherently know how to teach students to think (Smith &
Szymanski, 2013); yet, teaching students to think critically takes purposefully designed lessons
in which the CTS are modeled and used so that students become comfortable using the skills
autonomously (Warburton & Torff, 2005). Therefore, this study created, piloted, and evaluated
an 8-week professional development course designed to improve teachers’ critical thinking
practices by increasing the awareness and intention of those practices.

Theoretical Framework

Guiding this study was the combination of Guskey’s model of teacher change and
Vygotsky’s social construction of learning. Professional development (PD) is used throughout
education to hopefully improve teacher practice and in turn improve student outcomes. However,
teachers rarely leave PD with new beliefs because many PD opportunities focus on giving
teachers information without the opportunity to try out their new skills in real world situations
(Guskey, 2002). This type of PD fails to take into account that teachers rarely commit to new
instructional approaches until they have seen the new practice work with their students (Guskey,
2002). Therefore to create an intervention that could ultimately change teachers’ beliefs,
Guskey’s (2002) model (Fig. 1), was followed. Rather than attempting to convince teachers the
necessity of infusing their lessons with CT (change in teacher belief), participants took part in activities designed to engage their own CTS. Participants were asked to reflect on their current practices, to participate in activities that modeled classroom CTS, and then to try out the new practice and reflect upon the experience. The implementation of the new activities (change in teacher practice) offered the participants the opportunity to determine if the strategies introduced in the intervention worked in the real world. Reflecting on these experiences allowed teachers to examine the outcomes of their students’ learning as well as their own beliefs and attitudes about CT in their classroom.

The teachers in this study all entered the PD with some prior knowledge regarding CT. However, there was a general lack of in-depth knowledge that precluded them from infusing their lessons with CT opportunities. This echoes the research stating that teachers often lack confidence in teaching about critical thinking because they lack the pertinent knowledge (Raudenbush et al., 1992; Rotherman & Willingham, 2009; Smith & Szymanksi, 2013). Hence, following Vygotsky’s social construct of learning the participants of this study worked together to move beyond their prior knowledge to obtain new knowledge and skills through peer collaboration (Shabani, Khatib, & Ebadi, 2010). As a group, the participants worked together to
define CT and analyzed their knowledge and practices regarding higher level questioning and inquiry based learning.

Working within Vygotsky’s social construct of learning the intervention was created to include English and math teachers. The use of two curricular areas allowed the participants to not only investigate and analyze CT within their discipline but to also benefit from cross-curricular conversation about CT theory and general teaching practices. While it was important to work with their subject-specific colleagues, a completely homogenous group was not used because it was valuable for participants to observe how their peers from another content area engaged critical thinking in their classrooms and then use these discussions to improve everyone’s practice by asking questions and challenging assumptions.

**Context of Problem**

As a former high school history teacher and current high school administrator, I have witnessed a lack of critical thinking skills in the classroom as both an observer and practitioner. As a history teacher, I created a classroom that I believed would enable my students to succeed in the college history class; never taking into account that many of my students could graduate college without ever taking a history course. In hindsight, I was preparing my students for the educational path that I took, rather than creating opportunities for them to garner skills that would be applicable in any college class or beyond in their careers. As a supervisor of instruction, I now observe classes where the focus tends to be the acquisition of knowledge rather than the building of skills. During a 2017 pilot study, I determined that the teachers I interviewed at Smithville High School (research site) believed that CTS were important components of their students’ education, yet very few consciously included ways for students’ to improve CTS. While these teachers were able to define critical thinking, their practices were
inconsistent when describing how they encouraged their students to use critical thinking skills. This disconnect inhibited teachers’ ability to teach students how to think critically. Therefore, this study was designed to assess teachers’ pre-intervention knowledge, beliefs and practices; as well as to create, pilot, and evaluate an intervention designed to improve teachers’ awareness and intention of their CT practices.

**Research Questions**

1) What are teachers’ pre-intervention knowledge, beliefs, and practices surrounding critical thinking?

2) What changes are observed in the teachers’ awareness and intention of CT practices during the intervention and in their lesson planning after the intervention?

3) What are teachers’ perceptions of how the PD improved their awareness and intention regarding the infusion of critical thinking into their classes?

   a) What aspects of the intervention do they discuss as being most effective for their learning?

   b) How could the intervention be improved or expanded?
CHAPTER 2: LITERATURE REVIEW

Critical thinking has been a tenet of education since Socrates sat in Ancient Greece asking questions. Yet, over two millennia later educators still find it difficult to infuse CT into their classrooms. Although attempts have been made to prioritize CT through its inclusion in state standards, textbooks, and curriculum, many high school students still lack opportunities that encourage them to build CTS. Addressing this deficit requires teachers who are aware of their CT practice and are intentional with the infusion of these practices into their lessons. Unfortunately, a gap exists between teachers’ knowledge, beliefs, and practices inhibiting teachers’ best CT practices. These practices can be improved through explicit instruction and opportunities to engage in meta-awareness of practice. However to understand how a professional development (PD) can meet the needs of teachers who wish to improve their CT practices, CT must first be operationalized. Then this literature review will discuss the effects of the gap between knowledge, beliefs, and practice on instruction and assessment, then describe the need for specific training to improve CT practices, and conclude with how a research-based PD can be developed to increase teachers’ CT awareness and intention.

Critical Thinking - Defined

Meeting today’s societal demands and professional opportunities require students who can analyze, evaluate, and synthesize information. Unfortunately, an analysis of assessments, classroom observations, and standardized test scores has demonstrated that while schools claim to focus on the development of CTS, students’ ability to think critically is not improving (Burris & Garton, 2007; Dam & Volman, 2004; Marshall & Horton, 2011; Raudenbush et al., 1992; Stapleton, 2011). Improving students CTS requires teachers with the requisite knowledge to infuse CT into their classrooms. This knowledge begins with the ability to define CT and while
defining critical thinking has been compared to a conceptual swamp (Lewis & Smith, 1993), when reviewing a variety of CT definitions a common theme emerges; people who think critically can make decisions about how to use the information presented.

Decision making is reflected in some of the most common definitions provided by researchers when examining critical thinking. John Dewey, often credited with being one of the first American educators to differentiate levels of thinking, felt that critical thinking was a reflective mental process that originated with a state of doubt and then expanded to search for ways to ease that doubt (Gersten, 2003). Making decisions, in Dewey’s definition of CT, is when a person determines what information to use to move from doubt to understanding. Deciding how to use the information presented is also seen in the definition offered by Robert Ennis, a foremost CT researcher (Dam & Volman, 2004; Lewis & Smith, 1993; Stapleton, 2011). Ennis believes that CT is reasonable, reflective thinking focused on deciding what to believe or do (Ennis, 1997). Another definition offered by Beyer (1990) states that critical thinking is the assessing of authenticity, accuracy, and/or worth of knowledge, claims, and arguments. Facione, another common voice in the realm of CT, states that CT is a purposeful, reflective judgment which manifests itself in reasoned consideration of the evidence, context, methods, standards and conceptualization in deciding what to believe or what to do (Facione, 2011). Common across these definitions is that CT is a reflective, decision making process that allows a person to evaluate, synthesize, and analyze information. Critical thinkers have the ability to work with new material, use a variety of mental strategies to assess this material, and then create new information.

Working with material and assessing the information for usefulness, are often encapsulated in the field of education through a variety of thinking taxonomies. Perhaps the most
well-known was created by Benjamin Bloom. The goal of Bloom’s Taxonomy was to serve as a common language about learning goals to facilitate communication across persons, subject matter, and grade levels over half a century ago. He had hoped that the use of his taxonomy could be a way to determine congruence in educational objectives, activities, and assessments within a unit, course, or curriculum (Krathwohl, 2002). Building on the work started by Bloom, others have developed taxonomies that can be linked to critical thinking. One of these taxonomies is Wiggins and McTighe’s Six Facets of Understanding (2005). These facets were meant to be “indicators of understanding” (Wiggins and McTighe, 2005). Understanding for Wiggins and McTighe (2005) is “to make connections and bind together our knowledge into something that makes sense of things.” The Six Facets of Understanding includes explanation, interpretation, application, perspective, empathy, and self-knowledge. While designed to insure that assessments include the transfer of knowledge and not just the regurgitation of facts, at the center of the Six Facets of Understanding is the ability to use knowledge to create new information. Hence the Six Facets of Understanding can be used to examine CT opportunities in the classroom.

Unfortunately, while taxonomies exist and may be referenced by teachers in their critical thinking discussions, teachers often find it difficult to operate beyond the lowest levels of knowledge, comprehension, and application, when designing lessons and assessments (Marzano, 1993). This discrepancy between teacher belief and ability was observed in Schulz and Fitzpatrick’s (2016) qualitative study of 38 K-9 teachers in Canada. The teachers in this study knew of Bloom's Taxonomy and believed that it was important to teach their students how to think, but they had not been taught how to teach thinking or to apply the taxonomy to instruction and assessment. While a small study, these findings demonstrate how a gap between belief and
practice can create a barrier to CT. Additionally, Barak and Shakhman (2007) in a qualitative study attempting to determine what teachers knew about fostering thinking at the upper levels of Bloom’s Taxonomy, determined that few teachers were familiar with the methods to improve higher level thinking. While this was an extremely small study, the findings are similar to Schulz and Fitzpatrick’s (2016) finding that teachers tend to lack the knowledge to infuse their classrooms with opportunities to improve students’ CTS. Seemingly a lack of knowledge surrounding CT leads to a gap between belief and practices for teachers. This gap can cause teachers to believe they are engaging students in CT, even when they are not. Any attempt to increase teachers’ CT awareness and intention should begin with an acknowledgement of this gap between teacher belief and practice.

The Effects of a Gap between Knowledge, Beliefs, and Practice

Engaging students in critical thinking requires teachers who are aware of their CT practices and can intentionally infuse these practices into their lessons. However, teachers cannot intentionally infuse CT into their lessons if they lack the knowledge to do so. Ab Kadir (2017) combined this knowledge, awareness, and intention to develop what he described as critical thinking pedagogical content knowledge (CTPCK). CTPCK (Fig. 2) is where critical thinking knowledge, pedagogical knowledge, and content knowledge meet (Ab Kadir, 2017). Teachers
who possess CTPCK know and understand how to best infuse CT practices into their content area. Unfortunately, Ab Kadir (2017) argued that while teachers are expected to know how to teach critical thinking in the 21st century, his research does not support this assumption. Teachers have not been taught how to teach thinking skills. This lack of knowledge leads to a gap between beliefs and practices which negatively influences classroom instruction and assessment.

**Classroom instruction.** Several studies exemplify how a lack of knowledge about CT can lead to a gap between belief and practice as teachers state that CTS are important then share they are unsure how to increase these skills in the classroom (Barak & Shakhman, 2007; Stapleton, 2011). Fisher, Bol, and Pribesh (2011) discovered that while social studies teachers stated they were engaging their students in higher order thinking through the use of discussion, these discussions were not observed during a mixed method study. Also, in a small Jordanian study, high school social studies teachers believed they taught their students to think critically even though they could not define CT. Also, there were no strategies observed supporting the growth of CTS in the classroom (Alazzi, 2008). The teachers in these studies believed they knew how to engage CT and were actively asking their students to think critically and yet these studies demonstrate that teacher beliefs did not often match practice. Teachers that lack knowledge of best CT practices believe they are improving their students’ CTS but are not truly engaging their students in CT activities.

There are a multitude of activities that can help students improve their CTS, but if teachers are unaware of their deficiencies then their practices will not improve. Teachers who possess this gap are uncomfortable engaging student in CT and therefore rely on more teacher-centered activities. In a large, but dated mixed method study, it was discovered that teachers who
lack the required knowledge to engage students in CT rely on teaching facts while avoiding challenging discussions or student questions that promote deeper understandings (Raudenbush, et al., 1992). Avoiding challenging discussions or higher level questions tends to create lessons focused on content acquisition rather than thinking skills. Lucey, Shifflit, and Weilbacher (2014) found in a large scale quantitative study that while teachers believed fostering critical thinking was an important part of social studies education, these same teachers used whole class instruction as the preeminent method of content delivery. Additionally, there were no strategies observed to foster higher order thinking in the instruction. The teachers in this study exemplified educators who know CT is important, say they are engaging students in CT, but simply are unsure how to do so. While these teachers may have believed CT was important, they did not have the necessary knowledge to make this belief a common practice.

**Assessment.** The gap between knowledge, beliefs, and practice does not just make CT absent from instruction, but from assessment as well. Stock (2013) found that while teachers stated that higher level thinking questions were important in summative assessments, their assessments were mostly lower level thinking questions. Additionally, only one in four teachers in this study could not identify three higher level questions within a system of questions, demonstrating their lack of CT knowledge (Stock, 2013). This lack of higher-level thinking questions on assessments is not a new phenomenon, and was also discovered in the Pacific Northwest when study participants stated that higher order thinking skills were important components to student learning, even though their assessments were comprised mostly of questions focused on recall and inference (Stiggins, Griswold, Green, and Associates, 1987). A lack of CTS in classroom activities and assessments cannot continue to be the norm as we move through the 21st century. Rather, teachers must be trained to adapt their practices to better meet
the needs of their 21st century learners through the infusion of CTS into their classroom. This can be accomplished through the closure of the gap between beliefs and practices leading to an increase in CT awareness and intention.

**Training to Improve CT Practices**

Teachers require training to learn how to successfully infuse critical thinking activities into their classrooms (Rotherman & Willingham, 2009; Smith & Szymanski, 2013). Unfortunately, specific CT training seems to be lacking. Stapleton (2011) addressed how this lack of teachers’ training influenced 72 high school teachers in Hong Kong. He determined that while teachers believed that critical thinking should be infused into the curriculum, the teachers were uncomfortable doing so because they had not been trained to build a stronger understanding of critical thinking. Innabi and El Sheikh (2006) detailed that no great change in perceptions, beliefs, or use of CT occurred in Jordan after 15 years of educational reform focused on the improvement of students’ ability to think critically. This comparative study of 24 math teachers in 1988 and then again in 2004, found that although teachers could talk about critical thinking, these practices rarely found their way into the classroom. This lack of implementation seemingly occurred because the teachers were unsure of the purpose or application of CT (Innabi and Sheikh, 2006). This study illustrated that the addition of CT to the curriculum without offering teachers necessary support does not improve practice. Improving teachers CT practice requires professional development that explicitly addresses the knowledge and skills required to infuse CT opportunities in the classroom.

One of the first steps to improving teachers’ CT practices through PD is improving teachers’ awareness of their practice surrounding CT. Zohar (2006), who has written extensively about the importance of teacher knowledge in the improvement of critical thinking skills,
interviewed, observed, and collected artifacts from a group of 14 junior high and high school teachers who attended a workshop meant to encourage the use of critical thinking in science classrooms. He found that to improve CTS in their classrooms, teachers had to become aware of their thinking practices. This awareness was labeled as the meta-strategic knowledge of thinking. Teachers who participated in the professional development learned the importance of being able to identify and use the appropriate thinking skills in their classroom. They were required to identify the higher order thinking skills they were using in activities, and then incorporate these skills into their classes. Zohar (2006) created a cycle of learn and then do to improve CT practices. Zohar (2006) argued that teachers had to be purposefully engaged in metacognition directed towards their thinking to improve their pedagogical practices. As teachers became better at using the language of thinking they were able to model and scaffold activities that created learners who were better critical thinkers.

Zohar’s (2006) study stressed that teachers with a meta-awareness of their own thinking could improve their pedagogy. Awareness of practice as a method towards better pedagogy was also evidenced in a study when 20 faculty members were asked to score a common critical thinking assessment. Through the scoring of the assessment, the faculty recognized that their students lacked the ability to think critically. The faculty then realized that they had to adjust their practice to be more selective in the content they used in class, to include more real world problems, and to ask more high-level questions in class and on assessments (Haynes, Lisic, Goltz, Stein, & Harris, 2016). Rather than the researchers telling the faculty about their gaps, they allowed them to work together on an assessment designed to allow the faculty to draw their own conclusions about their practices. Increased opportunity for meta-awareness allowed for a more meaningful experience that led to a supposed change in practice. These studies demonstrate
the importance of providing teachers with the ability to analyze their own CT pedagogical practices. PD designed to improve teachers’ CT practices must include opportunities for participants to reflect on their practices, so that they can recognize any apparent deficiencies in their own CT practices.

Improving teachers’ meta-awareness of their own CT practices should be followed by opportunities in which teachers are taught how to explicitly infuse their lessons with CT. Infusion of CT can take place when the instruction is explicit (Ennis, 1997). Explicit instruction occurs when teachers identify the thinking skills, explain the expectations, and model the thinking skills (Beyer, 2008; Fogarty & McTighe, 2001). While these studies are from a variety of fields, they show that when participants engage in PD specifically designed to improve a participants’ CTS, positive changes are recorded. For example, a study conducted with nursing educators found that an intervention focused on asking higher-level questions made several positive changes in the participants’ post-intervention practices (Gul, Khan, Ahmed, Cassum, Saeed, Parpio, Profetto-McGrath, & Schopflocher, 2014). Another study that included the observations of 22 teachers involved in professional development to transform their practice into more inquiry-based approaches found that when given the time to explore the concept before explanation, the students thought more deeply and increased their level of cognitive engagement (Marshall & Horton, 2011). Concurrently, when 8th grade teachers in Colombia used more active instruction, such as argumentation and analysis, students participated and demonstrated the necessary critical thinking skills (Alfonso, 2015). The participants in these studies were given the opportunity to learn and work with strategies known to engage critical thinking and their participation in the interventions improved their practice. Increasing teachers’ awareness of their
practices surrounding CT as well as the opportunity to use strategies designed to increase students’ CTS can improve teachers’ CT practices.

