MATHEMATICS AND SCIENCE TEACHERS' TRANSFER OF ONLINE LEARNING TO FACE-TO-FACE CLASSROOMS

A Dissertation Presented to the
Faculty of the College of Education
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In Partial Fulfillment
of the Requirements for the Degree

Doctor of Education
in
Curriculum & Instruction

by

Kimberly A. Hicks

December 2016

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Abstract

Historically, science and mathematics teacher educators model best practices in face-to-face settings as a way to teach about learner-centered instruction. As this challenge has begun to be met in recent years by instructors of teachers in online settings, research into what is typically considered effective in face-to-face environments to an online model has moved to center stage. It is essential for teacher educators to push their thinking about how they can model best practices in different ways and to study how teachers make sense of and translate what they learn to the K-12 face-to-face setting. However, online educational opportunities for in-service teachers and the transfer of that learning to the face-to-face classroom have not been widely researched.

The purpose of this phenomenological study was to examine middle grades mathematics and science teachers' perceived learning in online environments regarding: a) what transferred to the face-to-face classroom, and b) what experiences in the online program facilitated that transfer. This study employed qualitative methodologies to ascertain instances of and the nature of this transfer as reported by four teachers who successfully graduated from the M.Ed. program, iSMART. Individual teacher course documents and two individual teacher interviews and transcriptions constituted the qualitative data collected over a 16-week period. Data analysis strategies included: a) and open-coding process, b) horizontalization, and c) the use of thematic analysis, which identified themes that describe the nature of what teachers transfer from the online learning experiences to the K-12 classroom.. Triangulation of data, along with member

checks, ensured that the themes did not have a limited point of view, thus establishing trustworthiness (Polkinghorne, 1989, Creswell, 2007). The six themes that were extracted from the data analysis are: (a) the influence of the cohort model and collaboration on the face-to-face classroom, (b) the use of discourse in the classroom to facilitate learning, (c) the use of technology in the classroom, (d) the integration of mathematics and science in the face-to-face classroom setting, (e) the transfer of content knowledge from the iSMART coursework, colleagues, and instructors, (f) the transfer of pedagogical knowledge from the iSMART coursework, colleagues, and instructors. Findings of the study confirm research about the use of instructional strategies that facilitate transfer (Guskey, 2000), as well previous studies about learning transfer with in-service and pre-service teachers in face-to-face classroom settings. This study has implications for teacher educators, professional development providers, and school leaders. Research reveals that instructional practices of the instructor can facilitate transfer to a greater degree (Guskey, 2000), as was confirmed by the results of this study. Understanding how middle grades mathematics and science teachers acclimate themselves to the online environments, as well as transfer their learning to their face-to-face classroom, is a crucial piece to constructing high-quality professional development and higher education courses for both pre-service and in-service educators. .

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Chapter I

Introduction

Van Manen stated, "A description is a powerful one if it reawakens our basic experience of the phenomenon it describes, and in such a manner that we experience the more foundational grounds of the experience" (Van Manen, 1990, p.122).

Internet-based learning has been occurring since the 1960s with the start of the Advanced Research Projects Agency Network (ARPANET), the precursor to the current Internet (Hill, Wiley, Nelson, & Han 2004). However, it was not until the 1980s with the formation of formal news groups that uses of the Internet for learning and education were established (Schrum & Berenfeld, 1997). In the past decade, online education has quickly become a leading force in higher education due to the expanding role of technology and the increased access to the Internet (Bourne & Moore, 2004).

Higher education faculty find that building an effective course in an online environment is much more than just replicating their materials in a face-to-face course to an online setting. Providing effective course content online parallels face-to-face instruction in that considerations must include learner characteristics, course organization, and the preparation of the instructor (Willis, 1994). Also, moving to an online environment does not exempt the instructor from what is commonly accepted as effective teaching, such as understanding the learners' needs (Dick, Carey, & Carey, 2001).

A strategy for considering how to design effective online instruction is to be informed about learner perceptions in online environments. Existing research about learners' perceptions in online environments encompasses on a myriad of topics that focuses mainly on how the learner understands the theory about the online environment

(Braun, 2008; Cook, Annetta, Dickerson, Minogue, 2011; Robertson, Grant, & Jackson, 2005) and/or how the learner interacts with various aspects of the online environment (Carey, Kleiman, Russell, Venable, & Louie, 2008; Exter, Korkmaz, Harlin, & Bichelmeyer, 2009; Groth, & Burgess, 2009). What is missing from the literature is research attending to learners' perceptions in online environments *when the learner is a teacher*. Stemming from that is the transfer of that learning to the face-to-face environment. Teachers as learners in online environments are unique because of the complexity of teaching teachers *about* teaching children, is typically done in face-to-face environments. Adding to the complexity of teaching teachers in online environments is the specificity when the teachers are teachers of science or mathematics because of the nature of the content and how that content functions with both the learner and the online environment. Therefore, research on how teachers of science and mathematics transfer their online learning to their face-to-face classroom environment fills a gap in existing research about online learning.

In a traditional sense, transfer of learning is the application of what is learned to new and different contexts then extending that learning to new situations (Haskell, 2001). The ultimate aim of education is to apply what we have learned in one situation to another, different situation (McKeough, 1995); research about transfer of learning has occurred in both education and psychology settings for over 100 years (Barnett & Ceci, 2002). However, despite the fact that transfer has been studied for a great length of time, there is still significant scholarly disagreement with regard to the concept of transfer, how it is defined, to what extent the transfer occurs, and the underlying processes associated with the transfer (Lobato, 2006).

In recent years, many different viewpoints of transfer theory have come to light, giving different perspectives on how one actually transfers learning from the original learning context to a new and completely different context. One compelling idea is that learning in one context actually prepares individuals for problem solving or future learning in a new context (Bransford & Schwartz, 2001; Schwartz & Martin, 2004) In recent years, Lobato has built on that idea and model by documenting transfer using the 'actor oriented' perspective, and then furthered the research by developing the concept of 'focusing phenomena'. The work of focusing phenomena suggests that what is critical for the generalization of learning is not the number of contextual situations explored but the particular mathematical regularities and properties which students' attention is drawn and that students notice (Lobato, Clarke, & Ellis, 2005). While researchers such as Bransford and Schwartz (1999) have set forth views of transfer as preparation for future learning, yet there is still little research in the area of how teachers transfer their learning from an online environment to a face-to-face classroom setting.

Purpose of the Study

In order to add to the conversation about how teachers transfer their learning to their own classroom, this phenomenological study sought to examine the experiences and perceptions of middle school science and mathematics teachers had completed an online graduate program focused on the integration of science and mathematics. However, knowing what teachers are capable of learning while in training is not enough, coming to awareness and understanding of how that knowledge, both content and pedagogical, is affecting the classroom practice is paramount. Therefore, this study also focused on the transfer of the knowledge acquired from a masters-level program to a face-to-face

classroom through the lived-experience (Van Manen, 1990) of teachers participating in the graduate program.

Research Questions

This study sought to answer two research questions pertaining to the extent of transfer of learning in an online environment to the face-to-face classroom setting with regard to the M.Ed. program. Accordingly, the research questions for this study are:

Specifically for middle grades mathematics and science teachers in an online M.Ed. program, what are the perceptions of:

1. What transferred from the online program to the face-to-face classroom?
2. What facilitated that transfer?

Research Plan

For the purpose of this study, a phenomenological qualitative design was employed to describe the shared experiences of the teachers' learning in an online setting in order to get to the essence of the experience (Moustakas, 1994; Van Manen, 1990). Creswell (2007) posits that a narrative style is appropriate when reporting the events in a single subject's life, but phenomenology is appropriate to describe the lived experiences in several individuals' lives. He stated: "Phenomenologists focus on describing what all individuals have in common as they experience a phenomenon" (pp. 57-58). According to Patton (1990), a phenomenological study "is one that is focused on the descriptions of *what* people experience and *how* they experience what they experience (p. 71)." To study one's experience phenomenologically, is to consider how the subject relates to the experiences, how he/she is aware of the situation, how he/she understands the phenomenon what the phenomenon means to them and how they value

the phenomenon and what they have ultimately done with that learning (Kockelmans, 1987). With the subjects of this research study, it is important to have the teachers of the M.Ed. program consider their learning while in the M.Ed. program, reflect on the material learned while in the M.Ed. program and how the learning of that material has transferred to their face-to-face classroom. Additionally, it is important to consider how the teachers value that learning and the transfer of that learning to their face-to-face classroom. Lastly, the teachers need to reflect on what have done with that learning since their graduation from the M.Ed. program.

The complete data analysis led to an essence of the phenomenon that answered the research questions and ultimately, gave meaning to the experience of participating in an online masters program focused on the integration of mathematics and science and led the subsequent transfer of that learning to the face-to-face classroom.

Operational Terms

In this section it is necessary to provide clarification of terms used in this dissertation in an attempt to bring some consistency to the readers' understanding of how they are used in this research study.

Asynchronous. Learning activities or instruction in which the teachers and instructor do not participate at the same time (Jordan & Belanger, 2000; Moore, 1997).

Collaboration. Collaboration is a group effort of multiple individuals to accomplish a task or project. The process entails social interactions to solve problems with the goal of deepening learning and interpersonal support. Through this process synergy is created and is ultimately necessary in order to creatively solve complex problems in teaching and learning.

Content Knowledge. Refers to the specific body of knowledge that is used to define one mathematics or science course from another.

Facilitator. Instructor who guides learning through the use of activities instead of purely lecturing.

Hybrid Course. A course that incorporates a combination of face-to-face, traditional and online course activities.

Instructional Practice. Instructional Practice is a teacher's educational approach for turning knowledge into learning.

Interaction. The principle used by Dewey (1938) that "unifies the subjective (personal) and objective (social) worlds in an immediate timeframe. Through this interaction, ideas are generated that illuminate the external world. That is, meaning is constructed and shared, ideas are communicated and knowledge is constructed and confirmed" (Garrison & Anderson, 2003, p.13).

Professional Development. Continuing education opportunities that seek to provide opportunities of growth in 'knowledge, skill, and judgment' for practicing teachers as they learn new concepts, ideas, skills, applications, and teaching strategies (Fullan, Little, & Hargreaves, 1992).

Synchronous. Synchronous is a term which means "at the same time", is used to describe a type of online learning that involves real time student-teacher interaction on the web. The students and the teacher are required to access a specific web location at a specific time with the instructor providing the instructions.

Transfer of Learning. The phrase "transfer of learning" is a process in which knowledge constructing in one particular context or situation (source task) is used in a

different contexts or situation (target task) after being called up, amalgamated and or adapted (Bossard, Kermarrec, Buche, & Tisseau, 2008).

Summary

This chapter introduced the study's setting, the need for research, and the assumptions that framed the investigation into the transfer of learning from the online setting to the face-to-face classroom setting. Additionally, it provided a window into the relevance of the work and a brief introduction to the research plan, thus setting the stage for reporting the research. Lastly, Chapter 1 provided an overview of the issues involved in studying the transfer of learning so that Chapter 2 can further extend that overview theoretically with relevant literature. This will give further support of the work, in order to give a foundation for Chapter 3, which describes the research methods applied in the study. Chapter 4 will present the results of the data collection and analysis, followed by a discussion of the results. Chapter 5 will present conclusions drawn from the results and recommendations for practice and further research. Also included in the paper are references and appendices.

Chapter II

Review of Literature

Phenomenology attempts to develop a systematic narrative that 'explicates themes while remaining true to the universal quality or essence of a certain type of experience" [van Manen, 1990, p. 97]

This chapter outlines the theoretical basis for the study and describes how previous research supports the need for further research in the area of learner perceptions regarding instructional strategies and interaction in online environments and, in the case of teachers, how this translates to K-12 classrooms. Accordingly, the areas of how learners' transfer new knowledge to new contexts, how learners' self-efficacy influence their learning, and how adult learning theories impact teachers' learning are the main bodies of literature addressed in this chapter. In addition, because of the online program taught about the integration of technology in the teaching of science and mathematics, literature about the technological, pedagogical content knowledge (TPACK) is also reviewed in this chapter.

Transfer of Learning

The foundation and aim of all education is to provide learning experiences that extend beyond the initial environment to additional environments (Lobato, 2006; Mayer, 2002; & Haskell, 2001). Transfer of learning has been traditionally defined as the ability to apply knowledge learned in one context to a new context (Mestre, 2005). One of the reasons that transfer of learning has been studied by researchers for over 100 years is its direct relation to a main goal of education: providing learning experience that can be generalized and used by the learner outside the initial learning situation (Bransford, Brown, & Cocking, 1999). Transfer of learning problems have been categorized into four

major areas: a) those that deal with research methodology and the more technical problems associated with the measurement of transfer, b) the specification of the major variables influencing transfer of learning and the way in which these variables influence transfer, c) the development of adequate conceptual models or theoretical structures for organizing our knowledge about transfer, and d) the development of an educational technology that is capable of translating and applying our knowledge of transfer to the great variety of educational and training problems that exist (Subedi, 2004).