Creating PD to Improve CT Practices

Awareness and intention can be increased through opportunities for teachers to reflect on their own practice and be taught how to explicitly adapt their practices to engage students in CTS. Curwen, Miller, White-Smith, and Calfee (2010) conducted a longitudinal, mixed-methods study in which they found that it was through the use of consistent language regarding critical thinking as well as a demand that the teachers create lesson plans for the PD, reflect and then refine these lessons, that students' metacognition improved along with their teachers. These teachers were asked to think critically about their practices and there was a positive correlation to their students’ thinking ability. Involving teachers in higher order thinking tasks, developing a common language, offering time for discussion, application of new ideas, and allowing staff to model instructional strategies through peer demonstrations has also been suggested by staff development experts (Newman, Onosko, and Stevenson, 1988). The compilation of these studies has led to the design of a PD in this study that explicitly models CTS allowing participants to not only examine their own practices but to also experiment and reflect upon the new skills presented in the PD sessions.

While actively engaging teachers in higher level thinking skills has merit in improving their skills, the content of the PD must be well thought out and explicit so that the demonstrated activities can be transferred to the classroom. Boonjeam, Tesaputa, and Sri-ampai (2017) found that a program to improve critical thinking in elementary school teachers was successful when it 1) addressed the key principles of thinking, 2) set the objectives of the program, 3) modeled techniques to improve thinking, and 4) measured and evaluated the changes in the participants
practice. Halpern (1998) posited a similar structure to model the teaching of thinking skills. Her steps included 1) discussing the dispositions of critical thinkers, 2) giving instruction and practicing the skill, 3) creating structured training activities, and 4) providing a metacognitive component for assessing thinking. Both of these structures mirror the very steps a teacher should model when infusing a lesson with critical thinking skills. Therefore, PD to improve teachers' CT practices should provide time for CT to be explicitly explained, for participants to engage with CTS, and then for participants to assess the thinking skills used. A PD designed with time dedicated to participant engagement in these areas should allow for participants to complete the PD with the requisite CT practices to engage their students in CT.

Just as multiple definitions exist for critical thinking, so too are there multiple pedagogical practices that can be used to engage students in critical thinking. For example, critical thinkers should be able to question information provided and determine the best course of action. Therefore a common practice for engaging students in CT is the use of high-level questioning. These questions should be developed through the processes of analysis, synthesis, and evaluation. Hence, any PD to improve teachers’ CT practices should focus on the ability to ask high level thinking questions designed to encourage students to think deeply about the problem at hand. Onosko (1990) in a mixed-method study showed that teachers who emphasize thinking were more willing to delve into deeper questions. While this study was extremely small and the data was gathered through self-report, a more current, larger, and qualitative study determined that emphasizing critical questions helped to give more specific objectives to discussions and provided teachers with a framework to define critical thinking and help students determine which skills are most important (Nussbaum & Edwards, 2011). Finally, Preus (2012) in a qualitative study examining the restructuring of a district to focus more on the development
of critical thinkers, found that focusing on the essential questions of their discipline allowed teachers to infuse activities into their lessons that engaged students in CTS. Since asking probing and critical questions can improve students’ CTS, PD to improve teachers’ CT practices must provide the participants the opportunity to increase their use of higher-level questions.

While critical questions can improve critical thinking skills, other pedagogical practices can be used in conjunction with questioning to engage students in CT. One of the most common applications for CTS is problem solving, which can be used across the disciplines. The best problems are those that are authentic (Abrami, Bernard, Borokhovski, Waddington, Wade, & Persson, 2015) and based in real world cases. (Miri, David, & Uri, 2007). These cases can lead to discussions, which allow students to verbalize their thoughts and work towards a solution with the cooperation of other students (Tsui, 2002). For these discussions to be meaningful, teachers must create structured problems in which the critical thinking skills needed to accomplish the goal are explicit and modeled by the teacher, before allowing the students to work on their own.

These steps are often observed during lessons centered on problem based learning (PBL). While usually found in science instruction, other disciples can also benefit from PBL methodology. However, to properly institute PBL opportunities, teachers must be trained to develop structured problems that facilitate CTS, scaffold the necessary skills, and use less direct instruction (Lopez, 2017). A mixed-methods study of 74 pre-service teachers, demonstrated that teachers needed help planning for PBL as they had to learn how to guide learners to seek answers, ask questions, and to extend their thinking (Lopez, 2017). For participants to learn how to create problems that both address the needs of their curriculum as well as engage their students to think critically, the teachers should have activities modeled for them and be allowed to act in the role of the students (Harris & de Bruin, 2018). Additionally, according to a sizeable
mixed-methods study that interviewed both teachers and administrators, teachers required time to brainstorm, collaborate, develop problems, exchange ideas, and enact more profound critical thinking activities (Harris & de Bruin, 2018). Therefore, part of the PD planned for this study included opportunities for teachers to collaborate on inquiry based lessons they can use within the context of their discipline.

**Conclusion**

Any attempt to improve teachers’ CT practices must stress the importance of creating a more student-centered, less traditional classroom set-up that allows students to participate in activities that encourage them to engage in CTS. A transition to more student-centered activities does not require teachers to abandon their current curriculum completely, nor does it ask for teachers to change every practice they have ever known. Instead, teaching with the growth of CTS in mind, teachers must make mindful decisions regarding instruction so that they can offer more opportunities for students to develop their ability to think critically. Through explicit and purposeful use of thinking terminology and by offering teachers active opportunities to improve their own CTS, a well-planned professional development has the possibility of improving teachers' awareness and intention surrounding their CT practices, which will, in turn, improve students’ CTS.
CHAPTER 3: METHODOLOGY

The purpose of this study was to design, pilot, and evaluate an intervention focused on increasing the participants’ awareness and intention regarding their CT practices. Since intervention design is for the purposeful study of the implementation of change strategies (Fraser & Galinsky, 2010), an interventional research design was used. The intervention was analyzed using a qualitative case study approach so that the participants’ pre- and post-intervention knowledge, beliefs, and practices could be assessed. The participants’ knowledge, beliefs, and practices were collected through surveys, artifacts, reflective writing, and a focus group interview. The collection of these multiple points of data, as well as the fact that this intervention was bound to the time frame of March-May, 2019 allowed this intervention to meet the qualification to be examined as a case study (Creswell, 2014). The methods used to complete this study will now be discussed.

Sample

The study occurred at Smithville High School, a large, suburban school of 2200 students that was part of a regional high school district. Smithville was a high-achieving school with students who typically surpass the graduation rates and test scores of their counterparts at both the state and national level. The student body was 81.5% white, 7.4% Asian, 6.8% African American, 4.0% Hispanic, and .3% Asian Pacific, Native American, or more than 2 races. The majority of teachers at Smithville were veterans with more than five years of experience. The district operates using an Understanding by Design (UbD) curriculum model, and all academic curriculums had been rewritten in the last seven years to conform to the UbD guidelines. However, while UbD curriculum focuses on the acquisition of transferable skills rather than the
learning of minutiae, I have not observed a full transition to these practices through my former role as teacher and current role as administrator at Smithville High School.

Purposeful sampling was used to insure that the participants chosen allowed for the best opportunities to fully answer the research questions (Gall, Gall, & Borg, 2015). The study’s sample was compiled by inviting teachers at Smithville High School to participate via an e-mail (Appendix A). Ten teachers responded that they were interested in participating in the study. While ten teachers would have been a manageable number for this study, the decision was made to limit the study to four English, four math teachers (Table 1), and one special education teacher who worked in English classrooms for a total of nine participants. However, the special education teacher withdrew from the study after the first meeting for personal reasons. The choice to limit the study to the English and math teachers was done so that the participants would have both the opportunity to think critically about their practice with subject specific colleagues, but to also be able to discuss CT with teachers who were in a content area different from their own. A co-curricular group was used because CT is not the purview of any one discipline and infusing CT should occur across curriculums (Ennis, 2016; Gersten, 2003). Hence, it was

<table>
<thead>
<tr>
<th>Participant</th>
<th>Content Area</th>
<th>Years of Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maya</td>
<td>English</td>
<td>8</td>
</tr>
<tr>
<td>Holden</td>
<td>English</td>
<td>14</td>
</tr>
<tr>
<td>Colleen</td>
<td>Math</td>
<td>6</td>
</tr>
<tr>
<td>Beth</td>
<td>Math</td>
<td>16</td>
</tr>
<tr>
<td>Julia</td>
<td>English</td>
<td>4</td>
</tr>
<tr>
<td>Rachel</td>
<td>Math</td>
<td>17</td>
</tr>
<tr>
<td>Helen</td>
<td>English</td>
<td>37</td>
</tr>
</tbody>
</table>
believed that providing participants opportunities to experience the intervention with teachers from different content areas could help broaden their understanding of CT. The groups’ dichotomy was considered a strength by the participants and will be discussed in the findings section. An unlimited multi-disciplinary group was not used for fear that teachers would not have had enough content specialist to work with to engage in the critical analysis of their practices as it applied to their discipline. A single content group was not used because there would have been no opportunity to share across content areas.

**Intervention Design**

The intervention took place from March, 2019-May, 2019 and included eight, one hour sessions. The first session was used to set norms and expectations and the final sessions was used to complete a focus group interview (Appendix G). The six main sessions followed a cyclical pattern of knowledge building, reflection, and opportunities to try out the new knowledge in the participants’ classrooms. After the sessions concluded the participants were invited to anonymously complete a survey of the session and provide feedback. This process aligned with Guskey’s (2002) model of PD which stated teacher practice and beliefs are more likely to change when they are given opportunity to try out new practices in their classroom and observe student change.

After the first session, the following five session were designed so the participants had the opportunity to think critically about their critical thinking practices. This process began with the teachers creating a definition of CT that would be used for the study. Following this activity, participants were led through several sessions that addressed their questioning practices and then moved to expanding their knowledge about inquiry based lessons. Interspersed between these sessions were multiple opportunities to reflect on their own practices. After participants
increased their knowledge about questionings and inquiry, the facilitator led each group through a modified lesson study. Upon completion of the lesson study, the participants taught their lesson and reflected upon the experience. A detailed lesson plan used during the intervention is located in Appendix B.

The overarching design of this intervention focused on four key principles that allowed for the participants to think critically about their own practices while learning new practices to improve the infusion of critical thinking into their classroom. First, the activities of the intervention were designed so that the teachers had the opportunity to reflect upon their own practices. Providing teachers with the time to reflect upon their CT practices allowed them to discover the gaps within their practices and beliefs. Rather than being told where their practices were lacking surrounding CT, analyzing their own practices allowed for more meaningful engagement in the intervention. Additionally, the participants were given time to confront the gaps in their practice through individual and group reflections. Once the gaps were acknowledged, the teachers participated in activities designed to increase their knowledge and to plan with their colleagues to better infuse CT opportunities into their classroom. Finally, the participants were asked to purposefully create lessons to try out the new skills presented to determine their effectiveness in engage students in CT.

**Data Collection**

Intervention research design is used for the purposeful study of the implementation of change strategies (Fraser & Galinsky, 2010). Since the goal of this study was to determine if the PD created could increase the participants’ CT awareness and intention, data was collected to assess the participants’ pre-intervention knowledge, beliefs, and practice, as well as to determine if changes occurred in the participants’ knowledge, beliefs, and practices upon the completion of
the intervention. Answering the research questions that guided this study required the use of a pre-intervention questionnaire, session transcripts, participants’ reflective writing, participant provided lesson plans, and a focus group interview. How these data points were used to answer the research questions are outlined in Table 2.

Table 2 – Research Questions and Data Sources

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Data Sources</th>
</tr>
</thead>
</table>
| What are teachers’ pre-intervention knowledge, beliefs, and practices surrounding critical thinking? | ● Questionnaire  
● Intervention Transcripts  
● Teachers’ Reflective Writing |
| What changes are observed in the teachers’ awareness and intention of CT practices during the intervention and in their lesson planning after the intervention? | During  
● Transcripts  
● Teachers’ Reflective Writing  
● Lesson Plans  
After  
● Lesson Plans  
● Focus Group Interview |
| What are teachers’ perceptions of how the PD improved their awareness and intention regarding the infusion of critical thinking into their classes? | ● Teachers’ Reflective Writing  
● Focus Group Interview |

**Questionnaire.** The participants were asked to complete a questionnaire (Appendix C) via a Google Form prior to the intervention. The questionnaire was the first data source analyzed and also doubled as a needs assessment. This needs assessment allowed the facilitator to not only determine the best content to present, but to also measure the participants' knowledge, skills, and attitudes regarding the upcoming PD (Silberman, 2006). Successful and effective PD requires that teachers' have a voice in the learning they experience (Knowles, Holton, & Swanson, 1998; Silberman, 2006; Terehoff, 2002) and a needs assessment is the first method a facilitator can use to include his or her adult learners in the process of creating high quality PD. The questionnaire
gathered the participant’s biographical information, as well as asked the participants to demonstrate their knowledge regarding critical thinking, their use of critical thinking in the classroom, and the barriers they face infusing critical thinking into their classrooms. The analysis of this data point will help to answer research question 1 and will be discussed in the findings section.

**Lesson plans.** Lesson plans were collected three times during the intervention. The first lesson plan was collected after the first session. At this time, participants were asked to provide a lesson plan of an upcoming lesson in which they engaged their students in CT. The second lesson plan was collected after the participants learned the importance of purposefully planning the use of open questions to engage students in CT. The final lesson plan was collected following the modified lesson study. Collecting written work from the participants allowed the facilitator to gather the language and words of the participants unobtrusively and represented data that the participants had given attention (Creswell, 2014). The lesson plans of the participants were one measure to determine if the participants’ CT awareness and intention had changes during the intervention, directly addressing research question 2. An increase in CT practices was evidenced in the comparison of the first and last lesson plans collected and will be discussed in the findings.

**Reflective writing.** At the conclusion of most sessions, the participants were asked questions about the activities they had completed. Their responses were analyzed to determine if the activities met the planned outcomes and if the participants were critically engaged with the material. Since the reflections were not shared with the group, participants had the opportunity to be honest in their reflections regarding the sessions and activities. Although I am an administrator at Smithville High School, there were no members in the group that I directly supervise. Additionally, during the first session, I explained that nothing shared or observed
during the sessions would be shared with their supervisors, nor would the activities of the intervention be reflected on the district observation tool. The combination of a lack of teachers I directly supervised and the described conversation, led to the participants fully and truthfully engaging in their reflections. These reflective writing pieces offered a snapshot of what the participants thought was essential and were a reliable source of data concerning their attitudes and beliefs (Merriam, 2009). Since a critical focal point of this study was the participants' knowledge and beliefs, these writings provided insights not necessarily gained through session data and provided greater depth when answering all research questions.

**Focus group interview.** A focus group allowed for the creation of socially constructed data formed within the group's interaction where people heard each other's responses and built upon the offered answers (Merriam, 2009). Since this was very similar to the analysis and synthesis skills used throughout the entire intervention, a focus group interview at the end of the intervention brought the experience full circle and allowed the facilitator to analyze what changes occurred in the participants' CT awareness and intention surrounding their CT practices. The participants had the opportunity to discuss their participation in the intervention as well as to offer ways to expand or improve the intervention. The interview was audiotaped and transcribed to assist with data analysis. The focus group interview followed an interview protocol (Appendix G) and addressed research questions 2 and 3.

**Data Analysis**

The collection of multiple data sources required organization and the maintenance of a data collection system that allowed for easy access and analysis. As data collection occurred, it was arranged using Google Drive. The analysis of the data included the creation of and the interpretation of codes and themes to develop a narrative that addressed the research questions
INCREASING CT AWARENESS AND INTENTION

guiding this study: 1) What are teachers' pre-intervention knowledge, beliefs, and practices surrounding critical thinking? 2) What changes are observed in the teachers’ awareness and intention of CT practices during the intervention and in their lesson planning after the intervention? 3) What are teachers’ perceptions of how the PD improved their awareness and intention regarding the infusion of critical thinking into their classes?

Since the purpose of this study was to create and implement an intervention designed to improve teachers' CT practices, a variety of data sources were analyzed qualitatively to describe the participants' experiences. These experiences were evidenced through the analysis of the audiotaped/transcribed sessions, as well as the teachers’ reflective writing. The participants’ beliefs and practices were gathered through questionnaire and focus group data, as well as lesson plan analysis. Finally, the combination of this data allowed teachers' awareness and intention to be analyzed to determine if the intervention has produced a change in the participants’ CT practices.

**Organizing data sets.** All data collected was compiled into a Google Drive folder that was password protected. The multiple documents and sheets allowed me to collect data, to analyze data, and to create memos as needed during data collection and analysis. Following the sessions, I had each session transcribed and listened to each. At this point, I checked for accuracy and created preliminary notes on points of interest. The transcriptions and notes were saved in a Google Drive folder. Upon completion of the intervention, the transcriptions were reviewed again and analysis of data occurred. At this point, the data was organized chronologically with session materials, notes, transcriptions, and reflections gathered together. This allowed the facilitator to dive deeply into the data for each session, but to also analyze how the participation in the intervention was influencing the teachers’ knowledge, beliefs, and practices. Once all
sessions had been analyzed, the data was reorganized so that the lesson plans were grouped together chronologically. This allowed for the comparison of individual participants’ practice from the start to the conclusion of the intervention. The chronological organization of the data allowed for the creation of codes and themes that were used to develop the answers to the study’s research questions.