The research questions that were attended to in this study focused on the second problem area. The interest in transfer for this research study stems from the interest in evaluating the use of the online learning forum for teaching face-to-face instructional strategies. This evaluation will be done through the utilization of conceptual models and/or theoretical structures for organizing our knowledge about transfer. In other words, because the teachers of this study will be practicing teachers and the content of the courses are about teaching, it is of interest to understand how teachers transfer content learned in the online environment to the classroom. To better understand transfer, this section will discuss contemporary views of transfer and transfer taxonomies, and discuss pertinent seminal research.

History of Transfer Research

Through the years, transfer of learning research has been heavily intertwined with learning theory research. Beginning in the tradition of behaviorists, transfer of learning research focused on the Principle of Identical Elements, introduced by Edward Thorndike and Robert Woodworth in 1901. They maintained that transfer would not occur between two tasks unless there was similarity between them. This period of growth in the transfer

of learning research emphasized and aimed at determining why the transfer occurred and discovering the exact variable that influenced the transfer. However, beginning with Albert Bandura in 1992 a shift began to occur toward a more cognitivist perspective, focusing on the role of motivation and internal forces. During this period of transfer of learning research, individuals were identified as people who not only reflected but also evaluated and altered their own thinking. However, after Bandura a shift in thinking began and the development of modern, contemporary transfer of learning theories developed. Given that there are many contemporary theories since Bandura, only the theories that are most relevant are listed below and are discussed in greater detail the following two sections.

Contemporary Views of Transfer

Bransford & Schwartz. Bransford & Schwartz (1999) offered an original approach on the traditional cognitive view by recognizing the possibility of the knowledge and the environment shifting and/or changing. This approach placed emphasis on the preparation for future learning (PFL) which focuses on how prepared a person is for future learning and also assists with the identification of positive transfer by broadening the constructs which may be hidden in the historical approaches. The Preparation for Future Learning (PFL) approach directly investigates one's abilities to learn new information and then relates their learning to previous experiences. In their research, they noted that the subjects are like judges in a trial in that they are sequestered during the final task (target task) in order to protect them from any exposure to information that could possibly "contaminate" their solution (Bransford & Schwartz, 1999).

Bransford & Schwartz developed their own set of eight principles to guide the forms of learning that improve and obstruct transfer (Schwartz, Bransford, & Sears, 2005). Bransford & Schwartz posits that initial (or prior) learning is required for effective transfer. The second principle is that the prior knowledge and experience must be changed to deal with new settings and contexts (Bransford, Brown, & Cocking, 2000; Bransford & Schwartz, 1999). The third principle is that learners must have adequate opportunities to learn and practice in order to ensure strong transfer of learning.

Moving into the forth principal, Bransford and Schwartz (1999) posited that consequential transfer is affected by the way in which information is presented and learned. For instance, information learned in the context of solving problems or tasks is more likely to be utilized instinctively than information presented solely as facts. Following that, the fifth principle focuses on the representation of problems or tasks appropriately, as it is necessary in increasing positive transfer and decrease the possibility of negative transfer (Singley & Anderson, 1989). For instance, the type of examples or problems used in the learning, such as using concrete examples during instruction, will either enhance or weaken initial learning, which in theory can lead to better transfer. However, overly contextualized information can impede transfer due to the strength of the connection to the initial context.

The last two principles deal with metacognition. The sixth principle is that the information learned is connected so strongly to the initial context that the learner many times cannot relate the learning to a different context. Thus supporters of problem-based learning and similar strategies deal with over contextualization by including similar materials in multiple contexts, having problem solving that requires varying problem

parameters, and focusing the nature of problems on ones where students have to create solutions to a broad class of problems. The seventh, and final, principle is that emphasizing metacognition, such as having students monitor, reflect upon, and improve learning and problem solving strategies, also increases learning transfer. Metacognition refers to the knowledge of one's own cognition and his or her ability to regulate that cognition.

Curry and Sumrall (2006) suggested providing constructivist opportunities and communication, support or cues through scaffolding, real world connections, high and low road repetition, reflection or metacognition, and explicit explanations of goals and activity purposes to facilitate transfer. Similarly, Rittle- Johnson (2006) found prompting students to self-explain their thinking process during learning tasks facilitated transfer even over longer amounts of time. Perkins and Salomon (1992, 1994) also suggest explicit abstraction, active self- monitoring, arousing mindfulness, and using metaphors or analogies to enhance the transfer of learning. Whether or not learners extract these critical attributes from a learning task impacts the transfer to a subsequent task (Gick & Holyoak, 1980, 1983, 1987).

King Beach and "Reconceptualization of Transfer. "Transfer involves the movement of a person, a transaction, or a object from one place and time to another in our daily lives" (Beach, 2003, p.101). Instead of conceptualizing transfer in terms of movement between fixed settings such as described in traditional cognitive view, the transfer situation is considered active and changing similar to the PFL viewpoint using a socio-cultural perspective (Beach, 1999). This approach uses learning in both the original and targeted context, thus learning becomes a dynamic process (Greeno, Moore, &

Smith, 1993). This approach utilizes a constructivist form with an emphasis on the relationship between the learner and the context. The constructivist theory in general suggests a person creates new understandings through an interaction between their prior knowledge and beliefs and the information in which they come into contact (Richardson, 2003). Constructivism has also been recognized as an effective way to examine transfer (Macaulay & Cree, 1999).

Drawing on a number of socio-culturally oriented theories, King Beach (1999) suggested a *reconceptualization of transfer*. Beach's transfer theory presupposed that notions of transfer presuppose that tasks or situations across which transfer occurs are unchanging (Tuomi-Grohn, Engstrom, 2003). The process of creating tasks is excluded from being considered as part of the transfer process. Learners and social organizations exist in a mutually constitutive relation to one another across time. Thus, our experiences of continuity and transformation across time and social situations are neither a function of the individual nor the situation, but rather of their relation.

Beach in his research identified four primary types of consequential transitions: lateral, collateral, encompassing, and meditational. Lateral and collateral transitions involve people moving between preexisting social activities. Lateral transitions occur when the movement between two historically related activities is in a single direction, such as moving from school to work. Participation in one related activity precedes and is replaced by another activity in lateral transitions. Collateral transitions differ from lateral transitions in that they involve individuals' relatively simultaneous participation in two or more historically related activities. Examples of collateral transitions are: daily movement between home and school, participating in part-time work after school, and

moving between math and science class during the school week. Collateral transitions occur more frequently than lateral transitions do, but due to their complexity, they are more difficult to understand.

Robert Haskell & Levels of Transfer. Haskell (2001) defines *transfer* as "the use of past learning and the application of that learning to both similar and new situations. *Transfer of learning* has a more restricted meaning referring to the application of knowledge, skills and attitudes learned from purposeful training experiences, including the informal learning opportunities (Haskell, 2001). Haskell contends that the differentiation between learning and transfer is not universally understood. Additionally, Haskell pointed out the long accepted belief that emotions, personality, and motivation are critical to learning and transfer. It is "the personal meaning that information holds for us that affects the way we encode, retrieve and relate information" (Haskell, 2001, p.121).

Thus, Haskell believes that transfer of learning persists as one of the most vexing problems in the classroom today and based on that premise, he developed two taxonomies to help address this critical issue: one or levels of transfer and one for kinds of transfer (Calais, 2006)**.** Haskell's (2001) taxonomy for levels of transfer is a system of classification that directly reflects six precise degrees of similarity (Calais, 2006) and his taxonomy (Table 1 on next page) was set forth to better understand the relationship of concepts. This taxonomy specifically addresses the relationship between learning and transfer and the relationship between the application of knowledge and transfer.

Table 1

Haskell's Taxonomy of Six Levels of Transfer

Level	Type Of Transfer	Description
1	Nonspecific Transfer	Is the initial learning and it implies that all learning essentially is transfer of learning because all learning is contingent upon being connected to past learning.
2	Application Transfer	Is applying what has been learned to specific situations and it is the underscoring to the foundation that learning provides for transfer.
3	Context Transfer	Is the application of knowledge in a different context when the context has changed slightly? A lack of transfer may occur if the context changes at this level, even if the learned task itself does not change. This lack of transfer called "place learning" plays a central role in learning because the learning may be retrieved due to cues that are being provided by the physical place the initial learning took place in. The example of this level that Haskell uses is of not immediately recognizing someone because they are seen outside of their normal setting.
4	Near Transfer	(Previously discussed) Is actually the first level that is considered pure transfer and involves using knowledge in a new, similar situation (yet not identical to) the initial learning environment. Transferring experiences associated with driving a car with manual transmission to driving a truck with manual transmission is an example of procedural transmission.
5	Far Transfer	(Previously discussed) Is the fifth level and involves using knowledge in a context unlike the one where the initial learning took place. This level reflects analogical reasoning. Learning about logarithms in algebra and then applying the concept in microbiology in order to assess the growth of bacteria is an example of far transfer.
6	Displacement or Creative Transfer	Involves the creation of a new concept or idea by linking previous knowledge in a unique manner. This involves more than the mere insight that something is similar to something else. Being able to understand the transfer of learning between being in an elevator that is accelerating upwards at the right rate and it's equivalence to the Earth's gravitational pull. This transfer of learning, that acceleration and gravity is actually the same thing, refers to the Principle of Equivalence—a basic postulate of Einstein's Theory of General Relativity (Calais, 2006).

Joanne Lobato - Actor-Oriented Transfer Framework. "Transfer as the personal creation of relations of similarity, or how the 'actors' see situations as similar" (Lobato, 2003, p. 18). Accordingly, transfer is a generalization of learning that depends on connections made between prior learning activities and new learning situations. In order to determine what learning activities might be responsible for promoting transfer, transfer situations are analyzed retrospectively. Still further, Lobato (2003) advocates that 'the design of innovative curricular materials and pedagogical approaches is often aimed at helping students develop robust understandings that will generalize to decision making and problem solving, both inside and outside the classroom" (Lobato, 2006). Lobato's works on transfer learning and her move to acknowledge the contribution of social interactions, language, cultural artifacts, and normed practices has pushed the thinking about transfer of learning greatly (Lobato, 2012). The Actor-Oriented Transfer (AOT) Framework conceives transfer as the "personal construction of relations of similarity between activities, or how "actors" see situations as similar" (Lobato & Siebert, 2002, p. 89). Similar to other contemporary approaches to transfer (Bransford & Schwartz, 1999; Greeno et al., 1993), Lobato developed the AOT perspective in 1996 by establishing its prominence as a transfer theory by viewing transfer from the learner's perspective rather than the researcher's perspective as shown in Table 2 on the next page.

In order to do this, Lobato contrasts mainstream cognitive approaches, which tend to approach transfer from the perspective of individuals taking knowledge from one situation and then applying it to a different situation, with the lens of the actor-oriented transfer perspective (AOT) which is a generalization of learning that includes prior learning. Lobato compared those two approaches across five dimensions: "(a) the nature

Table 2

Classic vs. Actor-Oriented View of Transfer (adapted Lobato, 2003)

Dimension	Classical Transfer View	Actor-Oriented View
Definition	The application of knowledge learned in one situation to a new situation	The personal construction of relations of similarity across activities (seeing situation as the same).
Perspective	Observer's (expert's) perspective.	Actor's (learner's) perspective.
Research Method	Researchers look for improved performance between learning and transfer tasks.	Researchers look for the influence of prior activity on current activity- how actors construe situations as similar.
Research Questions	Was transfer obtained? (Can learners successfully apply knowledge previously acquired in the learning task to transfer task?) What conditions facilitate transfer?	What relations of similarities are created and how does the environment support them? How do learners actively construct knowledge in the transfer task based on experiences in the learning task?
Transfer Tasks	Paired learning and transfer tasks have structural features but differ by surface features.	Researchers acknowledge that what experts consider a surface feature may be structural substantive for a learner.
Location of Invariance	Transfer measures a psychological reaction	Transfer is distributed across mental, material, social, & cultural places.
Transfer Process	Transfer occurs if two symbolic mental representations are identical or overlap, or if a mapping between them can be constructed.	Multiple processes, such as attunement to affordances & constraints, assimilation, and "focusing phenomena" influence transfer.
Researcher 's Role	The research pre-defines the structural similarities between the learning and transfer context.	The researcher investigates what the learner sees as similar between the two scenarios.
Metaphor Dynamism	Transfer is a static construct--Students can either apply their knowledge in a transfer context or not.	Transfer is dynamic-students learn in the transfer context based on their prior experiences.

of knowing and representing, (b) point of view, (c) what transfers, (d) methods, and (e) goals" (Lobato, 2012, p. 234). The difference in this framework is that Lobato emphasizes the importance of the learner's interpretation of the activity, acknowledgement of their prior learning, their engagement in the activity and personal goals, as well as the generalization of their learning beyond the scope of their initial learning. Lobato focused on point of view as being that difference between an individual's internal perspective and that more external perspective of an observer. The AOT perspective looks at how a learner's prior experiences influence the transfer process as well as how the learner generalizes their learning experiences. The main foci of the framework are the learner (actor) and how the learners see the target situation (could a given task) similar to the initial learning situation (could be an initial task). The evidence of transfer is gathered by " scrutinizing a given activity by an indication of influence from a previous activities and by examining how people construe situations as similar". (Lobato & Siebert, 2002, p. 89). In other words, researcher should not decide or given a priority to what students should transfer but rather adopting a student center perspective to find out what students do transfer and investigating the mediating factors (Rebello et al., 2005, p.219).

Lobato's research demonstrates the complex nature of knowledge acquisition and the transfer of learning from one situation to another. It demonstrates the need to continue to look at a variety of lenses through which to view this individual and unique process, understanding that no one lens can adequately describe the phenomenon. As a result, the actor-oriented transfer perspective responds to diSessa and Wagner's (2005) position that transfer theories should describe knowledge, not merely successful or

unsuccessful performance. Operating from an actor-oriented view of transfer can result in the gathering of significantly different information about how students' generalize than is possible with classical transfer perspectives. Contrary to negative transfer theory, which connotes interference, actor-oriented transfer theory is useful for identifying individuals' generalizations (including the particular relations of similarity that people construct as their mathematical strategies evolve) and for demonstrating how individuals' generalizations are constrained by sociocultural practices, specifically by features of instructional environments (Lobato, 2008, p. 175).

Transfer Taxonomies.

Several types of transfer have been identified through various research studies over the years (Barnett & Ceci, 2002; Gick & Holyoak, 1987; Perkins & Salomon, 1988, 1994; Salomon & Perkins, 1989). There are four main types of taxonomies distinguishing transfer: positive and negative, near and far, referring to the type of environments – or fields—involved, and high road and low road, referring to the type of knowledge or skill involved.

The Effect-Perspective: Positive and Negative Transfer. The effect perspective of transfer is used with both learning and performance---speed and accuracy. It distinguishes between two broad classes that underlie all other classifications: *negative and positive transfer* and is determined by whether or not initial preparation helps performance on the second task (Gick & Holyoak, 1987). Negative transfer refers to the impairment of current learning and performance due the application of non-adaptive or inappropriate information or behaviors (Odinet, 2004; Singley & Anderson, 1989). The consequence is that learners perform worse on the transfer task than they would have if

they had not received the initial learning (Barnett & Ceci, 2002).

Positive transfer, in contrast, emphasizes the beneficial effects of prior experience on current thinking and action (Butterfield & Nelson, 1991). Examples of positive transfer are: (a) using addition and subtraction skills in mathematics to understand multiplication and division (b) learning to play badminton may help an individual to Ping-Pong, and (c) learning a related language to one's original language, however this can have both positive and negative transfer. The similarities may allow the learner to become skilled at the new language more easily, which is positive transfer. However, differences in pronunciation and syntax may create barriers, therefore becoming *negative transfer* (Perkins & Salomon, 1994).

Situation Perspective: Specific & General Transfer/ Near & Far Transfer. The situation-driven perspective on transfer taxonomies is concerned with describing the relation between transfer source (i.e., the prior experience) and the transfer target (i.e., the novel situation). There are two main types of situation perspective categories: specific or non-specific (general). General (or Non-Specific) transfer occurs when the original task and the transfer task are different in both content and structure (Bruner, 1960, 1996). Barnett and Ceci (2002) distinguished between two types of subset categories of specific situation transfer: far transfer—transferring to a dissimilar context—and near transfer—transferring to a similar context.

Perkins & Salomon (1994) extended the definition of near transfer to refer to a situation where the learning environment and the transfer environment are similar requiring little adaptation for transfer to take place. “Near transfer refers to transfer between very similar contexts, as for instance when students taking an exam face a mix

of problems of the same kinds that they have practiced separately in their homework" (Perkins & Salomon, 1994 p. 6453). Conversely, far transfer occurs when the these two environments are not similar and the learner much adapt on a much larger scale and modify their learning in order for the transfer to take place. Perkins & Salomon (1992) discussed far transfer as "always [involving] reflective thought in abstracting from one context and seeking connections with others" (p. 26).

Taking basic strategic principles learned in playing chess and applying them to a business situation is an example of far transfer using abstract contexts and applying them to a new context. This type of transfer is more difficult and is sometimes referred to as general transfer (Macaulay & Cree, 1999) and the distance in far transfer between prior learning and application is greater than the connection that is found in near transfer (Simons, 1999). However, when it comes to the differentiation between near and far transfer, problems can arise, for "what is near transfer to an expert may be far transfer to a novice" (Haskell, 2001, p. 30).

Knowledge Perspective: Vertical and Horizontal/Lateral Transfer. Gagne (1985) was the first researcher to describe different types of transfer and it began with a discussion of vertical and lateral transfer. Figure 5 below shows the difference between vertical and horizontal transfer. The graphical metaphor with a horizontal axis is a beneficial pictorial representation to explain the distinctiveness of the two processes and is useful in representing the fact that a given process can have components of both 'horizontal' and 'vertical' (figure 1 below).

Vertical transfer involves using a lower level skill in combination to achieve a higher-level skills or behavior through the process of acquiring knowledge by building on

more basic information and procedures. In this transfer, a learner recognizes features of the situation that intuitively activate elements of her/his prior knowledge. The learner does not have a preconceived knowledge structure that aligns with the problem information. Thus, the learner constructs a mental model through successive activation and suppression of associations between the knowledge elements. Real-world problem solving requires 'vertical' transfer because they require the learner to decide which variables can be neglected and they also decide what schema or model is applicable to the real-world situation (Rebello et al., 2005)

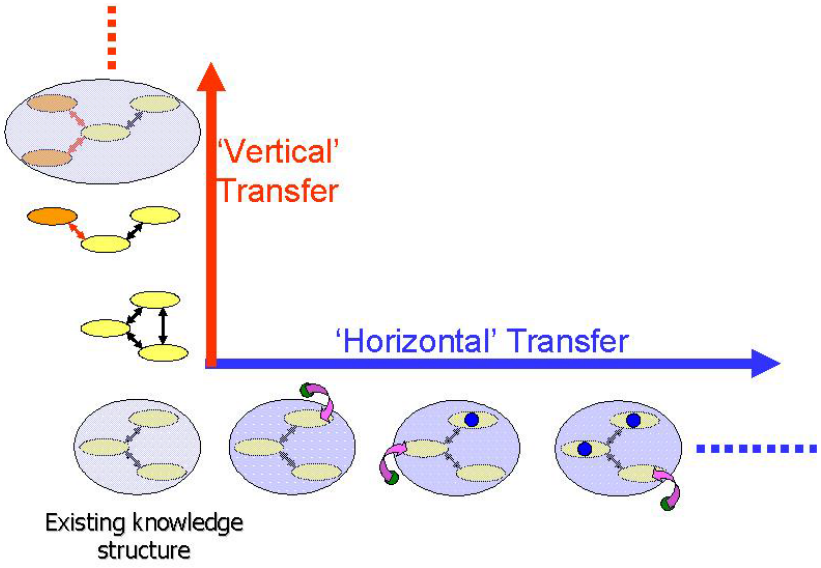

Figure 1. Horizontal and Vertical Transfer: 'Horizontal' transfer involves activation and mapping of new information onto an existing knowledge structure. 'Vertical' transfer involves creating a new knowledge structure to make sense of new information (Rebello, Cui, Bennett, Zollman, & Ozimek, 2007)

Juxtaposed next to that, lateral (or horizontal) transfer refers to learning that transfers across similar situations with a reasonable equivalent level of complexity. The knowledge of only one topic may be helpful, but not essential to learning another related

topic. In this type of transfer the learner reads out explicitly provided information from a problem scenario that activates a pre-created knowledge structure that is aligned with new information read out from the problem. If such alignment or assignment does not occur naturally (if the external problem representation does not match the learner's knowledge structure or internal problem representation) the learner is unable to solve the problem. An example of this is the 'plug and chug' problems at the end of the chapter in a mathematics textbook (Rebello, Cui, Bennett, Zollman, & Ozimek, 2007)

Problem-Solving Perspective: Low Road and High Road Transfer. Using the research of Gagne (1985), Salomon & Perkins (1989) created a similar dichotomy of vertical and later transfer distinguishing between low road and high road transfer. Both low and high road transfer are two similar terms that refer to whether or not the process that yields transfer is automatic and practiced or decontextualized and abstract (Salomon & Perkins, 1989). High road is characterized by a conscious attempt to formulate abstractions and make connections as compared to the more automatic and repetitious low-road transfer (p.118). Low road transfer depends upon the extensive, varied practice of the knowledge, skills and attitudes in a learning environment, and the automatic triggering of this well-learned behavior in a new context (Salomon & Perkins, 1989; Royer, Mestre, & Dufresne, 2005).

During low road transfer the application of a skill has been practiced enough that it is almost automatic, like driving a truck. The transfer of learning has been contextualized. High road transfer, on the other hand, is dependent up on the abstractions of the knowledge or skill from one context to application in a new context. High road transfer requires that the learner engage in reflective thought in order to abstract the

knowledge and skills from on e context and see the connections between that knowledge and skill in other contests (Perkins & Salomon, 1988). High road transfer requires that the learner be able to bridge the learning between novel context and 'requires the effort of deliberate abstraction and connection making and the ingenuity to make the abstractions and discover the connections" (Perkins & Salomon, 1988, p. 7). Active learning and deep thought processing are central to high road transfer, which leads to de-contextualization of the transfer process. For example, a secondary teacher who is teaching science, but studied mathematics in college, may integrate specific logarithm teaching into a microbiology unit (Simons, 1999).

Salomon & Perkins (1989) explain that high road transfer consists of backward and forward transfer. Forward reaching transfer refers to situations in which the individual mindfully abstracts information in the learning context to one or more potential transfer contexts, with the anticipation of its later application. Backward reaching transfer refers to situations in which the individual, when facing a new situation, deliberately searches for previously acquired knowledge that is relevant to the situation at hand (Salomon & Perkins, 1989). In doing this, the individual is abstracting in the transfer context features of the situation that allow for integration with previously learned skills and knowledge.

Research Studies About Learning Transfer.

In a study of in-service teacher preparation, Freed (1998) investigated the effects of teacher participation in TASK, a summer institute that allows teachers to learn using a constructivist approach, on teacher and student classroom behaviors. Teachers were interviewed and their science teaching was observed on several occasions. TASK

teachers asked more open-ended questions than non-TASK teachers. A higher linkage to past experiences and knowledge was found in the TASK teachers supporting the idea that a constructivist approach may enhance the transfer of learning. TASK teachers were also more likely to use linking or application comments during classroom instruction which can also enhance the transfer or learning by creating several connections for possible recall.

Guskey (2000) utilized the various taxonomies of transfer as his five levels for conceptualizing intended program outcomes. Those levels include: (a) mechanical level or near transfer, whereby the individual would implement new ideas in a new way; (b) routine level, or lateral transfer, in which the individual has sought to establish patterns with the knowledge but makes small changes with them; (c) refined level, or vertical, where the individual understands the impact of the learning and adapts to it—making changes to improve it and make it more effective; (d) integration level, or far, in which the learner makes deliberate efforts to apply their knowledge in various ways and with other people; (e) renewal level, or high road, where the individual actively seeks more effective alternative to their established use patterns.

In addressing his five level program evaluations, Guskey (2000, 2002) suggested that two questions in particular, must be addressed: (1) did the teachers incorporate new knowledge and skills into their work practices and (2) did the learning translate into any change in the teachers professional behaviors or activities? To assess if transfer has actually occurred the program evaluation must first determine what anticipated changes or outcomes are expected to occur as a result of the training program. Additionally it is necessary to look at where or in what settings the learners are expected to apply the

newly acquired knowledge, skills and attitudes, and when the transfer outcomes are to be measured (Ford, Quiñones, Sego, & Sorra, 1992; Guskey, 2000). The measurement of "transfer outcomes depends on how long knowledge skills and attitudes must be retained in order to conclude that successful transfer has occurred" (Ford & Weissbein, 1994, p. 30).