**Creating codes and developing themes.** As I began to analyze the multiple data points collected, I took note of interesting statements, phrases, or words. Open coding, an inductive practice, allowed the information gathered to drive the coding process (Creswell, 2014). However, while coding, I looked for topics readers would expect to find based on the research literature, as well as ideas that were surprising, not anticipated, or unusual (Creswell, 2014). Based upon the literature presented and the design of the intervention, expected codes developed around the definition of CT; the participants' belief about CT, particularly its necessity; as well as ways teachers believe they currently use CTS in the classroom. Research based codes also included teachers stating they use CT in multiple areas, such as tests, projects, and assessments. Finally, there were also codes created about barriers to CT, such as students’ inability to think at a higher level, lack of time, and curricular constraints. Surrounding the implementation and evaluation of the intervention, codes centered around Bloom’s Taxonomy; methods to engage CT; the use of CT before and during the intervention; and codes reflecting CT methods, such as higher level questioning, modeling, and analysis. In addition to these codes, the use of open coding allowed for the creation of codes that developed from the data and included suggested barriers to CT being student confidence and teachers’ fear that if material was not directly taught students would not learn. Finally, as the sessions and focus groups were analyzed, there was also codes surrounding the importance of word choice, intention, and awareness.
Once the codes were determined, a codebook was created in which similar data points were compiled and elaborated on with the use of quotes and phrases from the data. Further analysis of the codes, led to the creation of memos centered on the lesson plans provided, the modified lesson study, and the focus group interview. Once the codes were analyzed and supported by data points, I worked to create themes. The themes that emerged were the participants’ pre-intervention knowledge, beliefs, and practices; the need for explicit instruction and increased meta-awareness; changes in practice; and participants’ reaction to the intervention. These themes were used to guide the analysis and writing of the findings section.

Validity

Validity of a qualitative study can be assured through the use of triangulation, member checking, and rich, thick descriptions (Merriam, 2009). I made use of all three of these processes to insure the validity of my data analysis. Triangulation can be completed through the use of multiple sources of data (Merriam, 2009). This study made use of questionnaire results, reflective writing, the analysis of transcriptions and lesson plans, as well a focus group interview to support the findings put forth in this study. Since none of the findings relied on only one source of data, the finding can be considered valid through the use of triangulation. Additionally, the participants were asked to review the findings to insure they reflected what the participants experienced during the intervention (Creswell, 2014). The use of member checking also added to the validity of the study findings. Finally, the nature of this qualitative study allowed for the use of rich, thick descriptions in which readers were provided with enough description to “contextualize the study” and “determine the extent to which their situations match the research context” (Merriam, 2009). This final level also validated the findings of this study.

Limitations
There were two limitations to acknowledge in this study. First, as an assistant principal at the research site, I was aware of the possible implications this could have on the study. I used the first session to address the purpose of this study and to insure the participants that my role as facilitator was separate from my role in the school. This seemed to decrease the possible influence my role as building administrator had on the study. A second limitation was the length of the study. The limited length of time of this study, as is the nature of dissertation studies, led to a sole focus on the increase of teachers’ awareness and intention regarding CT practices rather than being able to also determine if there were increases in student critical thinking. Finally, the length of this study also precluded the researcher from observing classes, so there was a reliance on teacher self-report when analyzing changes in practice. These limitations will be more fully addressed when discussing possible future implications.
CHAPTER 4: FINDINGS

Improving teachers’ CT practice can be achieved through PD (Alfonso, 2015; Gul et al., 2014; Hayes et al., 2016; Marshall & Horton, 2011; Zohar, 2016). However, few of these studies examine the development and implementation of the PD. Since improving teachers’ CT practices requires explicit instruction and an increase in meta-awareness (Rotherman & Willingham, 2009; Smith & Szymanski, 2013), the process that improves CT practices should be detailed and examined. Therefore, the findings of this study will first analyze the participants’ pre-intervention knowledge, beliefs, and practices. Then the development of the research-based intervention will be synthesized so that the influence of the PD on the participants’ CT awareness and intention can be evaluated.

Pre-Intervention Knowledge, Beliefs, and Practices

Designing a professional development to improve teachers’ awareness and intention of their CT practices required assessing the participants’ pre-intervention knowledge, belief, and practices. Understanding the pre-intervention knowledge, beliefs, and practices assisted in the creation of a PD that addressed the needs of the participants. Additionally, analysis of the participants’ pre-intervention knowledge, beliefs, and practices illuminated that the teachers’ understanding of CT influenced their beliefs and practices. Therefore, the pre-intervention analysis examined the participants’ definition of CT, their understanding of CT as a process, the barriers they believe exist in the infusion of CT, and concludes with an examination of how their knowledge and beliefs were evidenced in their practice.

Critical thinking – defined. CT has been operationalized in this study as a reflective, decision making process that allows a person to evaluate, synthesize, and analyze information. This definition was derived from a synthesis of CT resources (Beyer, 1990; Dam & Volman,
INCREASING CT AWARENESS AND INTENTION

2004; Ennis, 1997; Facione, 2011; Gersten, 2003; Stapleton, 2011). Secondary educators do not typically read these sources and so the first step to understanding the participants’ pre-intervention knowledge was to collect their definitions of CT. The eight study participants had a general understanding that CT is actively using information, knowledge, or skill to create new information or knowledge (Table 3).

Table 3 - Participants’ Definition of CT

<table>
<thead>
<tr>
<th>Participant</th>
<th>CT Definition</th>
<th>Participant</th>
<th>CT Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maya (English)</td>
<td>actively analyzing and evaluating information in order to form an educated opinion on a subject</td>
<td>Colleen (Math)</td>
<td>Critical thinking is being presented with a problem and using information to get to a solution to a problem.</td>
</tr>
<tr>
<td>Holden (English)</td>
<td>the ability for a person to define their reasons for thinking/holding/believing a particular concept</td>
<td>Beth (Math)</td>
<td>interpret learning to a new context</td>
</tr>
<tr>
<td>Julia (English)</td>
<td>Critical thinking is being able to take something unknown and understand and make sense of it in a new way.</td>
<td>Rachel (Math)</td>
<td>The ability to solve a unique problem applying skills learned.</td>
</tr>
<tr>
<td>Helen (English)</td>
<td>The ability to take evidence and draw a conclusion.</td>
<td>Susan (Math)</td>
<td>Being able to take basic, fundamental skills and use them to think about and solve a more complicated problem (or a problem you haven’t seen worked out before).</td>
</tr>
</tbody>
</table>

However, while there was a tendency to discuss the creation of new knowledge throughout the definitions, a comparison of the definitions provided by the math and English teachers showed a difference between the two disciplines. The math teachers focused on the ability to solve problems using prior knowledge. They viewed CT as a stepping stone that allowed a student to move from a “basic,” “fundamental” problem to a more difficult, often
“real-world” problem. The math teachers believed there was a need for students to have prior knowledge in order to engage in critical thought. Colleen, a math teacher, stated, “even if we take it out of a math class... just a life issue they have to think critically about. You can’t come to a conclusion unless you have some type of road that you know you can head down or options that you can go down.” When the participants were asked if students required a level of knowledge before they could be expected to think critically, Beth, a math teacher, replied, “Yes, I think so. Because they won’t think critically about the question they won’t be able to analyze well...” Considering that the math teachers in the group described their subject matter as “black and white” and stated “efficiency” is valued; the definitions provided by the math teachers make sense. If the math teachers believe math is formulaic then the thinking that accompanies math must also be formulaic.

While the math teachers focused on the necessity of prior knowledge and problem solving, the English teachers believed that CT was the ability to use information to form an “educated opinion” or “make sense in a new way.” The four English teachers’ definitions of CT revolved around the ability to use information to create something new. These definitions did not require prerequisite knowledge, and were exemplified by Julia, who wrote, “CT is being able to take something we know and understand and make sense of it in a new way.” Helen wrote, “[CT is] the ability to take evidence and draw a conclusion.” These definitions demonstrated a broader understanding of CT that did not need to be tied to content, as was observed in the math teachers’ definitions reliance on problem solving. Although there were differences in how the math and English teachers defined CT, one similarity was discovered; the belief that thinking critically required a process.
**CT is a process.** CT as a process was a belief shared across the participants of this study. Reviewing the characteristics of critical thinkers provided by the participants (Table 4), illuminated the participants’ belief that CT cannot be done quickly, but instead requires a person to “see the big picture,” to “weigh options and long term effects” so that a person can “evaluate an argument,” or “create new ideas.” Critical thinkers were described as “flexible,” “persistent,” “curious,” and “inquisitive.” These skills and dispositions are not required when students are asked to answer simple, fact driven questions. Persistence and flexibility are not required to

| Table 4 - Dispositions and Skills of a Critical Thinker |
|---------------------------------|---------------------------------|
| **Dispositions** | **Skills** |
| **Math** | **Perseverance**<br>**Flexibility**<br>**Courage**<br>**Persistence** | **Ability to see big picture**<br>**Mastery of foundation skills**<br>**Logical thought process**<br>**Seeing long term effects**<br>**Balancing/Weighing options** |
| **English** | **Curiosity**<br>**Inquisitive** | **Pattern recognition**<br>**Analysis/synthesis of complex ideas**<br>**Evaluation of argument**<br>**Creating new ideas**<br>**Ability to research**<br>**Transfer skills and/or knowledge to new concepts or situations**<br>**Analyze**<br>**Listen and comprehend before responding** |

regurgitate the plot of a story. Nor do students have to be inquisitive to complete a problem in which they repeat the steps provided by the teacher. Instead, seeing the big picture and weighing options alludes to actively making connections and using the information gathered. The skills and dispositions offered by the participants (Table 4) demonstrated a belief that CT requires students to be actively involved in a multi-step process and reflected the definitions provided by
the participants (Table 3). The participants of this study believed CT is an active process in which a person creates new information or knowledge.

Believing that CT is an active process also became evident in the first session of the intervention. The subject specific groups were asked to give an example of a lesson within their discipline in which CT occurred. The math teachers suggested solving geometry proofs. Susan, the math representative, said, “We sort of view it [CT] as understanding the why...like why does it happen...You can solve the equation, but why?...Doing proofs is a big part of that, explaining why and how you’re getting from one step to the next step.” Rachel, another math teacher, added an important distinction to this explanation as she stated that, “[CT is] where you can think critically and be able to apply it to a unique scenario...moving from the point where you’re a machine to a problem solver.” For the math teachers, CT involved a metacognitive process in which students explained their reasoning when solving a problem. The idea of moving from machine to problem solver encapsulated this idea because it inferred that the student, when thinking critically, knows not only how to complete the problem, but can explain the answer and apply the skills to a new problem. These descriptions of problem solving demonstrated that CT required a process because these students were not just giving the right answer, but explaining how they achieved their answer.

The English teachers also offered an example of CT in their classrooms that exemplified CT as an active process. Holden, the English spokesperson, shared that an activity that engaged CT would be when students are asked to “Go back through [a piece of literature] and find a quote that they feel really captures who the character is...they might be able to find one...but to identify why, is where it steps into the realm of critical thinking.” Like their math colleagues, the English teachers offered an activity in which students were expected to complete a metacognitive
process. This example offered students the opportunity to think about what they have read and to delve deeper to explain a character in the story. This activity aligned with the math teachers’ explanation of CT as a metacognitive process and demonstrated an activity in which the students were expected to have read the material, to know how to annotate the material to find a meaningful quote, and then to analyze the quote. The examples provided by both the math and English teachers demonstrated an understanding that CT in the classroom requires providing students with the time and opportunity to be actively involved in a metacognitive process.

**Barriers to CT.** Assessing the teachers’ pre-intervention knowledge showed a group who could define CT and work together to provide an example of a CT activity. Yet, research states that students are graduating high school without the ability to think critically (Burris & Garton, 2007; Dam & Volman, 2004; Marshall & Horton, 2011; Raudenbush et al., 1992). So, if teachers can define CT and provide examples, why are students not being engaged in CT opportunities? Answering this question requires an understanding of teachers’ pre-intervention beliefs about the barriers that make infusing CT difficult.

The barriers to infusing CT discussed by the participants focused on external factors. These factors were determined to be external because, for the participants, the barriers were outside of their control. External barriers to the infusion of CT became apparent when the teachers were asked, “What barriers exist that limit your ability to infuse CT into your classes?” Rather than focusing on their practice, the participants discussed factors such as time and scope of curriculum, as well as student readiness and ability. These external factors brought to the foreground teacher fear as a barrier to CT.

**Time and content.** Only one teacher raised a lack of time and drive to cover content as a barrier to CT in the initial questionnaire. This teacher listed time, mixed with scope of
curriculum as a barrier to her ability to infuse CT into her lessons. Elaborating on this concept during a session, Beth shared, “Sometimes, if I have time, I’ll take the ‘gold’ questions, a higher level question, as a warm-up.” Beth explained that she would show the problem to her students and state, “This is going to be where we will get to, maybe not today, but we will get there.” Providing this example demonstrated that Beth wanted to push her students to higher level thinking, but that time is a constraint. She also explained that she sometimes allowed students to attempt new problems on their own by having students “talk with each other for like five minutes, but again five minutes is five minutes.” Beth exemplified a teacher who believed that CT opportunities are time consuming and cannot be added to lessons because she is already pressed for time. Susan summed up this feeling, “We have so much in our curriculum. I feel like there is not enough time to delve into topics...to show them [the students] those applications and why it is important...I feel like we just don’t have the time.” Interestingly, while time and scope of curriculum are typically listed as barriers to CT, for the teachers in this study these barriers were only discussed by a few teachers.

**Student readiness and ability.** While only one teacher raised time and content as a barrier in the initial questionnaire, six participants crafted their barriers around student ability and readiness. Four of the six teachers believed that students’ readiness to think critically was a barrier to critical thought in the classroom. Two of these teachers, both whom work with freshmen, believed a lack of prior practice with CT was the main barrier faced in their classroom. Students’ “confidence in and comfort with their ability to think critically,” acts as a barrier stated one participant. While another believed, “teaching freshmen that have never been asked to critically think before,” makes CT difficult in the classroom. These teachers believed that their students entered their rooms (one math and one English) without ever being asked to think
critically. They believed that their students had not been exposed to critical thinking prior to high school and are hence not ready to do so in their classes. This belief seemingly puts the lack of CT in their classrooms not on their own practices or on their students, but on the belief that the students have not been asked to think critically before high school. Lacking exposure is an external factor outside the participants’ own practice.

Building on a lack of exposure, two teachers also believed that students were not ready to think critically when they entered class. One English teacher stated that students have, “widely varying levels of readiness to engage nonfiction texts.” While a math teacher phrased this as “students do not have strong enough skills to think critically about the problem.” These participants focused on a lack of skills. The teachers seem to believe that CT cannot be infused into their classroom because students are not ready to engage in higher level thought. Rather than discuss the participants’ own inability to improve students’ CTS, they focused on the external factor of student readiness. This belief that students are not ready to think critically, but instead require increased content or skills, coincides with teachers who are more comfortable teaching content rather than thinking skills.

**Fear.** Teachers who are not comfortable teaching thinking skills can be a barrier to the infusion of CT. Susan captured this idea when she shared, “Our teachers were the sage on the stage and that’s how we learned...It’s hard to come up with these critical thinking things because that’s not how I learned.” A focus on content rather than “critical thinking things” as described by Susan, has led to teachers in this study demonstrating a fear of being able to identify critical thought in their classrooms. Beth stated, “I feel like if I ask some harder questions...I think they might be searching for the answer and thinking hard or they might be zoning out.” Susan wondered, “If they’re not participating in the discussion...then you’re not seeing it [critical
thought].” Beth and Susan both seemed hesitant including CT opportunities because they cannot “see” that all their students are completing the task. Determining if a student is thinking critically or if they are just sitting in class waiting for someone else to answer concerned these teachers. Participants feared that if students were not answering questions quickly then the students did not know the answer. The participants feared that if students were sitting quietly that they may not be paying attention. This seems to contradict the earlier stated belief that CT is an active process that requires time. This disconnect demonstrated a gap between belief and practice.

Providing CT opportunities requires students having time to process and work on activities that require higher level thinking. Yet teachers expressed the fear of allowing students to actively take part in the process. Holden stated, “I’m afraid if I don’t say it, they won’t learn it.” Holden feared that using CT to develop content could be ineffective because students could not learn a concept if it was not explained by the teacher. This fear was echoed and elaborated by Beth. Beth shared an experience from early in her teaching career when she used a discovery lesson in math and was “burned on it because I thought they were going to discover the right thing and they discovered the wrong thing, Then I took two classes 'undiscovering' the wrong thing…” While Beth did acknowledge that, “It was my first year of teaching, I probably screwed something up,” she was still extremely uncomfortable in attempting CT opportunities in her classroom to this day, almost 15 years later. She believed that it was better for her to directly instruct her students to insure they were learning the “right” way rather than offer the opportunities for the students to discover math on their own and possibly fail. Discovering that fear held back several of the participants from fully engaging their students in critical thought was an important finding as it allowed me to better understand the needs of the participants and
to develop a PD that could better address the gaps between the participants’ knowledge, beliefs, and practices.