A case study by Lowery (2002) sought to determine how preservice teacher constructed content and pedagogical content knowledge of science and mathematics and the extent of the knowledge constructed. Teachers received standard based mathematics and science methods instruction through a constructivist instructional approach at an elementary school. Methods course and school artifacts were collected along with teacher observations and interviews. Using constant comparative method, Lowery (2002) identified four learning categories that facilitated transfer. These were: (a) learning from the methods course and instructors, (b) learning from teachers, (c) learning from children, and (d) learning from self, peers, and others.

Lowery found that the teachers learned between and among the identified categories. Additionally there were four learning venues in which knowledge was constructed. These learning venues provided a discovery ground for learning in various forms: (a) learning through situated context, (b) learning through reflection, (c) learning through collaboration, and (d) learning through exemplary models. Data analysis revealed that the learning venues provided a means for the teachers to acquire the content and pedagogical content knowledge of mathematics and science, thereby becoming the conduits of knowledge construction.

In a research study done by Scott and Baker (2003), transfer of the skill

components taught in a teacher preparation program into classroom instruction was measured using phone interviews. The teachers, having already completed a three-year degree, took part in a one-year intensive teacher preparation program, which started with a focus on basic teaching skills and moved to more complex teaching models. The criteria used to determine transfer were: (1) frequency of use of the model, (2) comfort level of the teacher; (3) rational for use of the model, (4) comfort level of the students, (5) appropriate use of the model, (6) adaptations or modifications of the model (7) was the lesson described one prepared in the university workshop (8) could the teacher provide further appropriate examples of lessons using the model and (9) the number and extent of the criteria met determined the amount of degree of transfer (Scott & Baker, 2003).

More than half of the teachers transferred at least one teaching model. Scott and Baker (2003) spotlighted the number of course objectives transferred per teacher and made comparisons. In the first group of 23 graduates were interviewed and 49 strategies were transferred collectively. In the second group of 22 graduates were interviewed and 58 strategies were transferred collectively. Non-use reasons were also reported in Scott and Baker's research. Reasons for non-use included the lack of time, a lack of motivation, classroom management concerns, and a lack of understanding the models.

Yang's (2012) research looked at how preservice teachers transferred critical think skills learned in their educational program. The research sought to determine if the preservice teachers could make application of those skills directly to their classrooms. Transfer was evaluated based on how well the preservice teachers were able to transfer what they learned in their critical thinking classes to the students they were teaching. The level of transfer achieved was based on student performance of the critical thinking skills

and critical thinking inventories after being taught critical thinking skills by the teachers in the study.

Self-Efficacy

Given that self-efficacy can be defined as "the belief in one's capabilities to execute the course of action required, producing the given attainments" (Bandura, 1997, p.3), literature about self-efficacy informs this study because how teachers view themselves in a learning environment, where they are the learner, will ultimately affect how they transfer that learning to their face-to-face classroom. Bandura (1993) also described self-efficacy as "people's beliefs about their capabilities to exercise control over their own level of functioning and over event that affect their lives" (p. 188). Numerous studies point out that teachers with high self-efficacy levels are more open to new ideas, show greater willingness to try new teaching methods, organizes their classes better, and are more enthusiastic and satisfied with their teaching (Allinder, 1994; Ashton & Webb, 1986; Guskey, 2000). With respect to professional development and teacher learning/education, teacher self-efficacy is a crucial component in the process of learning and affects the quality of teaching (Guskey, 2000).

Self-efficacy beliefs not only influence how individuals think, but also the course of action they follow, expected outcomes, perseverance, self-motivation, and the accomplishments that they will realize (Bandura, 2006). Bandura (1997, 2006) explains that how one has performed on a past task will directly influence how they perform on the current, similar task. This initial belief then affects how much effort the person puts into performing similar tasks, which is the afore-mentioned self-fulfilling prophecy (Bandura, 2006). The converse also exists, in that if someone has had positive

experiences in a task previously, then in future, similar tasks they will exert more effort to achieve greater success.

Ashton and Webb's Research. Ashton and Webb (1986) focused the self-efficacy construct on teachers by defining teachers similar task. Based on Bandura's (1997) construct, Ashton and Webb (1986) were among the first researchers to develop a multidimensional model of teacher efficacy for assessing two dimensions of teacher efficacy by using two items that were developed by the RAND studies (Armor et al., 1976; Berman, McLaughlin, Bass, Pauley, & Zellman, 1977). A teacher in agreement with the first statement indicates that environmental factors overwhelm the teacher's power to influence student learning was labeled "teaching efficacy" that corresponded to Bandura's outcome expectations. The other indicates that teachers' confidence in their abilities to overcome factors that could make learning difficult for a student was labeled "personal teaching efficacy" that corresponded to Bandura's (1997) self-efficacy expectations.

A teacher with a low sense of self- efficacy will be preoccupied with perceived inadequacies and imagine them to be more pronounced than they are. However, a teacher with a high sense of self-efficacy will tend to maintain high expectations and choose challenging activities even when faced with difficulties. Self-efficacy will tend to influence transfer through its effect on cognitive engagement, as manifest in the use of effective learning strategies, metacognitive activity, and persistence (Ashton & Webb, 1986). Studies on self-efficacy have shown that positive self-efficacy beliefs predict use of effective learning strategies, self-monitoring, and self-evaluation beliefs (Zimmerman,

2000). Thus, teachers with high self-efficacy persist at transfer tasks and ultimately achieve greater success at transfer than learners with low self-efficacy.

Ashton and Webb (1986) separated the construct of teaching self-efficacy into two dimensions: (1) sense of teaching efficacy – the belief as to whether teaching can influence student learning despite external factors and (2) sense of personal teacher efficacy – an individual's assessment of his or her own teaching competence. In other words, if a teacher has a low sense of teaching efficacy, the belief will be that no teacher can affect student achievement, regardless of intentions. Therefore, the responsibility for learning or blame for lack of learning is placed upon the student and external factors. However, a teacher who has a high sense of personal teaching efficacy will feel, if not totally responsible for lack of student achievement, at least a shared responsibility with students. Additionally, a statistically significant connection was found between a high perception of the self- efficacy of the teachers and high achievements of the students in mathematics. These teachers placed higher academic standards, demonstrated confidence, and dealt individually with the unique needs of their students (Ashton & Webb, 1986).

Additional Research in Self-Efficacy. Tschannen-Moran, Woolfolk Hoy, & Hoy (1998) studied individual teacher self-efficacy and determined that teacher self-efficacy, because it is task-specific, can very greatly from one task to another and from one context to another. Not only has teachers' sense of self-efficacy been related to student outcomes such as achievement (Ashton & Webb, 1986), but also how teachers' behave in the classroom, motivation (Ashton & Webb, 1986) and to students' self-perceived efficacy (Tschannen-Moran & Woolfolk Hoy, 2007).

Teachers who have a stronger sense of self-efficacy tend to be more open to new ideas, persistent, resilient, and are more willing to experiment with new methods in order to meet the needs of their students (Guskey, 1988). Ross (1995) found that teachers with a high feeling of self- efficacy post more challenging targets for themselves and for their students, take responsibility for the students' achievements and persist also when they encounter difficulties. On the other hand teachers with low feelings of self- efficacy post more modest targets for themselves and for their students (Ross, 1995). A high level of self- efficacy helps the teacher to organize the knowledge and abilities needed to implement the teaching methods required for their particular content area. Thus, the teacher will be able to see what needs to be done in order to achievements of all students to a higher degree, even those which can be considered as problematic or lacking motivation (Tschannen-Moran & Woolfolk Hoy, 2001).

In the context of transfer, self-efficacy usually refers to confidence in the ability to do or learn a skill that can transfer to another domain (Pugh & Bergin, 2006). Individuals with high self-efficacy tend to be more likely to experience transfer success because the increased effort, persistence in the face of difficulty, and the cognitive engagement associated with high self-efficacy should foster the development of deep-level, connected knowledge structures needed for transfer (Bandura & Cervone, 1983; Zimmerman & Martinez-Pons, 1990).

Adult Learning Theory. Part of adults' learning well, and thus being able to transfer that learning, involves how knowing how adults learn well. When adults enrolling in a course, they know why they are enrolling and what goal they want to achieve. They must see a reason for learning something (Knowles, 1989). Learning has to

be applicable to their work or other responsibilities to be of value to them. Knowles (1980, 1989) concluded that adults have accumulated a wealth of life experiences and knowledge that includes career activities, family experiences, and previous education. It is because of these experiences that adult learners need to connect the current learning situations to this.

Speck (1996) notes that the following important points of adult learning theory should be considered when professional development activities are designed; and supports the statements made by Malcolm Knowles (1989). First, Speck (1996) acknowledges that adults will commit to learning when the goals and objectives are considered realistic and personally relevant and important to them. Real world application and relevance is important to the adult learner's personal and professional desires. Therefore, formal education and professional development for adults need to give learners some control over the what, who, how, why, when, and where of their learning situation.

Speck (1996) developed a set of guidelines, informed by andragogy that should be considered when developing professional development activities and educational activities for educators. He believed that adults generally commit to learning when the goals and objectives are realistic and important to them. This applies to finding real world application within the learning in order to find relevance to the adult learner's personal and professional needs. Adult learners also need direct, concrete experiences in which they apply the learning in real work. The closer that they learning event is to an actual practice situation, the easier the learning transference will be.

Feedback and Adult Learning Theory. Within the work, adults tend to be self-directed and will resist learning activities they believe attack their competence (Scheeler, Ruhl, & McAfee, 2004). Thus, professional development efforts need to give teachers some control over the what, who how, why, when, and where of their learning. Adult learners must see the relationship between the professional development and their day-to-day activities. Another characteristic of adult learning is that it involves ego. Professional development must be structured to provide peer support and to reduce the fear of judgment during learning (Yang, 2004).

Adults also need to receive feedback on the results of their efforts (Thurlings, Vermeulen, Bastiaens, & Stijnen, 2013). Opportunities must be built into learning activities that allow the learner to practice the learning and receive structured, non-threatening, helpful feedback. Participation in small-group activities during the learning event will help move the adult learners beyond understanding to application, analysis, synthesis, and evaluation. Small-group activities are important in that they provide an opportunity to share, reflect, and generalize their learning experiences (Mezirow, 1981). The diversity with which adult learners come to the learning event must be accommodated. The learner's previous experiences, knowledge, self-direction, interests, and competencies must be included while developing the learning event. The transfer of learning for an adult is not automatic and must be facilitated. Coaching, as well as other follow-up support, is necessary for learning transfer.

Technological Pedagogical Content Knowledge (TPACK)

The technological pedagogical content knowledge (TPACK) framework describes the kinds of knowledge that teachers need in order to teach with technology, and also the

complex ways in which these bodies of knowledge interact with each other. This framework builds upon the pedagogical content knowledge (PCK) construct discussed by Shulman (1986) to describe how and why teacher knowledge of pedagogy and content cannot be considered solely in isolation. Shulman, in his seminal work, stated that teachers needed to master the interaction between pedagogy and content in order to implement strategies that help students fully understand content. The TPACK framework extended Shulman's (1986) notion of PCK by including the knowledge of technology component in teaching. Not only do teachers need to understand how to use technology in the classroom, but also they need to understand how technology, pedagogy, and content interrelate in order to create a form of knowledge that goes beyond the PCK approach that Shulman presented.

In the TPACK framework (as displayed in Figure 2 on the next page) what teachers need to know is centered in three broad knowledge bases: content, pedagogy and technology--- and it is the interactions (or relationships) and the complexities between and among these knowledge bases that create a dynamic relationship and push the boundaries of teaching (Koehler & Mishra, 2008: Mishra & Koehler, 2006). Using TPACK as a framework for measuring teaching knowledge has been proven to have an impact on the type of training and professional development experiences that are designed for both preservice and in-service teachers.

Seven components are included in the TPACK framework. They are defined as: (a) technology knowledge (TK), (b) content knowledge (CK), (c) pedagogical knowledge (PK), (d) pedagogical content knowledge (PCK), (e) technological content knowledge

(TCK), (f) technological pedagogical knowledge (TPK), and (g) technological pedagogical content knowledge (TPACK) (Mishra & Koehler, 2008).

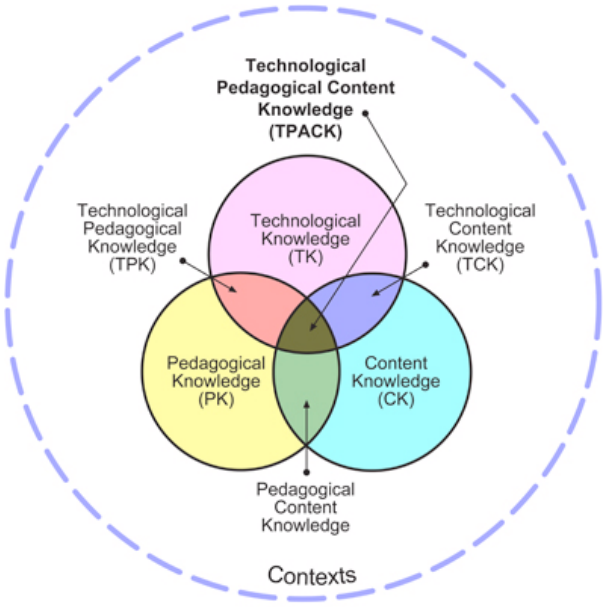

Figure 2. The TPACK Model by Mishra & Koehler (2006, 2008)

Technology knowledge refers to the knowledge about various technologies, ranging from low-tech technologies such as pencil and paper to digital technologies such as the Internet, digital video, interactive whiteboards, and software programs. Content knowledge is the depth and breadth of understanding about the ideas, topics, or subject-matter knowledge that a teacher is planning to teach to students and how the nature of knowledge is different for various content areas.

Pedagogical knowledge refers to the methods and processes of teaching and the understanding about a variety of instructional practices, strategies, and methods to promote student learning. This includes knowledge in lesson plan development, classroom management, and assessment. Pedagogical content knowledge refers to the content knowledge that deals with the teaching process (Shulman, 1986). Pedagogical content knowledge differs for various content areas, as it blends both content and

pedagogy with the goal being to develop better teaching practices in the content areas. This includes understanding of assessment, common misconceptions, and adapting instruction to diverse learners in specific subject matter.

Technological content knowledge refers to the knowledge of how technology can create representations for specific content. It suggests that teachers understand that, by using specific technologies, they can change the way learners practice and understand concepts in a specific content area. Technological pedagogical knowledge refers to the knowledge of how various technologies can be used in teaching, and to understanding that using technology may change the way teachers teach. Technological pedagogical content knowledge refers to the knowledge required by teachers for integrating technology into their teaching in any content area. Teachers have an intuitive understanding of the complex interplay between the three basic components of knowledge (CK, PK, TK) by teaching content using appropriate pedagogical methods and technologies (Koehler & Mishra, 2005).

The process to bring technology into content and pedagogy to form TPACK is not an easy one. Koehler & Mishra (2009) have stated that the process is complex and challenging. Despite the challenges, there have been dozens of methods proposed for the development of connected, contextualized knowledge as described in the TPACK framework. One approach that has had much success is Activity Types. The use of activity types is a method to build on teachers' existing knowledge in subject matter disciplines (Harris, Mishra, & Koehler, 2009). Teachers build knowledge about technology upon already existing knowledge of pedagogy (PK) and content (CK), and pedagogical content knowledge (PCK). This approach uses the learning experiences to

focus upon specific curricular goals. Each learning experience can be broken down into smaller components that specify what students do during each portion of the learning experience. For each part of the learning experience that is broken down; a specific activity type is assigned to it. For each activity type, specific technologies that support student learning are identified. Researchers have identified specific activity types that commonly occur each of the content areas.

Among the various approaches, an emphasis upon how teachers integrate technology in their practice is more important than the emphasis upon what teachers integrate in their practice (Mishra & Koehler, 2006). Various technologies that are available have both limitations and strengths (Mishra & Koehler, 2006), regardless of the method teacher educators select to develop teachers' TPACK. Therefore, it is important that the development of TPACK should begin with relatively familiar technologies and then gradually progress to those levels that are more advanced (Koehler, Mishra, Wolf, Zellner, & Kereluik, 2011). Additionally, when confronting the ways in which technology, content, and pedagogy interact in classrooms contexts; teachers, as instructional designers of their own curriculum can take an active role and utilize authentic problems of practice (Brush & Saye, 2009) in their classroom. The use of the TPACK framework provides teachers and teacher educators with a framework that guides them to achieve meaningful and authentic integration of technology into the classroom. While how the learner functions and interacts in the online learning environment is important, it is not the end goal. The utilization of the knowledge learned in the online setting and how the learners' transfer that knowledge or skill to a new situation is the goal of teacher education.

Summary

Professional development and teacher training has become an integral part of effective teaching (Dede, 2006). This chapter has presented a background of research about how transfer-learning theories have developed over the past decade and have provided the background information necessary to inform the present study. Transferring both content and pedagogical knowledge in mathematics and science courses are essential to preparing mathematically and scientifically literate children. The approaches to the transfer of learning have evolved from the historical view to focus on cognition and context. Additionally, specific ways to focus on transfer have been identified by researchers, along with barriers to the transfer of learning. However, as Bransford, Brown, & Cocking (2000) contend, without initial, deep learning, future transfer of learning is impossible. Understanding the methods that teachers use to transfer their learning will assist in strengthening teacher education programs, and in the long run providing students with a superior education. Additionally, integrating transfer-learning theory with both self-efficacy literature and TPACK research provides a picture of the online learner in a fully online setting.

Chapter III

Methodology

Phenomenology seeks to expose the implicit structure and meaning of such experiences. It is the search for the "essence of things" that cannot be revealed by ordinary observation (Moustakas, 1994).

This chapter describes the research design utilized in this study including the relationship of the research questions to the variables under examination and the procedures followed in the development and implementation of the study. A full description of the purpose of the study, research setting, data analysis, trustworthiness, and limitations regarding validity and reliability are also presented. The intent of this chapter is to provide the reader with sufficient detail to: (a) judge the appropriateness of the methodology, (b) evaluate the research conclusions, and (c) replicate the study in other settings.

Research Questions

The purpose of this study is to understand and describe teachers' perceptions and the transfer of their learning from online coursework of a master's program to their face-to-face classrooms. Accordingly, the research questions for this study were:

Specifically for middle grades mathematics and science teachers in an online M.Ed. program, what are the perceptions of:

1. What transferred from the online program to the face-to-face classroom?
2. What facilitated that transfer?

Context

This study took place within an online Master's of Education program called Integration of Science, Mathematics, and Reflective Teaching (iSMART). This two-year program was for middle grades science and mathematics teachers across Texas and

focused on the integration of science and mathematics as a means of developing teachers' content knowledge, the program also focused on developing the teachers' technological and leadership skills (Lee, Chauvot, Plankis, Vowell, & Culpepper, 2011). The activities of the program included: (a) analyzing theories and models of integration of science and mathematics; (b) analyzing, writing and implementing curricula; (c) studying children's thinking of content, and (d) reflecting on video of own and fellow iSMART teachers' practices. The online learning program that was researched in this study is operated by the Curriculum and Instruction department of a publicly funded urban Tier I research university located in located in a south central region of the United States.

The result of the iSMART program was to foster leadership skills through reflective collaboration with on-line classmates, as well as develop in-depth teacher content and pedagogical knowledge (Lee, Chauvot, Vowell, Culpepper, & Plankis, 2013). The activities of the program include analyzing theories and models of integration of science and mathematics, analyzing and writing curriculum, studying children's thinking of content, and reflecting on video of own practices.

Four cohorts of 22-27 teachers were admitted each fall over four years. A total of 97 teachers were admitted in the program, and 94 completed the program. Each cohort followed the same sequence of courses for two years. This sequence and courses changed slightly between the first and second cohort, due to changes in the department and college, and due the outcomes demonstrated by the first cohort. In addition to the cohort format, the teachers were placed in small groups within their courses where both science and mathematics teachers were represented in each group. Both asynchronous

and synchronous formats were utilized in the iSMART program where the teachers would meet online in real-time for 50% of the time.

Blackboard Course Management is the Learning Management System (LMS) technology supported by the university for over 4,000 courses and was utilized by the iSMART program. Blackboard CM allows the instructor to post course contents as well as keep student informed, involved, and collaborating with other students online. Students can access the course content anytime-anywhere. There are three ways that an instructor can utilize the BCM system: (a) the traditional course allows the instructor to have the syllabus, lecture notes, handouts, or group discussions online in Blackboard as a supplement to the face-to-face class; (b) the hybrid course allows the instructor to put much of the material online since 50% or more of the content must be delivered online; and (c) the online course requires the instructor to plan and develop the material from a different perspective than other modes of instruction. In this method, the instructor will use Blackboard Collaborate to deliver the course material to the students 'face-to-face' in an online environment.

Blackboard Collaborate delivers education-focused collaboration solutions that provide a wide spectrum of collaboration including web conferencing and mobile collaboration. It helps instructors to create virtual classrooms, offices, and meeting spaces that reach more students. It also offers innovative approaches to peer-to-peer interaction and learning. The university has the institution license of Collaborate for instructors to integrate into teaching and enhance students' interaction and learning in virtual environment. Collaborate is integrated into Blackboard for students to access easily with one single sign-in and has the web conferencing, instant messaging, whiteboard, and

voice authoring capabilities that provide students' collaboration, interaction, and engagement. University instructors have used the following instructional strategies within Blackboard Collaborate: (a) give a live lecture because the live lecture can be recorded/archived so that it can be used for the review and/or for students who are absent, (b) use the Whiteboard for students to engage in brainstorming activities, (c) have the multiple breakout rooms for students to engage the group discussion, (d) conduct virtual meetings and/or office hours so that the instructor can meet one-on-on or with groups of students to facilitate small group instruction, (e) invite remote guest speakers in order that the instructor can create more engaging learning environment for inviting the experts to the class, (f) deliver asynchronous course content so that the instructor can record course orientation, welcome, or problem-solving sessions to extend the learning past the online course session time periods, and (g) give oral examinations and/or use the virtual space for foreign language classes and other classes requiring a face-to-face examination.

Research Design

The research design of this study was a phenomenological research design (Creswell, 2007), which is furthered informed by elements of critical ethnography (Patton, 1990, 2002; Carspecken, 1996). I provided a holistic account of the real-life phenomenon of the experiences that facilitated transfer of learning from the online setting to the face-to-face classroom setting. In an effort to do this, the researcher sought to gather, analyze, and synthesize interview data and supplementary course documents in order to identify themes common to each teacher and that offered an enlightened understanding of the teachers' experience. The aim of the research is to reach 'the essence of the individuals' lived experience' of the phenomenon (the transfer of

knowledge from the iSMART program), while also seeking to understand the phenomenon (the iSMART program in general) (Cilesiz, 2011). Given that the course selection was intention for each semester that the teachers were engaging in the iSMART program, it was the intent of the researcher to seek to determine if there was transfer of that knowledge from the online setting to the face-to-face classroom by the teachers during their time in the iSMART program and since they have graduated from the program.

The utilization of a phenomenological research design is effective for observing social systems when all subjects have in common a shared lived experience, such as the iSMART program because it is 'a systematic attempt to uncover and describe the structures, the internal meaning structures, of the lived experience' (van Manen, 1997, pp. 9-10). It is these everyday and human experiences that allow for the construction of a social theory over time by focusing on a specific case of the phenomenon (Crichton, 1997). The phenomenon in this study was the transfer of learning in an online setting to the face-to-face classroom. Phenomenology also rests on the assumption that there is structure and essence to these shared experiences that can be narrated (Creswell, 1998, Marshall & Rossman, 1999) and the four teachers provided ample data for that documentation. Additionally, within the constraints of a qualitative approach, the phenomenological research design was utilized in order to investigate the transfer of learning process as it focused on the dynamics or processes found within single settings or contexts through the use of in-depth and multiple interviews with the teachers (Polkinghorne, 1989).

The goal of this phenomenological study was to develop an understanding of the teachers' perceptions of their learning during their time in the iSMART program and subsequent transfer of that learning during their time in the iSMART program and since they have graduated from the program. The second goal was to develop an understanding of what facilitated that transfer to their teaching practice. With these goals in mind, the information gathered within this research study was able to inform the development of research conclusions specific to the iSMART case. Through the use of multiple one-on-one interviews, each 's coursework from their time in iSMART, additional course documents (syllabi and instructor's handouts), and the initial questionnaire (Huberman & Miles, 2002), I was able to use the steps of thematic analysis in order to arrive at the understanding of how the teachers' achieved the goals of the research study. This research examined and discussed one model of online learning used with mathematics and science educators in order to increase the educators' content and pedagogical knowledge in a face-to-face classroom environment in order to begin the conversation about how teachers' transfer their learning from the online environment to the face-to-face classroom setting.