**Beliefs and practices.** CT is a reflective, decision making process that allows a person to evaluate, synthesize, and analyze information; in practice a lesson that infuses CT should offer students the opportunity to be curious, to problem solve, and to be inquisitive. Students should be given time to evaluate and analyze information, to synthesize the information and generate hypotheses, to present their work, and then to reflect on and evaluate the process. Engaging students in critical thought requires time; time for them to work with the material presented, time to process what they are being asked to do, and time to question and inquire of themselves, their peers, and their teacher. Infusing CTS into the classroom must be explicit (Ennis, 1997) and entails the identification of thinking skills, an explanation of expectations, and the modeling of the thinking skills (Beyer, 2008; Fogarty & McTighe, 2001). These best practices were used as guide posts in the analysis of the participants’ pre-intervention practices.

The participants provided individual definitions of CT (Table 3) in which they demonstrated a general understanding that CT is actively using information, knowledge or skill to create new information. They shared that CT is a process that requires “perseverance,” “flexibility,” and “curiosity,” and also stated that CT can be observed in their classrooms through a multitude of activities such as, “analysis essays,” “solving real world problems,” and “classroom discussions” (Table 5). Additionally, seven lesson plans were collected and even though the teachers stated they were confident in their ability to infuse lessons with CT opportunities, did so on a fairly regular basis (Pre-Intervention Survey), and provided a working definition (Table 3), only one of the teachers provided a lesson plan that seemed to fully engage her students in CT. The other teachers exhibited a lack CT opportunities in classroom, sometimes
### Table 5 - Participant Pre-Intervention Knowledge and Practice

<table>
<thead>
<tr>
<th>Teacher</th>
<th>CT Definition</th>
<th>Pre-Intervention Knowledge and Practice</th>
<th>Pre-Intervention Lesson Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maya (English)</td>
<td>actively analyzing and evaluating information in order to form an educated opinion on a subject</td>
<td>Analysis essays, Class discussions, Claim/Support/Evidence activities, Quote walks</td>
<td>Students work in small groups to analyze significant passages from chapters 8-9 of <em>To Kill A Mockingbird</em>. Students will create a claim, evidence, support (CSE) paragraph.</td>
</tr>
<tr>
<td>Colleen (Math)</td>
<td>Critical thinking is being presented with a problem and using information to get to a solution to a problem.</td>
<td>Presenting a new type of problem to students that require prerequisite knowledge to solve.</td>
<td>Determine the dimensions of a rectangle by creating and solving systems of equations. This will be done by taking notes, working on their own, and practice. No more description than this.</td>
</tr>
<tr>
<td>Beth (Math)</td>
<td>Interpret learning to a new context</td>
<td>Highlight connection and see mathematics as a broad topic.</td>
<td>Apply the Lagrange error bound when appropriate. Start with a warm-up, present students with a series that does not alternate in symbols. Discuss the LaGrange equation. Have students decide how to deal with finding “M” in the formula.</td>
</tr>
<tr>
<td>Julia (English)</td>
<td>Critical thinking is being able to take something unknown and understand and make sense of it in a new way.</td>
<td>Coming to a unique and accurate understanding of the text expressed through class discussions or written expressions.</td>
<td>Novel analysis - 3 students start the class with a 10 minute discussion. They are prepared with a summary, assertion, quote support, and questions to sustain conversation. Class creates 1 or 2 questions and then the entire class participates in a large group discussion.</td>
</tr>
<tr>
<td>Rachel (Math)</td>
<td>The ability to solve a unique problem applying skills learned.</td>
<td>Solving real world problems.</td>
<td>Solve radical equations. Various equations on the board, students are to formulate a definition. Direct instruction, students work in pairs, students present solution, complete worksheet. Lesson ends with 2 problems</td>
</tr>
</tbody>
</table>
using CT terminology by not detailing how CT opportunities were explicitly infused into the lesson. While the participants defined CT as an active process, their lesson plans did not seem to include opportunities for students to actively engage in CT. This demonstrated a disconnect between belief and practice.

The lesson that best exemplified CT best practices was supplied by Maya, an English teacher, and arguably the strongest practitioner of critical thinking in the group. She asked students to analyze and assess passages in *To Kill a Mockingbird*. Students were broken into small groups, given significant passages to analyze, and then tasked with discussing the passage as a group until they could collaboratively develop a claim, data to support the claim, and provide an explanation of the claim and support in connection with the passage. While the lesson could have been improved if Maya was more purposeful with her directions, explained to her

| Susan (Math) | Being able to take basic, fundamental skills and use them to think about and solve a more complicated problem (or a problem you haven't seen worked out before). | Through application problems and follow-up questions to certain examples. | Students will measure each other and then find the mean and standard deviation. The groups will compare their data to the rest of class. Followed by discussion questions. Final questions were about predicting comparison to other classes. |
| Helen (English) | The ability to take evidence and draw a conclusion. | Classroom discussion, written responses (blog posts, essays, etc.) | Class discussion about the high school graduation requirement of completing algebra 2. Discuss article in small groups and then present findings to the class. Teacher will provide prompt questions to provoke discussion. |
students why they were completing the activity, and provided students with the time to reflect on the lesson, overall this activity met the requirements to be considered a lesson that was infused with CT opportunities for the students. This activity required students to work through a process to evaluate, synthesize, and analyze information and to make a decision about the significance of the quotes in the development of the plot of To Kill a Mockingbird.

While Maya exemplified a strong CT lesson, most of the initial lesson plans submitted by the participants did not meet the requirements of lessons infused with CT opportunities. The lessons provided by the other participants echoed what Fisher et al. (2011) as well as Alazzi (2008) found in their research, that teachers often state that CT is important and that they are engaging students in critical thought but when observed, strategies that infuse CT are not present. This was exhibited in some of the participants’ lesson plans (Table 6) as their stated definition and provided lesson plan did not coincide with one another.

| Table 6 – Samples of Original Lesson Plans |
|-----------------|-------------------------------------------------|
| Colleen         | You will be able to determine the difference of a rectangle by creating and solving a system of equations.                               |
|                 | Review of Homework                              |
|                 | Notes                                           |
|                 | On you own practice                             |
|                 | Students will have to complete one problem on their own and correctly set-up a system of equations and solve the problem.             |
| Beth            | Finding the error bound in the approximation of an infinite series.                              |
|                 | Warm-Up: Review of previous material of bounding error - alternating series error bound          |
|                 | Present the students with a series that does NOT alternate in sign                              |
|                 | Discuss the Language Error bound for series and diced how to deal with finding “M” in the formula. |
| Rachel          | You will be able to solve radical equations.                                                   |
|                 | Warm-Up: Various equations are on the board of radical and non-radical - students are
to formulate a definition of a radical equation.
Direct Instruction
Students work in pairs solving
Pairs - worksheet - proof, matches step with reason

Ticket to Leave: 2 problems with steps shown, students must pick problem that is incorrect and explain the error, then solve correctly.

Helen
Students should be able to identify the conflict regarding the high school graduation requirement of completing Algebra II.

Students will discuss the article in small groups; students will present their findings in small groups in oral and written fashion (I will provide a couple prompt questions to provoke discussion so they are thinking critically for most of the period.)

Students will think about how they want to defend or refute Baker’s thesis.

Participants’ lesson plans that did not match the definition provided or the beliefs stated by the participants regarding CT were exemplified by Colleen and Beth. Both teachers agreed that they were confident in their ability to infuse activities into the class that could improve CTS and did so 1-2 times/week (Pre-Intervention Survey). However, reviewing their lessons showed a lack of infused activities supporting the growth of CTS. Colleen planned for her students to review homework, take notes, and then practice on their own. Similarly, Beth had her students complete a warm-up, after which she presented the students with information, and then discussed with them the topic to decide, “How to deal with finding “M” in the formula.” Both of these lessons were teacher-centered with students being led through the material, offered an opportunity to complete some practice problems, and ended with a summary of the material from the teacher. These lessons did not match the stated CT beliefs of either teacher, who defined CT as being able to “use information to get to a solution” (Colleen) or to “interpret learning to a new context” (Beth). There were no opportunities written in either lesson plan where students were expected to construct knowledge. Additionally, these lesson plans did not give students the time...
to evaluate and analyze information or to synthesize the information to generate hypotheses. Students were not asked to present their findings or reflect upon the process. These lesson plans were collected after asking the participants to choose a lesson they believed engaged their students in critical thinking, so CT should have been apparent. The lessons demonstrated a disconnect between the participants’ own CT beliefs and practice as well as lessons that were not infused with the best CT practices.

While Colleen and Beth’s lesson plans demonstrated a disconnect between stated beliefs and practice, a few lesson plans used CT terminology but unlike in Maya’s lesson plans, it was unclear how the students were engaging in critical thought. Teaching students to think critically requires purposefully designed lessons in which CTS are modeled and used so that students become more comfortable using the skills autonomously (Warburton & Torff, 2005). While the terminology was present in several lesson plans, the activities provided did not seem to be explicit or modeled, both practices known to improve CT (Beyer, 2008; Fogarty & McTighe, 2001).

Helen, an English teacher, who stated that CT is the ability to take evidence and draw conclusions through classroom discussion and written responses, offered a lesson in which students would have a discussion about completing algebra 2 in high school. While this may be a topic in which students are interested and in which they were asked to think about their own experiences, Helen’s lesson plan did not include specific opportunities for CT, nor to draw conclusions. She stated that students would read an article, discuss in small groups, and then be provoked into discussion through teacher prompts. There was nothing in this lesson plan that encouraged students to develop their own conclusions but instead expected students to answer teacher generated questions. Additionally, no guidelines were offered to the students on
how/what to discuss, nor was there a description of how Helen would engage her students in higher level thinking and not just obtain responses that summarized the articles the students read. Reading the lesson plans, I determined that this was a teacher-centered lesson in which Helen drove the discussion.

Another lesson that used CT terminology without explicitly sketching out how students would engage in CT was provided by Rachel. Rachel believed that CT is exemplified in math through the solving of real world problems. Yet, her lesson plan, although supposedly designed to purposefully engage students in CT, lacked real world problems. Her objective was to have her students solve radical equations and this was accomplished through a warm-up activity where students reviewed a series of equations on the board to develop a definition of a radical equation and then moved onto a lesson comprised of direct instruction and pair work. The lesson plan lacked an expectation that the definitions created would be shared, analyzed, or evaluated. There was no explanation given of how the students reflected on this process so that they could gain a deeper understanding of the skill at hand. Rachel’s lesson demonstrated a lesson where CT activities were used but without the connection to her knowledge and beliefs, these activities did not explicitly infuse CT into the lesson.

Finally, the analysis of lesson plans demonstrated a lack of the process that the teachers stated was important to engaging critical thinking. The lessons focused on teacher delivered content with the possibility of a single activity included to engage some critical thought. An example was provided in Susan’s lesson about standard deviation. After the students completed their measurements and calculations, she asked students to combine their data with the other class to determine if the class believed their data was now more accurate. Another example was when Rachel ended her lesson with two problems that had steps shown on the board and required
her students to pick the problem that is incorrect and solve it correctly. While these concluding activities asked students to analyze and evaluate information, these activities were used at the end of class to review the information taught, not to solve real world problems or unique scenarios. These lessons demonstrated that participants in the study were not comfortable using critical thinking to introduce and teach content, but instead relied on activities that asked students to access their higher level thinking occasionally rather than being infused throughout the lessons.

**Awareness and intention needed.** The participants' knowledge, beliefs, and practices surrounding critical thinking prior to the intervention, exemplified teachers who lacked the necessary critical thinking pedagogical content knowledge (CTPCK) needed to infuse CT into their classrooms to actively build and improve their students’ critical thinking skills. The participants responses to both the questionnaire and in the first session, showed a group of educators who were aware of critical thinking and the necessity for students to acquire these skills (in fact, the majority of participants strongly agreed that students should possess the ability to think critically upon high school graduation) but that prior to the intervention there was no conscious effort to infuse critical thinking into their lessons. While the math teachers believed that CT was the ability to learn knowledge and apply it to a new problem and the English teachers believed CT was the ability to gain a deeper understanding and provide evidence of one’s thinking, very few of the lessons provided allowed students to actively engage in the material. Instead, the initial lesson plans were teacher centered focused on minimal opportunities for the students to engage in critical thinking. There were few opportunities for the students to try and fail. The lesson provided were examples of the teachers leading the students into what they determined to be critical thinking and then the teacher walking the students through the
activity via demonstration or direction. These lessons illuminated a gap between what teachers thought they were doing to engage students in CT and what they were actually doing in their classrooms. Hence, the goal of this intervention was to improve teachers’ CT practices through a reflective cycle that allowed them to examine their own practice, work with colleagues to improve their critical thinking pedagogical practices, and then to try out these practices with their classes. The creation of the PD was done with the support that the teachers requested, such as an increase of knowledge surrounding critical thinking, the introduction of critical thinking problems and activities, and the time to work with other teachers in their department.

**Improving Teachers’ CT Awareness and Intention**

Improving teachers’ awareness and intention regarding CT requires opportunities designed to improve the meta-awareness of their practice as well as learning how to explicitly infuse their practice with methods to engage students’ CT (Rotherman & Willingham, 2009; Smith & Szymanski, 2013). Therefore, this intervention provided the participants with opportunities to assess their current CT practices, to be introduced to new practices, and then to try out and reflect upon the success of the new practices in their classroom. This process was based on the literature stating improvement in teachers’ CT practices, requires a step by step process addressing key principle/dispositions of thinking, setting the objective of the program, modeling techniques, allowing for practice, and providing metacognitive components (Boonjeam et al., 2017; Halpern, 1998). A comparison of the lesson plans submitted at the start and at the conclusion of the intervention showed an increase in teachers' awareness and intention in their CT practices. Detailing this change in practice will be completed by a review of the original lesson plans, an analysis of the participants’ experiences during the intervention, and descriptions
of the changes in practice exhibited at the end of the intervention as observed in the final lesson plans.

**Review of original lesson plans.** Participants were asked to submit a lesson plan at the start of the intervention in which they engaged their students in CT. These original lesson plans included vocabulary typically associated with CT such as, “to think about,” “decide,” “analyze,” “formulate,” “solve,” and “assess.” Yet deeper analysis of the lesson plans (discussed in pre-intervention practice findings) showed that most of the participants relied on teacher centered lessons in which they delivered the content and then asked the students to solve problems or answer questions. Seemingly, the teachers believed CT was occurring in these lessons since they chose to submit them as exemplars, but there was little evidence that the teachers were engaging students in CT. The lesson plans (Table 5) did not, in general, provide students with opportunities to be inquisitive or to answer intentionally designed questions to engage critical thought. Combatting the lack of CT opportunities was done by improving the teachers’ awareness and intention of CT practices, through the explicit instruction of CT practices and providing opportunities to increase their meta-awareness of CT practices.

**Explicit instruction and increased meta-awareness.** Improving teachers’ CT practices does not require massive changes to the teachers’ pedagogy. Rather, teachers need opportunities to increase their knowledge about how to explicitly infuse CT into their classes as well as raise the meta-awareness surrounding their practices (Gul et al., 2014; Marshall & Horton, 2011; Zohar, 1999; Zohar, 2006). Increasing this knowledge began by creating a working definition of CT, then focused on improving questioning, and concluded with sessions designed to increase classroom inquiry opportunities.
Creating a definition. Infusing CT into the classroom must be explicit. Therefore, I began the first session by informing the participants that “Research shows that CT has to be done in very obvious and specific ways. And what we...tend to do as teachers is that we think we’re having our kids do critical thinking, but if you actually asked them, they don’t know they are doing it.” Hence, I began the process “to make teaching...more visible,” and to build “A no secrets classroom where you tell the students that this is what we’re doing and this is why we are doing it.” Modeling a no-secrets classroom, I then set the objective of the first session, “to create a working definition of CT.” Once the objective was set, the participants were tasked with “working as a content group, [to] create a definition for CT that is student-friendly...then predict the definition that the other group is going to create for the critical thinkers [in their content].

This activity modeled how to explicitly infuse CT into an activity since participants were asked to synthesize and create a definition.

The groups shared their definition and worked as a large group to synthesize the definitions provided to create one that would be used for our meetings. The math conversation revolved around the idea of CT as “understanding the why” and being able to “transfer these skills.” These concepts aligned with what the math teachers offered individually in the pre-intervention survey (Table 3). The English teachers discussed CT as “thinking about thinking” but more importantly that thinking becomes critical when students are asked to “identify why.” Like their math colleagues, these definitions coincided with what the English teachers had offered in the pre-intervention survey.

Hoping to encourage greater synthesis, I asked, “So what similarities did you see as we chatted?” Rachel offered, “The why, the term why.” Holden stated, “The need to explain,” and Margaret (who left the study after this first session) shared, “We were each focused on the
purpose of thinking.” Following these comments, I asked, “So what definition do we come up with?” At this point, Holden added, “I think decision making is vital.” Rachel responded with, “Understanding why to make that decision,” and Beth contributed, “So, I think that decision making is huge.” Until this point, decision making had not been discussed in either the definitions offered individually or in the definitions offered by the subject specific groups. Only when the entire group of math and English teachers evaluated the definitions to synthesize the information to develop a definition for the group did decision making come to the foreground. The definition created for our group was that CT is a strategic approach to explain the reason why you think something. The process of building this definition allowed the participants to think about their own definitions of CT, to discuss CT with their subject-specific colleagues, and then to share out with the group. This activity demonstrated how when CT is made explicit and purposeful, CT can be a tool used to help build new knowledge.