Teacher Selection

The teacher selection process began with seeking permission of the university's Institutional Review Board (IRB). Once permission was granted (see Appendix A), the selection process began in order to identify those teachers that were interested in participating in the research. In order to determine whom to interview, Merriam (1998) suggests selecting a sample based on criterion that is informed by the focus of the

research questions. Therefore, I chose to employ a purposeful sampling process (Patton, 1990), so that I could study the information-rich cases in detail (Palinkas, 2013). Given that the setting for this study was the iSMART program, the graduates of the iSMART program were the information-rich cases, as they had experiences relating to the phenomenon that was being researched as outlined in the research questions. The individual cohorts of teachers in the iSMART program further provided such a case due to the fact that each group of 22 - 27 teachers began the iSMART program together, and subsequently took all of the iSMART courses together as a cohort group.

The process of selecting individual teachers began with a convenience sampling procedure of sending out an online questionnaire about the graduates' teaching activity post-iSMART (Appendix B). The setting for that collection took place during the fall months of 2015 when the research team was gathering post-program data using a survey created in Qualtrics. The survey was sent out via email to iSMART graduates that had provided current contact information (Appendix C). Within this group of teachers, fourteen teachers selected that they would possibly be interested in participating in research about the transfer of their learning from the iSMART program to their face-to-face classroom. Follow up contact regarding participation in the research yielded a sample of five teachers, four from the first cohort and one from the third cohort. However, in January the teacher from the third cohort had to drop out due to a family issue. Given that all four teachers were from the same cohort, the specific course offerings for the first cohort have been listed in Table 3 (on the next page) in order to provide context for the course selections that the teachers engaged in during their time in

Table 3

iSMART Masters of Education Cohort 1 Degree Plan – 36 hrs.

Semester	Course Number	Course Name
Fall 2010	CUIN 6326	Teaching Science in Grades 4-8
	CUIN 7334	Developing Proportional Reasoning
Spring 2011	CUIN 7322	Curriculum Development in Science Education
	CUIN 7340	Issues in Mathematics Education
Summer 2011	CUIN 6365	Teacher as Researcher
	ELCS 6370	Research for Educational Leaders
Fall 2011	CUIN 6346	Teaching Secondary Math with Technology
	CUST 6311	Education in a Multicultural Society
	CUIN 6399	Masters Thesis
Spring 2012	CUIN 6328	Education in a Multicultural Society
	EPSY 6340	Principles of Human Learning
	CUIN 7399	Masters Thesis

the iSMART program. This timeline provides context to understand when the teachers took each course and which courses were paired together during a particular semester, as the iSMART program was very intentional about course selection. Each semester one mathematic and one science course were paired together in order to extend the learning for STEM activities and knowledge.

Data Collection Procedures

The data collection procedures for this research study were collection of program artifacts and two phenomenological interviews, which included the development of interview protocols, determination of interview sites, memoing, acquiring consent and transcription of the interviews. The specifics about content analysis are provided in a subsequent section. Each teacher had two interviews over the course of two months. The first interview protocol was the same for each teacher, but within that protocol there was

flexibility during the interview. The second interview was tailored specifically for them based off of their document and first interview analysis. Padilla-Diaz (2015) supports this process in that the phenomenological interview should be open or semi-structured.in order to allow the researcher to address the phenomenon 'profoundly', providing a space of aperture for the teachers to express their experiences in detail, approaching reality as faithfully.

In an effort to maintain organization and clarity of thought, a binder for each teacher was made with the hard copy documentation for each teacher. It contained the interview protocols, interview transcriptions, and interview notes. Those were filed first and followed by all documents that were utilized in the data analysis for that teacher. All documents were catalogued according the course title and number. Documents that were not used in the data analysis were filed in a separate binder for that teacher according to the course title and number. General documents for each course, such as syllabi and course documents that the instructors' utilized in their courses were filed in separated binders in order to be used to support the documentation if necessary. Binders were color coded and labeled for ease of use and located in a locked file cabinet as per the IRB.

Document Analysis. Content analysis was performed on the teachers' course documents three times during the data analysis stage: (a) prior to creating the first interview protocol, (b) after the first interview in order to gain additional insight into the teachers' interview answers and to provide context for the development of the second interview protocol, and (c) after the second interview to analyze the second interview answers. In order to develop the initial interview protocol for the data collection process with the teacher, an initial review of each teacher's course documents. The documents

were obtain from several sources: (a) the teacher provided them via (1) Dropbox, (2) Google Drive, or (3) hardcopy, (b) data files on the main computer network for the university that stores the iSMART research, (c) stored, locked file cabinet for all iSMART data with the principal investigator of the iSMART program.

Before beginning the review of the course documents of each specific teacher, the course syllabi were reviewed to reveal the various assignments and activities that the teachers were expected to complete as requirements of the course. The initial review of the syllabi was aimed at gaining an understanding of the responsibilities that the course instructor (teacher educator) had with respect to the assignments and course activities and it was used to assist in the document analysis of the course documents for each teacher that will be interviewed for the study. The syllabi of each instructor and the course documents corresponding to that course, for each individual teacher, were analyzed together in order to gain a perspective about possible aspects of transfer that impacted the classroom learning in meaningful ways. The data obtained from that analysis was utilized in the interviews with the teachers in order to probe the teachers' more deeply about their learning within the context of the iSMART program.

There were three aspects about online learning within the context of the iSMART program online learning that were attended to in the interviews: (a) the interactions with both the teacher educator and other teachers in the online learning environment, (b) the instructional practices modeled by the teacher educator, and (c) coursework completed by the teacher that has added to their body of knowledge. The purpose was to gain understanding as to the depth of transfer of learning that the teachers achieved between

the online learning environment and the face-to-face classroom setting and which factors had the most impact.

Interview Process. This study sought to gain information from teachers through the use of one-on-one interviews. The purpose of the interview process was to understand the teacher as a student, as well as his/her "feelings, thoughts, and intentions" (Patton, 2002, p. 341). The interview is a necessary component as it allows the researcher "to find out information that cannot be observed directly" (Patton, 2000). According to Kruger (1988), the spoken interview allows the subjects to be as close as possible to their lived experience. It is suggested that the open-ended interview be conducted in a non-directive manner since this allows for flexibility in allowing the investigator to grasp more fully the participants' understanding of the situation (Kruger 1988; Moustakas, 1994).

Conducting interviews is, according to Moustakas (1994) the best method for employing a phenomenological study, which was the intention. More open-ended and less structured questions (Carspecken, 1996) were used in this study so as to support the belief that each teacher's view is unique. Multiple interviews with each teacher allowed for the teacher's perspective to arise through the data and show how the transfer of learning process occurred in their learning. This ultimately led to the identification of possible themes within the data. For the first interview, once the initial document analysis had been completed, the first interview protocol was developed and emails were sent out to set up interview dates with each teacher. After the first set of interviews were completed, the files were transcribed within 24 hours by Rev.com and immediately a second round of analysis on both, the course documents for each teacher and the first

interview, began. From this analysis the second interview protocol, which was specific to each teacher, was created and the second interview was set up with teacher. The second interview took place via Skype and all interview dates can be found in Table 4 below.

Table 4

Interview Dates for Teachers

Teacher	Interview 1 Date	Interview 2 Date
Ann	2/2/16	4/17/16
Reagan	2/24/16	4/26/16
Taylor	1/30/16	4/24/16
Misty	2/10/16	4/16/16

Interview Protocols. The development of the initial interview protocol (Carspecken, 1996) was based on themes obtained using the post-program survey and the initial data analyses, as well as informed by discussions with my advisor, Dr. Jennifer Chauvot. This first protocol was the same for all four teachers and can be found in Appendix D. The focus of this interview protocol had four goals: (a) to ensure that each teacher felt comfortable sharing information with me, (b) to gain an understanding of how their career had changed and morphed since their graduation from the iSMART program, (c) to discuss their perceptions of their experiences during their time in iSMART (what they felt was beneficial and essential, as well as not, and (d) how their teaching experiences during their time in iSMART affected their learning while in iSMART. My questions were "directed to the teacher's experiences, feelings, beliefs and convictions about the theme in question" (Groenewald, 2004).

After the first set of interviews, a second set of interview protocols were created. Each of these protocols was specific to each teacher and was based on the first interview

and then interconnected to the course document analysis of that specific teacher that was ongoing. The goal of the second protocol was to create a deeper understanding of the teacher's transfer process according to specific themes that had begun to arise from the data through the process of horizontalization in order to further develop the theses that were beginning to arise from the data obtained during the first round of interviews. The protocols for the second set of interviews can be found in Appendices E-H. This second round of interviews were more focused, with the purpose of drawing out the elements of the experience from each teacher so that the 'essence' can begin to form. For this reason it was important that the wording of the questions have specific intent as to not allow my bias to come into play when asking my questions.

Interview Sites. As the aim for this study sought to look at the perceptions of teachers about their learning and how that learning has subsequently transferred to their classroom practice, the interview site of this study required careful consideration. In a desire to keep the teachers in a setting/context equally accessible as well as comfortable to them, I decided to conduct one-on-one interviews with each teacher in a setting chosen by the teacher in hopes of obtaining open and honest responses. Conducting interviews in a site comfortable to the teachers also cut down on the number of distractions that might possibly occur elsewhere. It also made for an environment conducive to audiotaping. All of the initial interviews were approximately 60-70 minutes in length and were conducted face-to-face in a location determined by the teacher. In this setting, all of the teachers were initially asked the same open-ended questions and from there different follow-up questions as the interview progressed. Each of the second interviews

took place via Skype since the majority of the coursework for the iSMART program was online, the teachers and myself both felt comfortable doing the interview online.

Consent. Before any data collection began and at the beginning of each interview, the teachers were informed that their ability to take part in this study is at will and could be terminated at any time. The teachers were also made aware of the use of audio tape recording devices for transcription purposes only, as well as informed on how these devices would be secure. The teachers were also informed that their identity would be protected through the use of pseudonyms.

Pseudonyms were given to all teachers, so that they are not identifiable to anyone other than the principal investigator. If a name were inadvertently mentioned, that portion would be erased. Transcripts would be destroyed upon completion to further ensure teachers anonymity. In accordance with IRB regulation protocol, all interview data and notes collected would be maintained in a secure location away that only I would have access to.

In the event that a question was posed in either interview caused discomfort, the teacher was told at the beginning of the process that they had the right to refuse to answer the question, or withdraw from the study without penalty. Furthermore, the teachers were allowed to stop the interview at anytime and were informed of this right at the beginning of the interview. Finally, the teachers were told that he or she may withdraw from the study without penalty at any time during the process or after the data was collected, simply by informing me of his or her intent. After all concerns were addressed at the beginning of the first interview, those who agreed to take part in the study were asked to

sign an informed consent so that data collection could begin. A copy of the consent form is located in Appendix I.

Memoing. 'Memoing' (Miles & Huberman, 1984, p. 69) was another important data source that I used in this study in order to triangulate the data. It was my field notes of the interview data that added to what I heard, saw, experienced and thought in the course of collecting and reflecting on the process of meeting with each teacher. I did this in order to not become easily absorbed in the just the data-collection process, but so that I would continually reflect on what is happening. However, it was important that I maintained a balance between descriptive notes and reflective notes, such as hunches, impressions, feelings, and so on. Miles and Huberman (1984) emphasize that memos (or field notes) must be dated so that the researcher can later correlate them with the data.

Transcription of Interviews. Rev.com transcribed the first four interviews in order that data analysis could begin in a timelier manner. However, I personally transcribed all four of the second interviews in an effort to fully engage with the content of the interview for a deeper level of understanding. This entailed, first, re-listening to the audio recording of the interviews, several times, right after the interview was completed in order to get a feel for the teachers' inflections and intonations as they described their experiences. This also allowed me to correlate the notes taken during the interview session with the transcriptions. After listening to the audio recordings several times, the transcribed interviews were used to identify the significant statements.

Data Analysis Procedures

Data analysis, in general, is the process of making meaning from collected data until the researcher believes a point of data saturation (Creswell, 2013). Data saturation is

said to be attained when there is enough information to replicate the study (O'Reilly & Parker, 2012; Fusch & Ness, 2015), when the ability to obtain additional new information has been attained (Guest, Bunce, & Johnson, 2006), or when further coding is no longer feasible (Guest, Bunce, & Johnson, 2006). I was able to obtain the information necessary for the study within the confines of two semi-structured interviews. Phenomenological qualitative data analysis requires the researcher to inspect, organize, and transfer the data that has been collected in such a way that it portrays the 'essence' of the phenomenon being studied (Creswell, 2007). Additionally, phenomenological research focuses on the perceptions, feelings and thoughts of those who actually experienced the phenomenon in an effort to describe both the essence of the lived-experiences as well as the teachers' reactions (van Manen, 1990). This phenomenological description of the teachers' understanding consisted of both the 'what' they experienced and 'how' they experienced it (Moustakas, 1994).

A substantial amount of time was spent examining the data in order to fully understand their experience as they experienced it (Patton, 2002). Kvale (1996) remarks with regard to data capturing during the qualitative interview that it "is literally an inter view, an interchange of views between two persons conversing about a theme of mutual interest," where the researcher attempts to "understand the world from the subjects' point of view, to unfold meaning of peoples' experiences" (pp. 1-2). At the root of phenomenology is "the intent is to understand the phenomena in their own terms — to provide a description of human experience as it is experienced by the person herself" (Bentz & Shapiro, 1998, p. 96) and allowing the essence to emerge (Moustakas, 1994).

In order to do this, thematic analysis was employed throughout the course of data collection and subsequently, used in the data analysis process (Creswell, 1007).

Thematic Analysis. A qualitative phenomenological framework was used to analyze the data " for significant statements, measuring unit's textural and structural description, and descriptions of the 'essence' (Creswell, 2007, p. 78). Thematics analysis design was used in the process of recovering the theme or themes that are embodied and dramatized in the evolving meanings and imagery of the work" (van Manen, 1990, p. 78). As thematic analysis moves away from reporting the 'facts' to making an interpretation of people and their experiences, responses from teachers were segmented and then coded in order to form small sets of non-overlapping themes (Creswell, 2013).

The intent is that these themes revealed shared patterns of behavior, perceptions of the teachers' regarding the transfer of their learning to their face-to-face classroom teaching practice. After the thematic analysis was completed and themes formed, inferences were drawn and conclusions made regarding the findings. In order to analyze the data (the interviews along with the supporting documents), the process of thematic analysis was used in conjunction with the following methods: (a) bracketing, (b) horizontalization, and (c) clusters of meaning, (Creswell, 2007), all of which follow the phenomenological data analysis method as described by both Creswell (2013) and Moustakas (1994).

Bracketing. In order to fully describe the lived-experiences of the teachers' and the teachers' perceptions as they truly are, researchers must carefully bracket out their own experiences related to the phenomenon so as not to include their own biases in the descriptive reporting of the data and decrease the trustworthiness of the study (Tufford &

Newman, 2010). Bracketing allowed the researcher to provide a derivation of new knowledge from the data and allowed the researcher to focus on setting aside personal prejudices and predispositions so that any possible bias in the data collection and subsequent analysis could be avoided (Giorgi, 1983). In order to achieve this, the researcher was prepared to enter the world of the teacher with an open mind, free of pre-conceptions (Moustakas, 1994). By bracketing personal assumptions and presuppositions prior to the data collection, it allowed the researcher to identify more easily those that surfaced during the data analysis process (Valle & King, 1978).

Horizontalization. The aim of this study was to achieve phenomenological reduction also known as *horizontalization*, as it relates to phenomenological data analysis. The goal of horizontalization is to concern oneself with the phenomenon as it was directly experienced and only then should specific questions be formulated. This first step of phenomenological data analysis required examining the data for any and all relevant statements, thus accepting all expressions as equally valid and important with respect to the phenomena being studied as the interview protocols were being created (Moustakas, 1994).

This is a critical phase of explicating the data, in that those statements that are seen to illuminate the researched phenomenon are extracted or 'isolated' (Creswell, 1998; Holloway, 1997). The list of units of relevant meaning extracted from each interview was carefully scrutinized and the clearly redundant units eliminated (Moustakas, 1994). To do this, the literal content, the number (the significance) of times a meaning was mentioned and also how (non-verbal or paralinguistic cues) were stated. The actual meaning of two

seemingly similar units of meaning might be different in terms of weight or chronology of events (Hycner, 1999).

The process began by examining the data for relevant statements using post-it notes of a specific size and color (each relating to the topics needing to be discussed in the interviews). Using the color-coded system, a second set of documents were made that would be used for data analysis after the data collection had been completed. To ensure that all of the data collection is collected in an organized way, documentation was made as to what the system was and why the choices were made they way they were. Significant statements were highlighted from the course documents, interviews and notes made during the data collection by color-coding them according to themes found in the data with highlighters, Sharpies, and Post-its. This was important to process of horizontalization in order in order to be able to describe the general features of the lived experience of the teachers that had participated in the iSMART program.

During the data collection, an understanding of that lived experience of the teachers began to be developed. As data analysis moved into a more formal stage, there was a shift in focus from getting to know the teachers and their experience to how their experience has impacted their face-to-face classroom. The quest was to gain understanding into how they perceived their experiences during their time in the program and how that learning has transferred to their face-to-face classroom. This required a continual bracketing of personal biases and experiences in order to have an objective and faithful handling of the data (Kruger, 1988). By bracketing those experiences, the phenomenon could be met in a free and unprejudiced way, so that it could be accurately described and understood.

After this awareness, the ‘essence’, or structure of experiences, began to develop as significant statements were highlighted from the second copy of the course documents, interviews and notes made during the data collection. The color-coding process continued and was extended further. Notes were made of what the color codes meant in order to provide clarity in what the documentation meant. There was a switch in size of post-it note to ensure that I would follow a particular system that I had set out for myself. As themes began to emerge in the data, specific colors of highlighters were used to annotate those themes in the documents. Through a close examination of the data to identify key information based on the teachers’ lived experiences, general themes were established that attended to the research questions and provided additional understanding of the phenomenon (Creswell, 2013). In order to complete the horizontalization of data, all relevant statements expressed by the teachers were listed during the process.

Development of Themes. During the process of horizontalization, significant statements found within those phenomenological themes were grouped together. This process allowed the data to be clustered into ‘non-redundant units’ of meaning which further developed into the themes for the data (Creswell, 2007, p. 235). The themes developed from the data through a continual back and forth cross checking of documents to ensure consistency. This process occurred within: (a) the recorded interviews, (b) teachers’ course documents and (c) various general course-supporting documents. This allowed the list of non-redundant units of meaning to derive clusters of appropriate meaning, the themes that formed the findings for this study. (Holloway, 1997)

Trustworthiness

Establishing trustworthiness for this qualitative phenomenological study was critical to ensure that the research was credible, dependable, transferable, and confirmable. Polkinghorne (1989) defines trustworthiness in qualitative research as that which "an accurate portrait of the common features and structural connections manifested in the examples collected" (p. 59). Several strategies were used to address the issue of credibility for the study and to ensure that the data collection process was trustworthy in design.

Triangulation of Data. Three different sources of data collection were chosen for the research so that the teachers' perceptions about their learning and transfer of that learning could be evaluated. Triangulation of data allowed for the data to be viewed from a variety of angles and merged into an overall essence of the experience concerning the use of teacher surveys, teacher interviews, and teacher documents from their time in the iSMART program.

Member Checks. In order to increase the reliability of the study, each teacher was provided with a transcribed copy of her interview. The teachers were asked to review the transcription for accuracy and provide any comments regarding corrections that needed to be made or clarification that needed to be addressed (Gall, Gall & Borg, 2007).

Clarify Researcher Bias. At the beginning of the study, researcher bias was identified that was related to preconceived notions of online learning and what should transfer to a teacher's classroom practice from a viewpoint of a mathematic coach. The

reader was also made aware of any researcher biases so that they could understand any prior assumptions.

Detailed Descriptions. Rich, thick descriptions were used when providing the details of this phenomenological study (Creswell, 1998). The reader would be able to examine the descriptions in the study, including the sample selection, design, and methodology to determine how relevant the findings may be to his or her circumstances and thus make decisions about their transferability. Detailed descriptions about the teachers, settings, and other relevant factors were provided so that readers could determine whether or not the results could be generalized or transferred to other populations (Creswell, 2014). Given that the initial learning site of this online learning program was a publicly funded state university located in an urban Tier 1 research institution located in a south central region of the United States and operated by the Curriculum and Instruction department, it was important to provide these detailed descriptions so that the study could be replicated in a different setting.

Audit Trail. As the researcher, accurate and detailed records of all interviews, surveys, and teachers course documents (Creswell, 2007) were kept. This ensured that all reports were valid and trustworthy. The purpose of this study was to report the data collected in a non-biased, credible and honest presentation. Every attempt was made to bracket out personal experiences and provide an accurate account of findings through true reporting of the teachers' perceptions throughout the research.

Limitations of the Study

As with any study, this one has defined parameters and boundaries. In designing this research methodology, it is important to recognize that there are limitations that need

to be acknowledged and need to be mitigated. One of the limitations of the current study is that the teachers were not randomly selected to participate in the initial survey for this study due to the fact that this study focuses on a specific group of people, teachers that have graduated from a fully online program. This design means that the findings could be directly applicable only to this group of students and possibly to this study. This limits the generalizability of the study because the sample may not be representative of the target population.

Moreover, the current study was limited to teachers who agreed to participate in the study and self-report on their transfer of learning from the iSMART program to their face-to-face classroom teaching practice. To minimize the potential effects of self-report bias, another researcher on the iSMART team administered, collected, and managed the data for the initial survey. To maximize participation, the survey could be completed in the privacy of teachers' home, provided they had access to the Internet. Creswell (1998) suggested that one of the means used to assess the quality of the qualitative research is an examination of whether the researcher has made his or her own subjectivity explicit. As stated in the trustworthiness section, because I am conducting the research at the institution where I am working and have had my own experiences in online learning, this is particularly important.

I also attended to how the teachers were selected for the interview process, what artifacts I choose to analyze, and how that factored into my analysis process. Specifically, the iSMART research team assisted in the process of collecting the survey data and as well as crosschecked the survey data analysis, to ensure the possibility of researcher bias was attended to. My advisor, Dr. Jennifer Chauvot consulted with me on

various decisions regarding the utilization of documents for each teacher. Johnson (1997), stated that 'typically, generalizability is not the major purpose of qualitative research for two reasons. First, random selection of teachers is rare, and second, the documentation of a particular circumstance is more often the goal" (p. 290). This is my hope that readers will be able to do this with the results of this research.

Lastly, there has been a considerable amount of time since iSMART teachers have graduated from the iSMART program, which could affect their ability to fully disclose the amount of transfer from the program to the face-to-face classroom. To reduce this, a detailed artifact analysis was done to stimulate the teacher's recall of assignments and dialogue about the assignments.

Summary

This chapter describes the methods, instruments, and procedures used in this study, including the design of the study, the sample, collection of data, analysis of data, trustworthiness, and researcher bias. A qualitative approach to research was the methodology. The researcher will attempt to follow an investigation with the teachers instead of an investigation of the teachers. The analysis of these data can produce information that can be helpful for schools who would like to enhance the professional development opportunities for their teachers and improve the education of their students.

Chapter IV

Data Analysis

As such, a so-called thematic phrase does not do justice to the fullness of the life of a phenomenon. A thematic phrase only serves to point at, to allude to, or to hint at an aspect of the phenomenon.
[van Manen, 1990, p. 92]

Chapter four presents the research findings from the study that focused on the transfer of middle grades mathematics and science teachers' learning in an online environment to their face-to-face classroom. This study examined both the coursework of the teachers while in the iSMART program and interviews conducted since graduation from the program, in order to answer the first research question: "For middle grades mathematics and science teachers in an online M.Ed. program, what are the perceptions of: What transferred from the online program to the face-to-face classroom?" The chapter is organized in three parts in order to support the research questions as outlined in chapter one. First, the four teachers are introduced with a brief biography to describe their background in teaching and what has happened with them professionally since graduation. Second, the findings, which involved the emergence of six themes, will be shared with the supporting evidence from the data. Third, a discussion is provided of how the six themes and the interactions between them answer Questions 1 or 2 or both.

Part 2 presents the structures that describe how the phenomenon was experienced in order to answer research question #1, as stated above, as well as the second research question: "What facilitated that transfer?" This section will describe the development of the themes and subthemes that ultimately supported the research. Part 3 will describe the essence of the research study; in order to illuminate how the teachers' experiences during

iSMART and the knowledge they obtained during that time were transferred to their face-to-face classroom.

Meet the Teachers: Ann, Reagan, Taylor, Misty

Ann. Ann has been teaching for 10 years and is currently teaching at a middle school GT academy. At the time of the study she was department head for the science department and had taught 8th grade math for 2.5 years. Prior to that she taught 6th grade science as well as a split of 6th/ 7th science. It is important to note that she Ann applied with Reagan, who at the time was also teaching at the same GT academy. Ann has always been familiar with technology and used it regularly in her lessons. She also considered herself 'a true math/science teacher'.