**Reflecting on creating a definition.** Working together to create a definition successfully allowed the participants to think about critical thinking. When asked the most valuable part of the first session, three of the participants stated, the act of defining CT. One participant shared anonymously in the post-session reflection, “The seemingly simple act of having us define what CT is was very thought provoking and challenged me to think about my own thinking.” Maya summarized the benefits of this experience in the focus group interview when she said:

> “When the group had to define what critical thinking was before you went in and talked to us about it, you were engaging us in critical thinking...You’re making us do it and then you’re telling us what we’re doing ...In a way you’re putting us in the position that students would be in. So now we’re seeing it from the teacher perspective but also the student perspective.”
Encouraging the teachers to think critically about critical thinking allowed them to dive deeper into their own knowledge and beliefs and to begin to assess their own practices. This pattern of engaging the participants in CT activities about their own practices continued throughout the remaining PD sessions.

**Questioning questions.** Focusing the participants’ on their questioning practices, I asked them to audiotape a lesson, listen to the lesson, and “write down all of your questions…and then using the 6 Facets of Understanding or Bloom...classify the questions that you asked. Where would the questions fall within those knowledge bases?” Bloom’s Taxonomy and Wiggins and McTighe’s 6 Facets of Understanding had been discussed in the first session and were used so that the participants had a baseline knowledge in which to classify their questions. The purpose of this activity was to raise the participants’ meta-awareness of their questioning practices and so the actual classification was not critical, but was instead an opportunity for the participants to assess the types of questions they asked during a lesson.

Reviewing the classifications, I created two word clouds (Figure 3) summarizing the types of questions asked. When asked to provide an initial response to these images, Rachel said she saw a focus on “skills” and “memorization.” Helen felt that the word cloud made her think of “regurgitate and lower order.” Susan summed up these feelings with, “Not much critical thinking.” The participants recognized that their questioning practices tended to center around what is described as the lower level thinking skills of recall, remembering, and explanation. Questions at this level do not allow students to engage in critical thought because the students are simply being asked to provide the teachers with the information they have been taught.
Reflecting on their initial questions. After logging and analyzing their question, all participants agreed that, “There were questions that could be improved to better engage students in critical thinking” (Session 2 Reflection). Overall, the participants believed that their questions were “similar” and tended to be “surface level” questions when they reviewed their classifications. Reflecting anonymously on the questions asked, one participant stated that she needed to “give [students] them time to see how expressions are evaluated rather than just giving them the answer right off the back.” This participant realized that while she may be asking higher level questions, she was not giving her students enough time to answer the question; she was looking for efficiency over critical thinking. Another reflected, “I need to phrase my questions better to allow my students to think about why, rather than spit back out the answer.” Again, there was a feeling that students were not being given enough time to answer higher level questions. Interestingly, the participants may have also been recognizing that their questions were not really asking students to think at a higher level but to instead answer questions that demanded quickness rather than the process many of the participants stated was important to
Thinking critically. Listening to the lessons allowed the participants to see the gaps between their beliefs and practices. This process made them recognize that their questions tended to not engage their students’ CTS and that this needed to be addressed.

**Opening and planning questions.** Engaging CTS can be done by shifting practices to include more open questions. Open question usually have more than one answer or more than one way to answer the question which in turn engages critical thought. Conversely, closed questions are fact driven and can be answered through memorization and recall. Therefore, I explained how “tiny word shifts can change your questions from being closed to opening them up.” The participants were given examples of closed questions from the audio taped lessons. Using the time allotted the subject specific groups were asked to “Analyze these [closed] questions...talk amongst your groups, and then create new questions that could engage your students in CT.” The participants successfully worked in their content groups to transform the closed questions to more open questions (Table 7). The questions created exemplified how shifts in wording could encourage critical thinking. Rather than asking for specific answers, these new questions gave students the opportunity to synthesize and analyze information, to evaluate their thinking.

<table>
<thead>
<tr>
<th>Table 7 - Examples of Question Changes</th>
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</thead>
<tbody>
<tr>
<td><strong>Example of Closed Questions</strong></td>
</tr>
<tr>
<td><strong>English</strong></td>
</tr>
<tr>
<td><strong>Math</strong></td>
</tr>
</tbody>
</table>
However, learning how to create more open questions was only the first step in the attempt to improve participants’ awareness and intention. Since infusing CT must be explicit (Beyer, 2008; Ennis, 1997; Fogarty & McTighe, 2001), I asked the participants to choose an upcoming lesson and “write down any questions you plan to ask…then really look at them...if they are closed, can you open them to enable higher level thinking...You have to be purposeful, know what you are going to ask.” Prior to the questioning session, analysis of the participants’ questions showed that 175 questions were asked by the eight participants. 146 of these questions were closed, meaning only 17% of the questions were open. However, after learning how to create more open questions, the percentage of open questions increased from 17% to 75%. While the percentage increased, the total number of questions decreased from 175 to 55. This was most likely because engaging in CT takes time, time for the students to answer and time for teachers to ask probing questions to move students towards the answer when they are having difficulty. This shift in practice more closely reflected the participants’ stated belief that CT requires a process.

**Reflecting on opening and planning questions.** Reflecting on the lesson taught with planned, open questions, the participants reported better student responses to their open questions. Seven of the eight participants agreed on the post-activity reflection that their questions were more open because the questions were planned out in their lesson plans and that these questions allowed students greater opportunity to think critically. The more open questions allowed students multiple ways to answer the questions rather than relying on recall or regurgitation. The reflection completed anonymously after the lesson showed that writing down the questions allowed one participant to “have more a purposeful design to create questions,” and another to, “become more aware of my own questions.” The questions submitted (Table 8)
Table 8 – Closed to Open Questions

<table>
<thead>
<tr>
<th>Closed Questions (Pre-Session)</th>
<th>Open Questions (Post Session)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Math</strong></td>
<td><strong>Math</strong></td>
</tr>
<tr>
<td>Do you remember what happens if you have a negative exponent?</td>
<td>What is the goal to starting to solve any equation?</td>
</tr>
<tr>
<td>What’s the 5th root of 32?</td>
<td>What is the purpose of an inverse operations?</td>
</tr>
<tr>
<td>What is the slope of the line?</td>
<td>What makes a solution extraneous?</td>
</tr>
<tr>
<td>What kind of inequality sign is this?</td>
<td>Why is the domain restricted in the square-root function?</td>
</tr>
<tr>
<td>Where is the log key on your calculator?</td>
<td></td>
</tr>
<tr>
<td><strong>English</strong></td>
<td><strong>English</strong></td>
</tr>
<tr>
<td>How did we do with the poems yesterday?</td>
<td>At what point do you make the choice to believe him or not?</td>
</tr>
<tr>
<td>What are the images you see?</td>
<td>What alternative would you suggest for this paragraph’s claim?</td>
</tr>
<tr>
<td>Everybody sees it yet nobody says anything, except for who?</td>
<td>What are some of the stereotypes associated with certain types of students?</td>
</tr>
<tr>
<td>Did you do better in Geometry?</td>
<td>Why is this language difficult for you to understand?</td>
</tr>
<tr>
<td>How does Bigger feel about his crime after being caught?</td>
<td>How can you most efficiently spend your human resources for maximum morale?</td>
</tr>
</tbody>
</table>

demonstrated how the participants used what was learned during the session to create questions that provided students with greater opportunity to think critically. Using open questions had participants reflecting, “my students were more responsive...” that “I got more student responses,” and that “My lessons were more engaging [with] higher class participation.” Focusing on open questions allowed these teachers to engage their students. The teachers observed that the use of open questions had a positive effect in their classes because their students’ responsiveness increased. Students were asked to think more deeply to answer the purposefully planned, open questions.

Preparing the questions ahead of time allowed the teachers to be more aware and intentional of their questioning practices. One teacher captured this idea when she shared, “I
usually just ask my questions on the fly because I know what points I want to hit, but this made me think about my questions and change the way I ask them to require more upper-level thinking.” One participant realized that, “Simple changes to word choice can intensify a class question.” While another shared, “I saw that you can easily turn questions into more upper level questions by simply changing the way you word it.” Asking the teachers to create a lesson plan that included the questions they wanted to ask made them more aware of what they wanted to ask and more intentional in creating questions that engaged students at a higher level. Another teacher reported that she “distinctly tried to create open questions that I would not have thought to ask otherwise…” and that, “it made me more aware of what I really wanted to get out of my lesson.” Finally, one participant summed up the importance of planning the questions by stating, “This activity made me think about how to exactly phrase my questions to get the best responses.”

The participants’ meta-awareness of their practice increased through the completion of this activity as demonstrated by the recognition that planning questions helped engage students in CT. They have realized that going “off the fly,” or “with the flow” was not the best practice to encourage students to think critically. One teacher shared that she continued this practice after the initial lesson plan because she felt that, “Just by jotting down on a post-it or in my lesson plans, on what I’m going to do that day, it (writing down the questions) helped in critical thinking.” The participants found this practice useful because it not only allowed them to ask better questions, but many also reported greater student responses.

Following the questioning sessions, participants reported that their understanding of CT had become “broader,” “clearer,” and more “purposeful.” Additionally, one participant reported that, “I feel stronger in...questioning,” while another felt that, “just changing the way I pose
increasing CT awareness and intention

questions...can have them think critically about the answer.” Finally, one shared, “I absolutely find myself changing the way I ask questions, so as to require students to use more CT.” Maya shared how open questioning helped her students reach new understandings during *To Kill a Mockingbird*. This occurred when she asked her students to look at the trial from May Ella’s perspective. “We always look at the trial through Tom’s perspective, we look at it through Atticus’...but it [asking students to look through May Ella’s perspective] opened up an entire discussion...and then they were asking questions and they saw the book ...from an entire new perspective that I had never seen before.” While Maya was arguably the strongest CT practitioner, her participation in the intervention increased her awareness of the need to use open ended questions and she saw a positive change in her class. For Maya, opening her questions helped her students to open up and share more ideas in class. Since the participants showed an increased confidence in their questioning skills that aligned with self-reported changes in their students’ thinking, the intervention shifted focus to increase participants’ knowledge of other methods that could be used to encourage students’ CT.

**Introducing inquiry.** The conversation about inquiry began in the fifth session of the intervention. Using Pear Deck (a Google Slides Add-On) I asked the participants “to reflect on what we’ve done and where we’re going.” This was an important session because due to the demands of the school calendar, it had been a few weeks since the last meeting and was the last session prior to Spring Break. So, this session allowed participants to recap what they had done and to get a roadmap for what was ahead for them. The session began with the question, “When you think back on our questioning exercises...what did you learn from this exercise?” The participants’ responses (Table 9) while anonymous were overall positive and showed a continued use of open, planned questions.
Table 9 - Participants’ Reflection of Questioning

“By mapping out my questions and creating a script for my questionings, I think it allowed me to ask some higher-level questions or at least attempt to.”

“Planning for open-ended questions keeps me accountable for asking them.”

“My lessons are more engaging, higher class participation.”

“I’m fascinated by the patterns that emerged as lessons went on, how the questions built into higher order thinking.”

“To write them out, I saw that word choice has a huge impact on the level of questions and/or responses.”

After discussing these responses, the participants were further engaged in thinking critically about the intervention when they were asked, “When you think about asking more open-ended questions, what do you wonder about?” One teacher wondered, “How do you motivate the student who is content to sit back and not engage in CT?” Beth stated, “That’s the same question I had.” Trying to answer this question as a group, pushed the participants into a discussion about student engagement. The math teachers were very concerned with not knowing if the students were learning the content when using CT activities. Susan shared, “If they don’t get in on the discussion, then I don’t know [if they understand].” Beth supported this concept when she shared her concern as “I think they might be searching for the answer, thinking hard, or they might be zoning out.” Underlying the participants wondering was still the fear that if they did not directly instruct students, the student would not learn the material. Also, the participants seem to fear engaging students in higher level questions, because when they ask questions that require processing time, they cannot “see” if the students know the information and are thinking or if they are unsure of the material. Since this seemed to be a concern, particularly for the math teachers, I asked the English teachers to weigh in on this topic, and Maya shared that she has her students use “their phones or Chromebook… [to] submit an answer only I can see. Because
sometimes I feel like they don’t have the confidence.” From this suggestion, Beth admitted, “I use index cards a lot, I could use the index cards.” Working together, the participants were able to express their concerns and discover a way to address the concern in their classroom. I did not provide a solution to their concern but instead helped to move the discussion forward (modeling an inquiry based activity) and allowed the participants to create their own solution.

Moving towards lessons grounded in inquiry, I offered some fundamental concepts at this point of the session to increase participants' awareness of the practice. I explained that using inquiry requires “persistence” and that “open ended questions are great but we also need to give our students some attempts at solving a problem they don’t know the answer to.” Finally, the participants were told that to engage their students in inquiry, they should try to use a topic “students have some interest in...and [be] given some autonomy.” This session concluded with a preview of the next session that would occur after Spring Break.

**Reflecting on reflecting.** Participants agreed that the review of previous sessions and the introduction of the new material was valuable. Particularly, the participants stated that working with the members of the group from the other content area was a strength of the session. One participant believed, “Talking with colleagues allowed me to see different perspectives.” While another shared appreciation for, “hearing what my colleagues thought.” Providing time for the colleagues to reflect with one another allowed for participants to increase their meta-awareness. Until this point, reflections had been collected and analyzed only by the facilitator but this session showed the importance of granting the participants the chance to reflect as a group. The responses to the post-session reflection demonstrated that the participants appreciated being able to see how the other teachers were fairing in their endeavor to increase CT in the classroom.
Inquiring to learn inquiry. During the final large group session, I outlined how to use inquiry to engage CT that included student exploration, analysis of additional information, students generating a hypothesis, presenting results, and reflecting on the findings. The use of inquiry in the classroom was exemplified with an activity from each content area. All participants were led through Steven Brookfield’s Scenario Analysis (Appendix D) and then through the One Grain of Rice story (Appendix E). The Scenario Analysis asked participants to read a story and then answer a series of questions that would force them to question the assumptions they had made while reading the story. I explained that by, “Offering those questions of what assumptions are being made...And then that alternative interpretation is really what is going to take it up into the next level...and you haven’t had to tell them much of anything.” After completing this activity, the group moved on to the One Grain of Rice Story. The participants were given a calendar and asked to listen to the story and try to determine the amount of rice they would have by the end of the story. This story was based upon exponential growth. Upon completion of these activities I explained that posing problems in which students are given, “a little bit of outside information… [can help students to] ...derive the math or pull out the important parts of a story in English.” The purpose of these activities was to introduce to the participants that CT activities can be used to build content and new knowledge; they just have to be willing to allow the students to try out new ideas on their own. As Holden stated during the session, “All it took was letting go of that fear in the beginning of, if I don’t say it, they’re not going to know it.”

This session was completed by having the participants work together in their content specific groups to develop a problem that could be posed in their class that would allow students to work towards a new understanding. Both content area groups were able to present a lesson
idea that included posing a problem and letting the students work to solve it on their own. Colleen, the math representative, shared a Three Act math problem. The problem was,

“So, you are on the beach...and there is a taco cart up on the boardwalk. You’re with your friend who says we should cut across the beach but you say we will walk a lot faster on the boardwalk. That’s kind of the problem… ‘Who do you think is going to get there first?’ So that’s a conversation between the kids...So that just kind of gets them thinking...and honestly, [it’s] a real world situation…”

Julia provided the English example. “Before starting a novel, I give them statements...like *To Kill a Mockingbird*, I might say… ‘Prejudice is something you see every day’...Ask the students if they agree or disagree and then they talk about why...They don’t, at that point, even realize that we’re talking about themes from the novel.” Both of these examples demonstrate the teacher as the guide on the side who provides a prompt and then allowed the students to develop the content by being inquisitive with the material provided. Additionally, both examples were based in the real world and asked students to think about the why, reflecting the participants agreed upon definition that CT is the strategic approach to explain the reason why you think something. The examples provided by the participants demonstrated not only an increased understanding of problem posing but also of CT.

At this time, Rachel, a math teacher, shared that she had changed a recent lesson plan because of her involvement in this intervention. Rachel explained that she was teaching exponential growth and did so by telling the students that a genie came out of a bottle and can grant one wish. The students had to work together to decide if it would be better to take a total sum of money or a penny a day that would double every day for a month. The students had not been taught exponential growth yet, but instead this was used as an introduction to the concept.
Rachel used this activity after students had completed a test and reported that she, “asked them to think about it, write something down, and turn it in… They were just invested in it…I was blown away...At the end of the period, they were writing on the board…It was just something they were interested in.” Rachel’s anecdote demonstrated two things. The first is that her participation in this intervention has made her more aware of areas in which she can engage her students in CT. She stated that she did this problem because of “being in this group.” Second, this lesson demonstrated a strong inquiry based opportunity because the students were interested in the problem, were asked to work autonomously (without teacher assistance), and were engaged. This example was a good share for the group as we moved towards the development of inquiry based lessons.

The final sessions of the intervention used the protocol, “What, So What, Now What?” (Appendix F) to engage the participants in a modified lesson study within their subject specific groups. Lesson study was a new concept for the participants so the protocol made the process easier as there was a clear pattern to follow during the session. Each participant briefly described an upcoming lesson that they believed could be infused with inquiry opportunities. The participants outlined a concern and then listened while their subject specific colleagues discussed the lesson and concern. The participants’ time concluded with their reactions to their colleagues’ conversation. Upon the conclusion of the modified lesson study, the participants adjusted and taught their new lesson. Prior to teaching the lesson, six of the participants strongly agreed and two participants agreed that discussing the lesson with their colleagues helped to develop a lesson that offered students more opportunities to think critically. Additionally, five participants strongly agreed and three participants agreed that their colleagues influenced their lesson design.
Overall, the in-depth conversations that occurred during the modified lesson study helped the participants to process the CT practices that had been discussed in previous sessions.

The participants believed working together, discussing pedagogy, and receiving feedback were the most valuable aspects of the modified lesson study. Five participants taught the lesson within a week of the lesson study and implemented the suggested changes. Colleen and Beth misunderstood the activity and brought a recently taught lesson that they wanted feedback on to the lesson study and Holden presented a lesson that would not be taught until after the intervention had been completed. The lesson plans presented showed growth from the original lesson plans because these were more detailed and include purposeful attempts to infuse CT. However, the suggestions given during the modified lesson plans encouraged the participants to push even further to make student thinking visible and having teachers slow down their instruction.

**Making CT a Process.** By this point, the participants had begun to realize that CT requires time and cannot be done quickly or without purpose. For example, during the English meeting, Holden suggested to Helen that she use “creative writing exercises as pre-, pre-, pre-[writing], to open the students up to feeling free to write about anything.” After listening to her colleagues, Julia summarized the feedback she received as, “Rather than making this a one-off assessment, to make it more of a process, and I really like the idea of revisiting it again.” Maya believed the comments she received, “gave me a couple pre-activities to do.” Overall, the lessons presented had components of CT in them demonstrating an increase in the awareness and intention of the participants, but these discussions helped the English teachers to refine their practices even further to provide their students with the time necessary to truly engage in critical thought.
While the English teachers helped their colleagues to slow down, the Math teachers assisted their colleagues in finding ways to engage students more fully in critical thought as well as slowing down their instruction. After discussing her plan and listening to her colleagues, Rachel asked the group, “So I know to slow down, but do you like my thought of...giving the graphs, and then… [have students] find characteristics, and then the second day, after doing cosine, go into graphing?” The other teachers agreed and Rachel felt, “This was a great way to bounce off ideas.” Susan also requested help in finding a more creative way to introduce radians. Her colleagues suggested she adapt her original plan of having the students watch a GIF of a circle in class, to asking students to watch the GIF at home and come up with “three comments or questions about the GIF.” This suggestion by Beth provided the students the chance to independently view and discover what the GIF might mean in regards to Algebra 2. Colleen and Beth then led a conversation about how to make use of the students’ prior knowledge of the unit circle to figure out what a radian is and how it is used in math. Susan expressed, “Okay, I am loving it.” Prior to the conclusion of Susan’s time, Colleen cautioned her, “Time...That’s the hardest thing...waiting.” Colleen was reiterating to Susan that this type of work required giving students the time to work through the problems and that there could be silence in the room as the student worked. Susan would have to be ok with this silence and not quickly giving students the answer if they seemed to be struggling. After the lesson, Susan reflected, “I think my students ended up with a good understanding of what a radian is. Some of them even understood it from the GIF.” The excerpts of these conversations exemplify the infusion of CT as the teachers created opportunities for their students to be inquisitive in attempts to build content knowledge through purposefully created problems.
Reflecting on inquiry. Participants appreciated the time to work with colleagues and believed this time positively influenced their lesson. Following the lesson study and prior to teaching the lesson, six participants strongly agreed and two participants agreed that “discussing my lesson with my colleague helped me to develop a lesson that offers my students more opportunities to think critically” (Post-Lesson Study Reflection). The participants acknowledged the benefits of having time to work with their content colleagues to deeply discuss pedagogy. One found it, “valuable to just hear how they approached certain topics.” Another seconded this idea with appreciation for, “Just the chance to think together.” The participants appreciated the ability to discuss content with colleagues who teach in the same discipline. Teaching can be isolating at times and the participants believed their pedagogy was improved because they were able to discuss their lessons and received feedback from their colleagues. The lesson study allowed the participants’ time to slow down and really think about what they wanted to teach and how they could do so in a way that would engage CT.

Teachers’ awareness and intention were improved by their participation in the modified lesson study. Holden shared, “My questions got a lot more specific...I took for granted that an opportunity for students to do a whole presentation on something they care about would be [enough]...But now my questions can help them get there.” A math teacher reported, “It made me think of different angles to approach the lesson rather than the same way I have done it in the past.” Helen said, “It allowed me to reconsider how to introduce the lesson to activate thinking.” Julia felt her lesson “was more focused and that my planning beyond this lesson was heightened.” These teachers attested to the fact that discussing and planning their lessons with colleagues prior to teaching the lesson made them more intentional and aware of their CT practices.
**Changes in practice.** Completing the intervention, participants demonstrated increased awareness and intention of CT practices. This increase in awareness and intention was exhibited in lesson plans that were grounded in inquiry, student-centered, and included purposeful questions created to engage critical thought. A focus on inquiry was shown by several teachers as they allowed their students to discover information by working on their own or in small groups. Susan asked her students to view a GIF they had not seen before and write down three things they noticed about the GIF. This information was then used to guide the students to build their knowledge about circumference and arcs. Susan stated, “Through the examples in the lesson, I gave the students the opportunity to come up with their own understanding of a radian…” Rachel asked her students to work in pairs to look at the unit circle and come up with five characteristics. After the pair found five characteristics, the pairs switched to discuss their findings with another group. This led to students using the information to graph the sine function and answer a series of questions.

Switching to English, Julia asked her students to demonstrate their mastery of Acts I and II of *Romeo and Juliet* by having them create a claim about any aspect of the play that interested them. Rather than providing the students with a list of topics, as she did in the past, she allowed the class to brainstorm and create a list of their own. Julia discovered that the use of “broad questions allowed for students to focus on aspects of the play that were interesting to them.” These lessons focused on engaging the students in new information and giving them time to work through the activities to create new knowledge. None of the participants stood in front of the class and lectured about the topic but instead provided students an opportunity to figure out the solution on their own. The use of inquiry in these lesson plans demonstrated a greater awareness and intention of CT practices than found in the initial lesson plans.
Increased awareness and intention were also shown in the final lesson plans as they included greater student-choice and student-centered activities. By shifting focus from themselves as “knowledge-givers” and students as “knowledge-receivers” (Onosko, 1990), the participants seemed to let go of the fear of, as encapsulated by Holden’s comment of, “If I don’t say it, they won’t learn it.” Maya asked her students to work in groups to answer higher order questions about Romeo and Juliet, rather than lecturing about the topic. She found that, “students were asking questions about big ideas based on the passages and questions I asked them.” Colleen asked her students to work in groups to solve equations. She remained on the side and forced her class to work together to use their prior knowledge to solve a new equation. Helen also showed an increased awareness of student-centered lessons. Rather than providing students with college essay topics, she asked students to “recount a time you faced a challenge,” or to “discuss an accomplishment that sparked a period of growth.” Relinquishing some control of assignments and activities allowed students to have a greater voice and hopefully more fully engage in CT.

Including questions in the final lesson plans also demonstrated an increase in the participants’ awareness and intention of their CT practices. This was the greatest change evidenced as the initial lesson plans included no planned questions. Teachers stated they asked questions in their initial lesson plans, but there was little evidence that there was actual opportunities for CT to occur. Conversely, all eight of the final lesson plans included questions that were written down and designed so that they might encourage CT (Table 10). Colleen’s change of practice to plan questions was one of the first points she made during the focus group interview at the end of the intervention. She said, “So on the first one [initial lesson plan], we were asked to highlight the times and activities when critical thinking occurred, so I just have
notes highlighted, on your own highlighted....And then in the second one [final lesson plan], listing the questions, I have a whole paragraph explaining what’s going on...I think it’s just that I’ve become more aware.” Colleen recognized that although she thought she was engaging her students in critical thought, in reality she was not. Her time in the intervention helped her to recognize the need to plan questions so that she could engage her students in CT in class.

The questions included in the final lesson plan demonstrate how the participants purposefully used questions to provide their students with greater opportunity to think critically.

<table>
<thead>
<tr>
<th>English</th>
<th>Math</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why didn’t Shakespeare start the play with Romeo loving Juliet? (Maya)</td>
<td>How can we solve this? (Colleen)</td>
</tr>
<tr>
<td>Why should your audience care about this topic? (Holden)</td>
<td>How are logarithms and exponentials related? (Beth)</td>
</tr>
<tr>
<td>What is the relationship between Juliet and the Nurse? (Julia)</td>
<td>How does the ordered pair of the Unit Circle compare to the ordered pair of the Sine graph? (Rachel)</td>
</tr>
<tr>
<td>Describe a topic, idea, or concept you find so engaging it makes you lose all track of time. Why does it captivate you? (Helen)</td>
<td>What relationship do you notice between arc lengths and each circle’s radius? (Susan)</td>
</tr>
</tbody>
</table>

The examination of the final lesson plans showed an increase in CT awareness and intention from the participants’ pre-intervention practices. The participants’ awareness and intention had been increased through activities designed to explicitly improve their CT knowledge and build the meta-awareness of their own practices.

**Participant Reflections of the Intervention**

Research shows that teachers’ CT practices can be improved through explicit instruction and increased opportunities for meta-awareness of practice (Rotherman & Willingham, 2009; Smith & Szymanski, 2013). However, many of these studies fail to outline the professional
development offered. Therefore, the purpose of this study was to outline a PD designed to increase participants' awareness and intention of their CT practices, discuss the change in practice, and determine the PD’s effectiveness. Hence, at the conclusion of the intervention, the participants took part in a focus group interview to discuss their perceptions of the PD and offer improvements for the future. The participants’ suggestions demonstrated a growth in knowledge and meta-awareness of their CT practices. Overall, the participants believed that being asked to think about their thinking made them more aware of their practices, that working on their questioning practices was the most effective activity in changing their practice, and that additional time for the PD could improve the intervention.

Thinking about thinking. Assessing their practice before and after the intervention, participants believed they became more intentional and aware of their CT practices. Julia shared, “I think I would use the word intentional because I knew my CT was there. My content wants it to be there, but now I am much more aware of when to use it, how to use it…” Julia acknowledged that her content, English, lends itself to CT and that she knew prior to the intervention that she should be engaging her students in critical thinking opportunities, but that following the PD, she felt more comfortable and aware of how best to engage her students’ CTS. Maya, Colleen, and Beth all stated they were “more intentional” after the intervention. Maya shared, “I’m also more reflective of my lessons. More open with using CT and how they [the students] can problem solve… and that it’s ok [for them] to fail.” Colleen said, “[my] awareness is there when planning and I find myself scripting those questions, trying to create questions within a lesson so they can lend more [to] CT.” Beth captured this as, “Being more meta about the questions that are being asked. Why am I asking this question, what do I want them to do” and that CT is not, “as hard it sounds, you just have to think about it.” These participants
believed that the intervention had increased their awareness of how to engage their students’ critical thinking, so that they were actively looking for ways to infuse CT opportunities into their lessons. They now had new expectations that their students can think critically in their class. The intervention allowed participants to see the benefits of thinking about their thinking to create better opportunities for their students to think critically.

*Improving questioning.* Improving their questioning skills was the area participants felt most changed by the intervention. Beth shared, “Thinking about the words helped a lot. My goal since has been to write down three questions with good words and then see where the class takes them.” Originally, Beth had stated she asked questions “on the fly” and so this statement shows a change in her practice from the start of the intervention. The intervention left an impression on her regarding the importance of planning questions to engage students’ CTS. Maya stated, “Asking more open questions...allowed me to get more participation in class discussion.” Opening questions allowed for Maya, an already strong practitioner of CT, to improve her student participation. Maya found that by opening her questions she provided her students with greater opportunity to engage in CT. Julia also saw an improvement in her class participation because of her new questioning practices, “I have found myself just changing [from ‘Any questions?’] to ‘What questions do we have?’ and I have gotten some really interesting questions or responses that I don’t normally address.” Maya and Julia have witnessed positive changes in their classrooms by adjusting their questioning practices. Both teachers believe that asking more critical questions asked has improved student engagement.

*Most effective aspects of the intervention.* Participants felt that working with cross-curricular groups and being given opportunities to think about their panning were the most effective aspects of the PD. The participants are used to working with teachers within their
In an effort to increase CT awareness and intention, participants found working with colleagues from different disciplines powerful. Beth provided the overview as “Seeing the other side and seeing how other people are working in CT in their discipline is huge.” Colleen echoed the statement, “We got to bounce ideas off of each other and critique...because just to hear it from someone who’s not thinking in the same track as you are, was really beneficial.” Holden shared that “Talking to [math] guys forced us to really think about our process,” and Susan framed it within her classroom as, “to hear what each group came up with was good because in our classrooms we have a mix of people.” Typically, professional development is offered to teachers of the same content area. However, the participants in this study found working with a different content area sharpened the lens they used to increase their CT practices. The participants believed working with a different content area encouraged them to more deeply analyze and then explain their process. They could not expect that the teachers in the opposing content area would simply understand the concepts they were discussing, so they had to be more purposeful in their explanations and analysis. The participants all acknowledged that strict inner-disciplinary conversation may not have been as productive because teachers of the same content could bring the same perspectives to the sessions. Holden likened it to “confirmation bias.” Working with teachers from different content areas allowed teachers to push beyond their comfort zone and really think about CT practices.

*Question logging.* While participants found it beneficial to work together, the act of logging and analyzing their questions was the most effective activity for the participants. Susan stated that listening to her questions was “eye-opening” and Colleen described listening to the questions as “a scary truth.” As Colleen shared earlier in the intervention, this activity was useful because it was something that she had not done since “student-teaching.” Many of the teachers have not had the opportunity to closely analyze their practices.
Listening to their questions, an activity designed to increase the meta-awareness of the participants’ practice, achieved this goal. Susan stated, “[The] question log was really helpful to have me think about my questions and think about how changing a couple of words could easily make it more CT…” Julia shared, “[I] found myself evaluating my questions as I go through [a lesson], whereas before I looked at my questions as a checklist.” Both Susan and Julia believed that examining their questions helped improve their CT practices. Particularly, they believed they have undergone a change in how they questioned their students. Seemingly, by being asked to think about their questioning practices, the participants became more reflective of their practices and encouraged them to look for ways to include higher level questions within their lessons.

Additionally, Beth felt that listening to her questions made her realize that she, “Might ask three questions at once instead of focusing on one really good question. So I’ve tried to tone that down...Ask a good question and let it marinate to get good responses.” Early in the intervention Beth, who teaches AP Calculus, was concerned about losing time when attempting to engage students in CT. Her reflection in the focus group interview demonstrated that she now recognized the necessity of slowing down and focusing on asking a “good question.” Reflecting on their questioning practices allowed the participants to increase their awareness and intention of their CT practices.

**Suggested improvements to the intervention.** Overall, the participants found the intervention beneficial. However, when looking forward, the participants desired more time. The current intervention was eight sessions with the first session explaining the process and the last session used to conduct a focus group interview. Participants believed that if the intervention was repeated in the future, time spent discussing assessments and another lesson study could improve the intervention. Holden specifically wanted time dedicated to “test analysis.” He offered that
perhaps, “We take our current tests and show, like you did with our questioning techniques where we categorize our questions...how could we take all this type of thinking and actually apply it to a final test of some sort.” While this was a strong suggestions for a future intervention, this suggestion also demonstrated that Holden was thinking deeply about his practice. Through the intervention activities, he has come to realize there are other areas of his practice that could be addressed and would like the opportunity to discuss his assessments with his colleagues in the group. Holden showed an increase in meta-awareness and an understanding that explicit instruction in CT practice could improve how he assesses his students.

Building on an increased meta-awareness surrounding practice, Colleen, “would have liked the opportunity for a second inquiry lesson.” What Colleen described was a continuation of the initial lesson plan study where you, “maybe have a post meeting about how the lesson went and then, ‘Ok, here’s what I’m going to do next week. We’re going to try it with the same group of kids. And here’s my idea.” Colleen showed a desire to continue the work started in the sessions and like Holden had an increase in the meta-awareness of her practice as she recognized the need for continued time to work on her practice.

Susan found such a benefit in the cross-curricular group that she suggested a cross-curricular grouping for the lesson study. She wanted feedback on her lesson from her English colleagues because, “to present you [English teachers] with a lesson, to see what I’m thinking about it with my kids that aren’t math brained...I would have liked to hear from you guys. If I did this [lesson], what don’t you understand?” Susan discovered that discussing her practice with colleagues outside of her content area helped her to think about all of her students and she recognized that not all students think about math in the same way. Considering that at the beginning of the intervention Susan saw the two disciplines separate in the way they address CT,
this suggestion showed that Susan found the time working together with math and English teachers helpful and would like more opportunity to do so.

Conclusion

The participants found their time well spent in the intervention. Their awareness and intention improved and the way in which they reflected on the intervention and discussed future implications demonstrated a greater understanding of CT practices from their pre-intervention knowledge and beliefs. The explicit instruction of CT tied to multiple opportunities to increase participants’ meta-awareness revolving around their CT practice has seemingly improved the participants’ practices throughout the eight session intervention.
CHAPTER 5: DISCUSSION

Thinking critically, the ability to analyze, synthesize, and evaluate information, is a necessary skill in the 21st century. Today, information moves at the speed of a mouse click and so people must be able to determine what information is important and how that information can be used. Unfortunately, students continue to graduate high school without the critical thinking skills (CTS) required for 21st century success (Buris & Garton, 2007; Dam & Volman, 2004; Marshall & Horton, 2011; Raudenbush et al., 1992). Leaving high school without critical thinking skills seemingly occurs because teachers continue to rely on rote learning and memorization as they have for generations (Allamnakhrak, 2013; Cuban, 1993). This type of classroom instruction has persisted as the primary method of content delivery because teachers are unsure how to infuse lessons with critical thinking (CT) opportunities for their students. While teachers find it difficult to engage students in CT, educators do recognize the importance of CTS in their students’ lives (Barak & Shakhman, 2007; Stapleton, 2011). Since a gap exists between educators’ knowledge, beliefs, and practices, the purpose of this qualitative study was to design, implement, and assess an intervention to increase secondary educators’ CT awareness and intentions to improve their CT practices.

Research has demonstrated that CT opportunities can be increased in the classroom by offering teachers explicit instruction about CT practices combined with opportunities for teachers to increase the meta-awareness surrounding their own practice (Beyer, 2008; Ennis, 1997; Fogarty & McTighe, 2001; Zohar, 2006). Following these constructs and situating the intervention in line with Guskey’s (2002) model of PD led to the creation of an eight-week intervention that revolved around a cycle of learn, do, and reflect. Specifically, this cycle coincided with the guiding principles of the study:
1) Design activities so participants can identify the gaps between their beliefs and practices
2) Provide time for the participants to confront these gaps
3) Model explicit methods of infusing lessons with opportunities to engage students in CT
4) Encourage participants to try-out the new skills in the classroom

Following these principles allowed the participants to think deeply about their own practices, discuss these practices with their colleagues, and then to try-out the practices introduced to improve the infusion of CTS into their classrooms. This study took place at Smithville High School, a large suburban high school situated within a regional high school district and was designed around the following three research questions:

1) What are teachers’ pre-intervention knowledge, beliefs, and practices surrounding critical thinking?
2) What changes are observed in the teachers’ intention and awareness of CT practices during the intervention and in their lesson planning after the intervention?
3) What are teachers’ perceptions of how the PD improved their awareness and intention regarding the infusion of critical thinking into their classes?

These questions were addressed as eight participants worked together with the researcher to improve their awareness and intention surrounding their CT practices. The cross curricular group contained four math teachers and four English teachers. The decision was made to use multiple disciplines because CT is not the domain of any one subject and although math and English are typically thought to be subjects that require a different set of skills, both require CT. Also, working across disciplines allowed participants to benefit from each other’s CT knowledge and experience. According to participants, discussing both current and new practices with colleagues from another discipline was arguably one of the strongest aspects of the intervention.
The sessions were focused on three main activities: creating a working definition of CT, improving participants’ questioning skills, and infusing the participants’ lessons with more inquiry-based opportunities. Through each of these activities, some taking place over multiple sessions, participants were introduced to new material, offered time to reflect on current and/or new practices, and to discuss their experiences with the group. The main data points were a pre-intervention questionnaire, session transcripts, reflective writing, participants’ lesson plans, and a final focus group interview. Overall, providing participants’ with the time to think critically about their critical thinking practices increased the participants’ awareness and intention surrounding their CT practices.

Increases in the participants’ CT awareness and intention was evidenced in the lesson plans collected throughout the intervention. This improvement was facilitated through explicit instruction of CT practices as well as opportunities to increase participants’ meta-awareness of their practices. One of the most important activities that improved the teachers’ knowledge and in turn their practice was when the participants worked together creating a definition for CT. While the participants were individually able to define CT before the intervention, working as a group allowed them to develop a more sophisticated definition that included the importance of decision making in CT. Participants realized that CT was more than just being able to answer why. They realized that when students think critically they should be able to make decisions about what to do with the material or problems presented. This was not an idea that was apparent in the definitions offered by the participants prior to the study.

Additionally, early in the intervention participants were prompted to discuss barriers they face when attempting to ask their students to think critically. While typical barriers of time and scope of curriculum were discussed, participants also focused on student readiness and ability.
Interestingly, while the barriers of readiness and ability were discussed early in the intervention as the participants’ knowledge and practice improved these barriers seemed to dissipate. While trying out new skills, participants mentioned improved student interaction and participation. These were the same students who at the beginning of the study some participants believed were not able to or ready to engage in critical thought. The students’ readiness or ability had not changed, rather the participants were now able to engage the students in opportunities designed to engage the students in critical thinking. Therefore, it can be supposed that the initially mentioned barriers of readiness and ability were not true barriers but were excuses the participants used to describe the lack of critical thinking in their classroom. The participants were unaware of the gaps that existed between their beliefs and practices. As the gaps between knowledge, belief, and practice closed the external barriers of student readiness and ability were removed.

In reality, underlying these barriers was teachers’ fear. Several participants agreed that they were afraid that if they did not directly teach the content, then the students would either not learn the information or learn the wrong material. Interestingly, fear did not come up as a barrier in the pre-intervention survey, but instead only surfaced as the participants were given the time to discuss the barriers they face with their colleagues. The collaborative nature of the sessions allowed the participants to reflect not only on their own practices, but also on how they had been trained. The idea of mirroring former teachers who had situated themselves as the stage on the sage was not a thought presented individually, but as participants began to share their beliefs and attempted to understand why their practice did not engage students in critical thought, these ideas came to the foreground. The examination of fear as a barrier exemplified the importance of the
discussions that occurred during the intervention as the participants were given opportunities to think critically about their practices.

Participants reported that being given opportunities to think critically about their CT practices was the greatest impetus to increasing their awareness and intention surrounding CT. Working together in cross-curricular groups and being encouraged to think about how they approached CT in their lesson planning were the most effective aspects of the PD. Using time in the sessions to discuss and reflect upon current and new practices allowed for the participants to recognize the gaps that existed between their stated beliefs, supposed practices, and actual actions. Combined with explicit instruction, the increase in meta-awareness surrounding their CT practices allowed for the improvement of the participants’ CT awareness and intention. These key findings will now be discussed in light of the research presented in the literature review of this study.

Gaps between Beliefs and Practice

Research demonstrates that teachers often state CTs are important and believe they are infusing their lessons with activities designed to engage students in CT. However, upon closer observation, teachers are not engaging students in critical thought (Alazzi, 2008; Fisher et al., 2011). My participants, similar to those in these studies, also exhibited a disconnect between their knowledge of CT, their beliefs, and their practices. For example, the participants of this study shared the belief that CT is a process; that CT cannot be done quickly but requires time for people to process old information and develop new ideas. Yet, an examination of the participants’ initial lesson plans showed a decided lack of activities designed to give students time to engage in critical thought. Additionally, while the participants believed CT could be observed through a variety of activities, such as essays, discussions, and the solving of real world
INCREASING CT AWARENESS AND INTENTION

problems, these activities were absent from their initial lesson plans; lesson plans participants submitted to demonstrate a lesson that engaged students in CTS. Another gap between belief and practice was found when participants analyzed their questioning practices. While participants were confident in their ability to infuse lessons with CT, they discovered through analysis that they were asking questions that rarely went above the lowest levels of Bloom’s Taxonomy or Wiggins and McTighe’s Six Facets of Understanding. The participants of this study exemplified what is typically found in research, that teachers know CT is important but find it difficult to infuse CT opportunities into their classroom.

Most studies that focus on a lack of CT practices in classrooms, tend to discuss a lack of teacher knowledge (Barak & Shakhman, 2007; Raudenbush et al., 1992; Schulz & Fitzpatrick, 2016), a gap between belief and practice (Alazzi, 2008; Fisher et al., 2011), barriers such as reliance on more traditional methods of instructions (Lucey et al., 2014), or a lack of proper training (Innabi & El Sheikh, 2006; Stapleton, 2011). Rather than focus specifically on why there is a lack of CT in the secondary classroom, this study diverged from the literature to address how the gap between knowledge, beliefs, and practice could be closed through increased CT awareness and intention. Therefore, this intervention provided participants with reflective opportunities that allowed them to examine their own beliefs and practices so that they could determine for themselves any gaps that existed between what they believed about CT and their classroom practices.

One of the most important reflective activities that lead to an increased awareness of the gap between participants’ beliefs and practice occurred when the participants’ listened to the recording of their lesson while paying particular attention to the questions asked. While most participants had stated, prior to the intervention, that they engaged CT through higher level
questioning, reflecting on their questioning practices, allowed participants to recognize that their
questions mostly asked students to explain or remember, characteristics associated with the
lower levels of CT. This activity allowed participants to realize that their practices had room for
improvement, making them more open to the changes in practice suggested during the
intervention. Offering teachers the space to increase the meta-awareness surrounding their
practice allowed them the opportunity to increase their awareness and become more intentional
with their questioning practices. This increased intention was evidenced through the
purposefully, open-ended, written down questions included in the participants’ follow-up lesson
plans.

Providing participants with metacognitive opportunities aligned with what research states
can help make teachers better CT practitioners (Haynes, et al., 2016; Zohar, 2006). The
participants of this study had similar experiences as they worked together to create a definition of
CT, to examine their questioning practices, and to participate in a modified lesson study designed
to improve their ability to infuse inquiry based lessons into their practice. The examination of the
participants’ final lesson plans as well as their reflective writings and focus group interview
showed that the participants had become more aware of their CT practices and that this
awareness led to more intentional inclusion of CT opportunities.

**Improving CT Practices**

Increasing awareness was only the first step in improving CT practices. Participants
required explicit instruction on how to infuse CT into their lessons. Studies demonstrated that
explicit instruction on thinking skills, explaining the expectations, and modeling the thinking
skills (Beyer, 2008; Fogarty & McTighe, 2001) can improve teachers’ infusion of CT practices.
This study supported these finding as the participants’ reflected that defining CT, as well as
learning how to make small adjustments to their current practice positively affected their practice and created greater student engagement.

Interestingly, while studies support the importance of increasing meta-awareness and explicit instruction as methods to improve CT practice, an area this study extended the literature was in the importance of using CT to improve CT. Instead of instructing the participants about best CT practices, the participants were asked to actively engage in CT opportunities designed to improve their CT awareness and intention. The participants’ experiences during this intervention demonstrated the importance of actually asking teachers to think critically to improve their CT practices instead of just conceptually discussing CT.

Improving critical thinking practices by thinking critically was exemplified when participants were asked to examine their questioning practices. The participants of this study demonstrated their lack of comfort in asking higher-level questions when they submitted their question log. These logs showed that like their counterparts in several studies (Lucey et al., 2014; Raudenbush et al., 1992; Stiggins et al., 1987) the participants tended to ask questions at the lowest levels of CT. Through discussions during the intervention the participants recognized these patterns and worked to change their practice by creating a lesson plan that included purposefully planned and written down questions designed to engage CT. The discussions surrounding questioning practice brought to the foreground that the participants feared that if they did not directly teach the material the students would not learn it. This barrier to CT had not been discussed in prior research and brings forth an important observation when attempting to change teacher practice. Providing teachers with the opportunity to be reflective in their practices can help them to recognize that their tried and true practices may not be as effective in engaging
CT as believed. Examining their own gap between belief and practices helped the participants of this study to recognize a need to improve their CT practices.

Participating in a modified lesson study was another way in which participants were asked to improve their CT practices by thinking critically. During the modified lesson study, each participant was asked to bring a lesson to the group they felt could be improved to engage students in inquiry based learning opportunities. The modified lesson study engaged the participants in CT as they were asked to synthesize the information presented to them by their colleagues, in order to analyze and evaluate the current lesson, and to create suggestions for future implementation. Participants felt that this activity was useful in improving their lessons and allowed them to think more deeply about their lesson planning especially focused on the infusion of CT opportunities.

Overall, this study was aligned with previous research studies as it was built on the use of explicit instruction and increased meta-awareness to improve participants’ CT practices. Additionally, the participants demonstrated a gap between their CT knowledge, beliefs, and practices that was also seen in previous studies. However, this study added to the field by outlining the methods used to encourage the participants to think critically about their critical thinking practices, which successfully improved the participants’ CT awareness and intention in their classrooms.

**Recommendations for PD Providers**

The main goal of this study was to create a PD that could be analyzed and replicated to address the gap found in the literature surrounding CT PD. Typically studies state that participants’ CT practices improve, but do not outline how the improvement was accomplished. The success of this 8 week intervention, occurred because participants were asked to be
reflective of their own practices and then given time to try out practices designed to improve the infusion of CT opportunities in the classroom. Providing teachers with a cycle of reflect, learn, and do was a purposeful decision made and followed Guskey’s model of PD because when teachers observe changes in student learning outcomes, teacher practices and beliefs are more likely to change (Guskey, 2002). Allowing teachers time to learn, do, and reflect was a key component in the success of this intervention and should be mirrored in the future if similar results are desired.

The success of this intervention can be replicated if the four main principles design principles used in this study are followed. Once it is determined what skills need to be addressed or improved, providers of PD must design activities that allow the participants to discover the gaps in their practices. Too often PD providers tell teachers what is wrong with their practices and do not allow the teachers to discover the gaps in their own practices. Discovering the gaps in their practices, allow teachers the opportunity to recognize the need for the professional development. When this recognition occurs, the professional development can be internalized and does not feel as if it is a top-down mandate. Once the gaps are discovered, participants must then be given time to confront these gaps. In this particular study, this was done by providing the teachers with explicit instruction to increase CT in the classroom. Also, activities were modelled so that the teachers could experience what critical thinking in the classroom may feel like. Once the skills were taught, the participants were then given the opportunity to try out the skills with their own classes. This allowed the teachers to experience how the new skills affected not only their practices, but also their students’ experience. PD practitioners need to be purposeful in the decisions they make about the content and delivery of the content when attempting to improve
teachers’ ability to infuse CT, so that the gaps between knowledge, beliefs, and practice can be closed.

Additionally, focusing on a specific set of new skills led to the success of this intervention. Providing the participants with a variety of new skills during each session could have led to information overload. Participants could have become too focused on learning the new strategies rather than thinking about what they were doing in their classes and how they could shift their practices to better engage students in critical thinking. Therefore, this study focused primarily on questioning and inquiry based instruction over an eight-week period. This narrow focus allowed the participants to dive deeply into both their current practices as well as to try out new strategies as it was easier to introduce, discuss, experiment, and reflect on practice. Hence, it is recommended that when PD providers are attempting to improve teachers’ ability to infuse CT into their classrooms, that the PD remain focused on a minimal number of strategies so that adequate time may be given to improve teachers’ awareness and intention surrounding CT practices.

A final key point for PD providers is that if they want to influence practice, reflection is an important tool to address differences in practice. As shown in this study, teachers often believe their practice is strong because it is what they have always done and have had success. However, encouraging educators to be more reflective showed a positive change in the participants of this study. Asking the teachers to audiotape and listen to themselves allowed the participants to slow down and truly think about their practice. Although it was time consuming, the participants of this study found it useful and discovered their questioning practices were not as strong as they believed. Today’s technology allows audiotaping oneself to be fairly easy and may be used to assist PD providers as they attempt to demonstrate the need for PD. Audio
recording can be used throughout PD to show changes or a lack of changes in practice during an intervention.

**Future Research**

A suggestion for future research would be to include a student survey at the beginning and at the end of the intervention to measure student engagement in CT. The purpose of improving teachers’ CT practices is so that they can help students become better critical thinkers. Therefore in the future it would be useful to have a baseline of student CTS. This information could help to determine if changes in teacher practice were actually influencing students’ skills. Additionally, since CT has to be explicit and students must know that they are being asked to think critically, a pre-intervention student survey could produce interesting data, as it would allow the researcher to determine if the students themselves believed they were being asked to think critically in class.

Another recommendation for further study would be completing a greater examination of practice by adding teacher observations to the intervention. In this study, all changes in practice were self-reported or derived from a comparison of lesson plans. Observing the participants could increase the data collected and allow for a greater analysis of teachers’ practice before, during, and after the intervention. The addition of student artifacts and teacher observations could allow for a more detailed picture of changes in teacher practice.

Finally, while this study took place during an eight-week period, if the study was extended, more data could have been gathered and perhaps greater changes in practice could have been gained. Ideally, the practices used during this intervention could be adapted to develop a longer lasting PD. A longer PD should maintain the cyclical nature of this intervention in which a CT practice was explained, participants’ current practice was examined through self-
reflection, and then the participants could work together to improve practice. Once a greater understanding was gained, the participants could be given an opportunity to try out the new practice and reflect on the experience. This cycle could be continued throughout focusing more deeply on one or two pedagogical practices or move onto other practices to continue to grow teacher CT pedagogical practices.

**Conclusion**

Critical thinking is key to success in the 21st century and yet students are graduating high school without the necessary skills to be successful. The purpose of this study was to examine if an intervention designed to increase participants’ awareness and intention via a cycle of learn, do, and reflect could improve teachers’ CT practices. Eight teachers demonstrated an improved awareness of their CT practices leading to the more intentional infusion of CT opportunities in their classrooms. This intervention demonstrated that CT practices can be improved when explicit instruction about CT practices is combined with opportunities for teachers to raise the meta-awareness surrounding their practices. Engaging participants in CT about their CT practices allowed them to more easily identify opportunities to infuse CTS into their classroom, which can eventually lead to the improvement of their students’ CTS.
References


Appendix A - Participant Recruitment Email

Good Morning!

I, as the principal investigator, will be conducting my doctoral study: Improving Secondary Educators’ Critical Thinking Pedagogical Content Knowledge through Professional Development at Cherokee High School. The overarching goal of this study is to determine if professional development created to improve teachers’ critical thinking pedagogical content knowledge (CTPCK) can improve the infusion of critical thinking skills (CTS) into the classroom. A secondary goal is to evaluate the professional development that will be piloted during this study. Ideally, the study group will include 10-12 participants who represent 2-3 content areas. The participants will be determined after a list of all respondents is created and analyzed.

Participants in the study will take part in 6 - 60 minute sessions that will occur after school during February, March, and April. Between the in-person sessions, participants will be asked to audiotape lessons and to reflect upon these lessons by completing a Google Form. In addition to the sessions, participants will be asked to complete a short questionnaire before the study begins and to complete a focus group interview session at the end of the study (session 8). During the meetings, participants will be encouraged to participate actively and to complete several reflective assignments. Google Classroom will be explained prior to use for those participants without prior experience. Participants will receive 20 professional development hours.

- February 2019- Questionnaire, Session 1 - 3
- March, 2019 - Sessions 4-6
- April - Sessions 7- 10 (including focus group session)

Your participation in the above mentioned study is voluntary, and your identity will be kept anonymous. All sessions and interviews will be audiotaped and transcribed to be used in my dissertation study. Additionally, any other data collected during this study will be used for the same research study. If you would like to participate in the study, please reply to this email by February 1. Thank you in advance for considering to be a part of my research and all that you do every day for our students. If you have any question or concerns, please contact me at sbretz@lrhsd.org.

Thank you,
Shannon Bretz
## Appendix B – Intervention Learning Plan

<table>
<thead>
<tr>
<th>Session</th>
<th>Learning Plan</th>
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<tbody>
<tr>
<td>Pre-Intervention - 60 Minutes</td>
<td><strong>Questionnaire:</strong> Appendix C</td>
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<tr>
<td>Session 1 - 60 minutes</td>
<td><strong>Explanation of Purpose</strong></td>
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<td></td>
<td><strong>Create Norms:</strong> Fears and Hopes Protocol</td>
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<tr>
<td>Session 2 - 60 minutes</td>
<td><strong>Develop a Definition</strong></td>
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<td></td>
<td>- Create a definition for critical thinking that is student friendly.</td>
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<td></td>
<td>- No terms that need exploration</td>
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<td></td>
<td>- Any level students can understand</td>
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<td></td>
<td>- List 3 activities that fulfill this definition</td>
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<tr>
<td></td>
<td>- Predict a definition the other discipline may use and list an activity that fulfills this definition.</td>
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<td></td>
<td><strong>Thinking About the Definition</strong></td>
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<td></td>
<td>- What perceptions were used when crafting your definition of the other content area?</td>
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<tr>
<td></td>
<td>- What are the definitions similar or different?</td>
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<td></td>
<td>- How are the activities you created similar to those used in the other content area?</td>
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<td></td>
<td><strong>Higher Level Thinking Schemes</strong></td>
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<td></td>
<td>- Inclusion must be purposeful</td>
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<td>- No secrets classroom – Tell the students what you expect from them.</td>
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<td></td>
<td>- Bloom’s Taxonomy</td>
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<td>- Wiggins and McTighe’s 6 Facets of Understanding</td>
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<tr>
<td>Session 3 - 60 minutes</td>
<td><strong>Explanation of Bloom’s Taxonomy with examples of “thinking verbs.”</strong></td>
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<td></td>
<td><strong>Explanation of 6 Facet of Understanding with examples of questions at each level.</strong></td>
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<tr>
<td></td>
<td><strong>Examples of question starters using Bloom’s Taxonomy and McTighe and Wiggins’ 6 Facets of Understanding</strong></td>
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<tr>
<td>Session 4-5 - 60 minutes/session</td>
<td><strong>Questioning</strong></td>
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<td><strong>Session 4 - Questioning Practice</strong></td>
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<td></td>
<td><em>Prior to this session, the participants audiotape a lesson. They listen to their recording and write</em></td>
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</tbody>
</table>
down each question they asked and then classify the questions using Bloom and/or McTighe and Wiggins.

**Higher Level Thinking Schemes**
- Inclusion must be purposeful
- No secrets classroom – Tell the students what you expect from them.
- Review Bloom’s Taxonomy
- Review McTighe and Wiggins’ 6 Facets of Understanding

**Show Word Cloud of Participants Questioning Practices**
- How would you categorize this information?
- What conclusions can you draw from this chart regarding the use of our questioning patterns?
- Based on your experiences and what you see, how would you explain our questioning patterns?
- In the future, how could we prioritize encouraging students to operate at a higher level of thinking?

**What makes a good question?**
- Planning for a purpose
- Connecting to learning goal
- Open v. Closed
- Anticipate student thinking
- Metacognition
- Discussion of examples of closed v. open questions
- Participants turn closed questions (submitted in their lesson plans) into open questions.

**Trying it out**
Participants plan a lesson and write down any questions they plan to ask. They teach the lesson and either audiotape themselves or have another participant peer observe the class to note down any questions asked. Once the participants review the recording or discuss the lesson with their peer observer, they complete the session reflection.

**Session 5 - A review**
This session is a review of questioning practices and looking forward to inquiry due to the demands of the school schedule.
| Group reflection of Questioning “Trying it out” | Inquiry Based Learning  
**Session 6 - Inquiry Learning**  
**Review of CT definition**  
**Inquiry Examples by Discipline**  
All participants engage in each of the activities.  
English: Brookfield’s *Scenario Analysis* (Appendix D)  
Math: *One Grain of Rice Story* (Appendix E)  
Content Groups work together to develop a lesson that could be taught using inquiry in their discipline.  
Share out lessons and discuss.  
**Explain how modified lesson study will take place in the next session.**  
**Session 7 - Modified Lesson Study**  
-The two content areas meet separately.  
-Each participant brings to the session a lesson he/she will be teaching in the next week or so.  
-Participate in *What, so what, now what* protocol |

-How can we be firelighters?  
-Guides not experts  
-Focus on how we pose problems  
-Requires set-up, focus on open-ended questions, provide for student choice, and can’t be one off  

-Provide examples of posing problems with inquiry as a focus in English and Math  
-English: Discussion/Essay, KWL, Question prompts  
-Math: Provide equation, students examine to ask questions and solve  

-Inquiry Learning  
-Student exploration  
-Analyze additional information  
-Generate hypothesis  
-Present results  
-Reflect and evaluate findings  

Sessions 6-7 - 60 minutes/session
<table>
<thead>
<tr>
<th><strong>Trying it out</strong></th>
<th>Participants use the information shared during the modified lesson plan and teach their lesson. After teaching the lesson, they complete the session reflection.</th>
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</thead>
<tbody>
<tr>
<td>Session 8 - 60 minutes</td>
<td><strong>Focus Group Interview</strong></td>
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</table>
Appendix C - Participant Questionnaire

This questionnaire will be sent out via Google Forms before the first session. The purpose of this questionnaire is to gather some general biographical information about the participants as well as to gain baseline information about the participants’ knowledge and beliefs about critical thinking. Also, the questions will be designed to garner the participants' current use of critical thinking in their classroom.

1. How many years have you been teaching? Fill in answer

2. What content area do you teach? Fill in answer

3. Define critical thinking? Fill in answer

4. Students should possess the ability to think critically when they graduate from high school.
   Strongly Agree   Agree   Neutral   Disagree   Strongly Disagree

5. Classroom activities can improve students' ability to think critically.
   Strongly Agree   Agree   Neutral   Disagree   Strongly Disagree

6. I am confident in my ability to infuse activities in my classroom that can improve my students’ ability to think critically.
   Strongly Agree   Agree   Neutral   Disagree   Strongly Disagree

7. How often do you engage your students in critical thinking?
   Daily   3-4 Days/Week   1-2 Days/Week   3-4 Days/Month   1-2 Days/Month

8. Please describe a specific example of how you engage your students’ critical thinking skills.
   Fill in answer

9. Students can demonstrate their ability to synthesize information in my discipline when they:
   Fill in answer

10. Students can demonstrate their ability to analyze information in my discipline when they:
    Fill in answer

11. Students can demonstrate their ability to evaluate information in my discipline when they:
    Fill in answer

**If you are unsure of the 3 terms above and how they connect to your discipline, please write “I don’t know.”**
12. What barriers exist that limit your ability to infuse critical thinking into your classes? Fill in answer

13. What supports do you need to increase critical thinking in your classes? Fill in answer

14. What are your personal goals for participating in this critical thinking professional development opportunity? Fill in answer

15. Please comment below if there is anything else you think I might need to know. Fill in answer
Appendix D- Brookfield’s Scenario Analysis – Green Acres

John and Mary, a college educated couple with a young daughter, have decided to move out of central Los Angeles to a community in the San Fernando Valley. They will both continue to work in the city but have decided that their daughter is being short changed in the quality of her life by being forced to grow up in L.A. Lately, they feel that the pressures of the city have been getting to them. There are more arguments between them, their daughter has begun wetting her bed, and much of their precious leisure time is spent on the expressway at the weekend trying to get out of the city.

More particularly, they feel that bringing their daughter up in a dangerous and dirty city is not good parenting and that sending her to public school will condemn her to an inferior education. To them, the suburban life style they see in the valley is more natural. There is more space, they can live in a house with a yard, their daughter can play in her neighborhood and they can send her to a local private school. They believe this move will improve their quality of life both environmentally and personally. Being away from the pressures of the city will help them build a stable, warm family life.

Assumptions Inventory
1. What assumptions do you think John and Mary are operating under in regard to their decision to relocate? List as many as you can.

2. Of the assumptions you have listed, which could John and Mary check by simple research and inquiry? How could they do this?

3. Give an alternate interpretation of this scenario. A version of what's happening that is consistent with the events described but that you think John and Mary would disagree with.

Assumptions
1. The San Fernando Valley will improve their quality of life. There will be no corresponding pressures in commuting into the city, and there will be neighborhood safety in play.
2. Public schooling is inferior to private schooling
3. Bedwetting is caused by the pressures of the city and so will cease in the valley.
4. Marital arguments are caused by the pressures of the city and so will cease in the valley.

Assumption Checking
1. Find a couple who have already made the change and interview them about its effect on their, and their daughter's, lives.
2. Sub-let their L.A. apartment and rent a house in the valley for a year - view it as a trial run.
3. Do an economic audit of the costs of the move - factoring in private school fees, gas etc.
4. Arrange to see a counselor to check out the state of the marriage - maybe the arguments are unrelated to city pressures.
5. See a pediatrician / psychologist about the bedwetting - maybe it's unrelated to city pressures.

**Interpretations**
1. The real problem is the lack of communication between John and Mary. The arguments and bedwetting are caused by that, not by city pressures.
2. Moving to the valley will increase the pressure. The commute will be horrendous and leave them tired and frustrated.
3. The pressures of private school education will add to the bedwetting problem. Moreover, their daughter will be educated in a school that does not look like the rest of Southern California.
Appendix E – One Grain of Rice Story

Long ago in India, there lived a raja who believed he was wise and fair, as a raja should be. The people in his province were rice farmers. The raja decreed that everyone must give nearly all of their rice to him. "I will store the rice safely," the raja promised the people, "so that in time of famine, everyone will have rice to eat, and no one will go hungry." Each year, the raja's rice collectors gathered nearly all of the people's rice and carried it away to the royal storehouses.

For many years, the rice grew well. The people gave nearly all of their rice to the raja, and the storehouses were always full. But the people were left with only enough rice to get by. Then one year the rice grew badly and there was famine and hunger. The people had no rice to give to the raja, and they had no rice to eat. The raja's ministers implored him, "Your highness, let us open the royal storehouses and give the rice to the people, as you promised." "No!" cried the raja. How do I know how long the famine will last? I must have the rice for myself. Promise or no promise, a raja must not go hungry!"

Time went on, and the people grew more and more hungry. But the raja would not give out the rice. One day, the raja ordered a feast for himself and his court--as, it seemed to him, a raja should now and then, even when there is famine. A servant led an elephant from a royal storehouse to the palace, carrying two full baskets of rice. A village girl named Rani saw that a trickle of rice was falling from one of the baskets. Quickly she jumped up and walked along beside the elephant, catching the falling rice in her skirt. She was clever, and she began to make a plan.

At the palace, a guard cried, "Halt, thief! Where are you going with that rice?"

"I am not a thief," Rani replied. "This rice fell from one of the baskets, and I am returning it now to the raja."

When the raja heard about Rani's good deed, he asked his ministers to bring her before him.

"I wish to reward you for returning what belongs to me," the raja said to Rani. "Ask me for anything, and you shall have it."

"Your highness," said Rani, "I do not deserve any reward at all. But if you wish, you may give me one grain of rice."

"Only one grain of rice?" exclaimed the raja. "Surely you will allow me to reward you more plentifully, as a raja should."

"Very well," said Rani. "If it pleased Your Highness, you may reward me in this way. Today, you will give me a single grain of rice. Then, each day for thirty days you will give me double the rice you gave me the day before. Thus, tomorrow you will give me two grains of rice, the next day four grains of rice, and so on for thirty day."

"This seems to be a modest reward," said the raja. "But you shall have it."
And Rani was presented with a single grain of rice.

Now, it is the student's job to build a spreadsheet based upon this story to determine the amount of rice given to Rani on any given day. We start the spreadsheet by listing under the heading, "day," 1,...,30. Then we proceed with the following formula: 2*(previous cell address) and fill down. After each day, read the part of the story that corresponds to that day. (Read the number AFTER they find it using the spreadsheet)

The next day, Rani was presented with two grains of rice.

And the following day, Rani was presented with four grains of rice.

On the ninth day, Rani was presented with two hundred fifty-six grains of rice. She had received in all five hundred and eleven grains of rice, enough for only a small handful. "This girl is honest, but not very clever," thought the raja. "She would have gained more rice by keeping what fell into her skirt!"

On the twelfth day, Rani received two thousand and forty-eight grains of rice, about four handfuls.

On the thirteenth day, she received four thousand and ninety-six grains of rice, enough to fill a bowl.

On the sixteenth day, Rani was presented with a bag containing thirty-two thousand, seven hundred and sixty-eight grains of rice. All together she had enough rice for two bags. "This doubling up adds up to more rice than I expected" thought the raja. "But surely her reward won't amount to much more."

On the twentieth day, Rani was presented with sixteen more bags filled with rice.

On the twenty-first day, she received one million, forty-eight thousand, five hundred and seventy-six grains of rice, enough to fill a basket.

On the twenty-fourth day, Rani was presented with eight million, three hundred and eighty-eight thousand, six hundred and eight grains of rice--enough to fill eight baskets, which were carried to her by eight royal deer.

On the twenty-seventh day, thirty-two brahma bulls were needed to deliver sixty-four baskets of rice. The raja was deeply troubled. "One grain of rice has grown very great indeed," he thought. "But I shall fulfill the reward to the end, as a raja should."

On the twenty-ninth day, Rani was presented with the contents of two royal storehouses.

On the thirtieth and final day, two hundred and fifty-six elephants crossed the province, carrying the contents of the last four royal storehouses--Five hundred and thirty-six million, eight hundred and seventy thousand, nine hundred and twelve grains of rice.
All together, Rani had received more than one billion grains of rice. The raja had no more rice to give. "And what will you do with this rice," said the raja with a sigh, "now that I have none?"

"I shall give it to all the hungry people," said Rani, "and I shall leave a basket of rice for you, too, if you promise from now on to take only as much rice as you need."

"I promise," said the raja. And for the rest of his days, the raja was truly wise and fair, as a raja should be.
Appendix F – What, So What, Now What Protocol

This protocol allows participants to connect to one another and to each other’s work, while at the same time allowing all group members to get useful feedback.

Introduction
There is an overall introduction of the protocol goals and steps. The group is then divided into groups of 3 or 4. All participants take a turn facilitating, and all participants present. The facilitator also gives feedback.

Process
1. Outline a Challenge or Success
   Participants individually outline a current challenge or success related to their work. They answer 2 questions:
   What? (What did I do? What am I working on?) and So What? (Why is this important to me?) (5 minutes)

2. In Rounds:
   a. The first presenter explains what they’ve written to their group, ending with a focus question. Participants in the group take notes/write questions.

   b. Group asks 2 or 3 clarifying questions (only).

   c. Individuals in the group talk amongst themselves, while the presenter listens into the conversation, taking notes and considering new insights and possible next steps. The presenter is silent during this step. The group takes up each of the following questions in some way, along with any other focused discussion the presenter has asked the group to have.
      • “What I heard the presenter say was…”
      • “Why this seems important to the presenter is…”
      • “What I wonder is…” or “The questions this raises for me are…”
      • “What this means to me is…”
      • “What I might suggest is…”

   d. Reflection by the presenter to the group – Now What?

Repeat for each participant in the group. (Approximately 15 minutes per person)

3. Debrief
Appendix G - Focus Group Interview

This interview will take place during the last session of the intervention with the purpose of gathering the participants' view of the intervention as well as their own critical thinking skills.

"Thank you for participating in the last eight sessions. I have appreciated your willingness to participate and to share your thoughts about your experience. The purpose of this last session is to recap our experience and to measure the effectiveness of the intervention. Before we begin, there are no right or wrong answers. Please be honest and share your experiences. This is an opportunity to share your perceptions and experiences during the sessions. A few “rules” since we are recording the session, please identify who you are each time you speak and please speak one at a time. Feel free to add to your answer, after others answer if you desire to do so. As the facilitator, I will not add to the discussion, but move us from question to question."

1. How would you describe your overall experiences in the professional development sessions?

2. How has the professional changed your awareness of critical thinking opportunities in your classroom?

3. How has the professional development changed your intentions regarding critical thinking in your classroom?

4. Compare your CT practices prior to the intervention to your current CT practices? What changes have you noticed?

5. What components of the professional development did you find most useful?

6. What components of the professional development do you believe needs to be improved?

7. What additional supports would you need to infuse critical thinking into your classes?