She stated that she wanted to 'obtain a greater depth of incorporating the two' while in the iSMART program. While in the iSMART program, and because of the Technology Grant Assignment, Ann started a Robotics Club at the GT Academy. At the time of the study there were 25 students Robotics and her group was the only Texas public school to compete at Nationals. "I mean, just year after year, awards after awards with robotics have been mind blowing. In addition to the Robotics club grant, Ann has obtained multiple grants totally well over $15,000. At the beginning of every school year as part of her open house, she does a pitch for grant money…and it works. She now has a Coding Program for the 6th graders to get them ready for Robotics in the 7th and 8th. There are 50 students in that program and she has trained and empowered teachers to lead that program for her.

This year will be Ann's last year at the GT Academy as she is moving to a new GT Elementary Academy to teach 5th grade math/science and help start up their GT

program, which has been her dream to do for a while. Having had so much success with menus, PBL, discourse, technology, and 'big thinking' at the middle school level, Ann desires to model that for her elementary counterparts with the hope that it will trickle down so that students will be prepared for the rigorous coursework that the GT Academy sets before them.

Reagan. Reagan is a math teacher, who applied with Ann for the iSMART, as they were both teaching at the GT academy. At the time of her application, Reagan had only been teaching two years and had taught a half a year of science for one of those years. She has taught all grades of middle math (6^{th}-8^{th}) and PAP 6^{th} and 7^{th} Math. She is currently teaching a $6^{th}/8^{th}$ grade split. Reagan was also an alternatively certified teacher, coming from the corporate world of business. She stated that her interest in the program was because "I have always seen how science and math could really work together and help the kids out in both areas". At the end of the iSMART program, Reagan was asked to take on the responsibility of department head for her school for a year. Additionally, Reagan attributed iSMART with her ability to find unique and creative ways to group students and utilize technology in the classroom. Reagan, like Taylor, has also taught several groups of students for more than one year.

Misty. As first generation student Misty did not have a strong support system while seeking her degrees, but she had the drive to accomplish whatever she set her mind to. When Misty entered the iSMART program she was only in her third year teaching and she felt it was a good time to refine her pedagogical skills since she did not enter the teaching profession through traditional avenues. She was alternatively certified and had little content training and even less pedagogical training upon entering the classroom for

the first time. Initially, she was shy in the discussions online because of her level of self-efficacy. Her participation in class was primarily through the use of the 'chat' box at the bottom of the screen, leaving the actual conversation to the more vocal students in the class.

However, Misty is a curious learner and an explorer, and because of that she was able to move forward in the program and build relationships and ultimately grow as a teacher and teacher leader. She transitioned from a Middle School Content Teacher to a teacher leadership position of Middle School Content Coach (during her time in iSMART) to a higher-level position of District Level Instructional Technology Specialist, which was created for her, and she is still currently serving in. While she was participating in iSMART, she was able to take what she was learning in class and immediately use it with her teachers in class the next day. This allowed her to increase her capacity to lead teachers, which ultimately allowed her to move forward in her career.

Taylor. Taylor was not part of the original cohort when it was selected, but she still wanted to participate and she let the director of the program know that. So when someone had to drop out she received a phone call to participate and she was on the next plane to attend the orientation and didn't look back. Her experience in the iSMART program was 'a dream come true' and she was going to do everything to earn her spot'. She is passionate about the education system and has been teaching for seven years now, but has changed curriculum within her content every year. Good or bad, she has stayed with and part of that she has attributed to the iSMART program. Taylor has had a myriad of experiences during her time teaching and has also taught several groups of students for multiple years, producing a cohort effect. Having a special needs child, Taylor is

sensitive to the needs of students in her classes, especially students who struggle or lag behind. Unfortunately, this year is the last year that Taylor will be teaching for a season. Taylor has taken a position with an engineering firm as a consultant. She hopes to remain connected to education, however.

Six Themes

Through the process of open coding, as described in Chapter III, both the interviews and course documents of the teachers were analyzed and six major themes emerged in response to the research questions which focused on, "What are the perceptions (lived experiences) of the middle grades mathematics and science teachers transferring their learning from an online environment to the face-to-face classroom setting?" In an attempt to uncover the essence of the teachers' common experience there were six overarching themes that spanned all four teachers' experiences. The six themes were: (a) the influence of the cohort model and collaboration on the face-to-face classroom, (b) the use of discourse in the classroom to facilitate learning, (c) the use of technology in the classroom, (d) the integration of mathematics and science in the face-to-face classroom setting, (e) the transfer of content knowledge from the iSMART coursework, colleagues, and instructors, (f) the transfer of pedagogical knowledge from the iSMART coursework, colleagues, and instructors. Table 5, on the next page, details the total number of codes per teacher as grouped in the major themes extracted from both the interview and document analysis data.

Using phenomenological reflection, these six themes could be extracted from the teachers' coursework and interviews and descriptions of their particular experiences could be written about (van Manen, 1990). It is the researcher's goal is to create a

Table 5

Major Themes Coded by Teacher

Major Themes	Ann	Reagan	Taylor	Misty	Total
Cohort Model	12	24	40	11	87
Discourse	16	60	74	24	174
Technology	21	45	26	46	138
Integration	31	24	64	35	154
Transfer of Content	30	62	59	23	174
Transfer of Pedagogy	9	73	80	22	184
Total	119	288	343	161	911

narrative that illuminates each theme and remains true to the quality of the essence of the experience. Additionally, as the data was coded from both the interviews and course documents a secondary sets of codes was developed to gain a deeper perspective on what the teachers' were experiencing. Using key words in text, each piece of text was coded with three additional codes to obtain a secondary set of codes to support the major themes. A copy of the secondary codes can be found in Appendix J. These codes were used to support the researcher's narrative, and ultimately answer the second Research Question regarding the individual experiences of each teacher.

Part 4 synthesizes the structures together that which describes the phenomenon in order to answer the question: "What is the essence of the lived experience of the teacher in in iSMART program and how does it differ between teachers?" The stories of the teachers will show a range of experiences as they moved through the program and beyond graduation to their current position. Each teacher had a unique experience, but collectively each teacher had a shared experience that was common to each teacher, thus the extracting the essence of the experience of participating in the iSMART program.

Individual Teacher Analysis

This section addresses the impression of the individuals teachers that were analyzed for this study: Ann, Reagan, Misty & Taylor (pseudonyms). The pseudonyms were chosen at random and do not indicate the order the teachers were interviewed initially. It was the intent of the researcher to use the process of bracketing during data collection and analysis, in order to remove the researcher's bias and personal experience as much as possible, in order to arrive at an understanding of the experience from the teachers' perspective alone. As a part of the phenomenology study, the researcher employed the use of *epoche* in hope that an atmosphere of trust and openness would be evident throughout the study.

Development of the Themes from Data Analysis

The interviews and coursework for each teacher were analyzed using domain analysis for emerging themes. A list of documents that were used in the analysis can be found in Appendix K. Analyses of the content of these transcripts were used to gain perspective of the major themes and the experiences and beliefs of the teachers. The themes that emerged from the analysis of these documents were classified into six domains: (a) Use of the cohort model in the classroom, (b) increased use of discourse in the classroom, (c) growth as a teacher/teacher leader, (d) increased and/or varied use of technology in the face to face classroom, (e) integration of math and science in the classroom, (f) transfer of content knowledge to the face-to-face classroom, and (g) transfer of pedagogical knowledge to the face-to-face classroom. Appendix L contains a table that depicts the transfer of learning themes and the subtheme categories that corresponded to them.

Theme One: Use of the Cohort Model in the Face-to-Face Classroom

The use of the cohort model in the face-to-face classroom was a continual theme for the teachers and was associated with building relationships and sharing experiences that were considered 'authentic'. The teachers expressed they had experienced relationships in their classrooms that sharing similarities to those of the 'cohort' model from the iSMART program. Those two relationships were (a) the students that they had 'looped' with over the years, either during their time in the iSMART program or after graduation, and (b) the various colleagues that they had started to relate to, as they did with the colleagues in their initial cohort for iSMART. Facilitating collaboration over time, both with students and colleagues, through the process of building strong relationships was also a strong theme for the teachers.

The initial data analysis uncovered the relationship of student-to-teacher in the cohort model as it occurred with three of the teachers who had moved up and down in the content curriculum, Ann, Reagan, and especially Taylor, moved curriculums every year both while in the iSMART program and after graduation. Misty also displayed evidence of transfer of cohort practices, but within a teacher leadership capacity. Van Manen (1990) refers to this 'uncovering or isolation of themes' as the selective or highlighting approach. What follows is the selective or highlighting approach to the teachers' understanding of how the cohort model of the iSMART program influenced, or had an impact, on their face-to-face classroom teaching or teacher leadership practices through the selection of exemplar uses of the theme found in the data. This also includes the subthemes that were introduced as the data was coded from all four teachers. Those subthemes, displayed by teacher in Table 6 below are: (a) identification of cohort model

activity in face-to-face classroom practices, (b) authentic experiences practiced in the classroom which fostered deeper learning and trust, (c) collaboration with both teachers and students, and (d) relationship building over time in order to understand how to meet the needs of both teachers and students.

Table 6

Subtheme Totals Per Teacher Supporting Theme #1: Use of the Cohort Model

Code	Total	Ann	Reagan	Taylor	Misty
Authentic Experience	24	3	4	13	4
Experience - Cohort Model	65	15	21	25	4
Collaboration	66	17	19	13	17
Relationships	17	3	9	4	1

Utilization of the cohort model. Ann presented a unique experience of utilizing the cohort model in her classroom practice during her first interview, not only did she benefit from using it with her students, but she has also used it in a teacher leadership capacity. Since Ann teaches at the GT Academy, she sees a lot of students that tend to work in pairs. Her students often question each other about whether or not they achieved the right answer. Her teaching is not about her students getting the right answers necessarily…it is about the depth of content and working together to increase that understanding. Therefore, since Ann came into iSMART as a pair with Reagan, this gave her a real life experience of what her students go through in her classes that she did not expect. She did see the transfer of the cohort model in her classes as she went through the program. She thinks that because Reagan and her were one of the only pairs, it gave her a glimpse into her do. She felt it was a really helpful way of looking at her

students…being a new student and going back to school, and having another professional to ask, "Okay, did I get this right? Did I hear this right?"

Reagan also spoke about her movement up from sixth to seventh grade while in the iSMART program during her interviews. During her third year teaching and her first year participating in the iSMART program, almost half of her 7th grade class was filled with students that she had the year previously. She maintained that schedule of teaching 6th and 7th grade for the next five years of her teaching career. Reagan was very honest about her time teaching her students two years in a row. She had not really considered the fact it mirrored a cohort model, but upon reflection she realized that it did hold true to the benefits she reaped from the program. She explained in her first interview that she liked having the kids twice…it was building that connection with them, seeing how they would progress and grow from one year to another". She felt that there is so much going on with students in middle school that it is very helpful to be able to build that personal relationship with them. By doing that, it takes out the excuse of students telling her, "Last year they never taught me that," because she was their teacher last year, and she could say, "That's not an option for you."

Strategic collaborations. When talking about the benefits of a cohort model, it is the effect of collaborating in strategic ways that the teachers believed was a key factor to their success inside the face-to-face classroom. Ann spoke about how the grouping strategies in iSMART led to strong collaborations with the cohort model. She remembers being placed in groups for the iSMART classes, which meant having to work with strengths and weaknesses of group members, but then frequently changing groups. This aided in the experience so that she could relate to her own student and how she would

group them in her own classroom. She became much more attentive to detail with respect to how she would grouped them strategically after that experience. She also remembers working with Reagan for a while and then changing groups. That change had an impact on her learning. She would still meet up with her and the other teachers from her district to collaborate on assignments, “Some of us would meet at Starbucks and things like that. Just really talking to the other teachers and talking it through. She expressed: "Okay, this is where my thinking was wrong." Gosh, even the online class cleared up their thinking ... You could put your camera on your work and people would share. I never left class being like, "Oh, I still don't understand." There was definitely camaraderie among all of us.”

When speaking about the collaboration of the cohort model found in the iSMART program, Reagan felt like the class was ‘in it together’ and working toward a common goal. Reagan talked about the importance of collaboration with others in a smaller group setting during the week (the same group that Ann spoke of), especially when it came to the science content because she was a mathematics teacher. Being in a small group allowed her to build connections with the teachers she was working with and help each other out if you didn't understand something. If she didn't understand a science connection that they were trying to make, those teachers could speak about that content. She recalled how nice and comfortable that first group was (when she was with Ann) and when the groups reshuffled, ‘it was almost heartbreaking. You'd worked so hard with this first small group, and they're like "No, now we're going to change it." You're like, "Ah, now you're going to change it," but then you work well with these other people. It was really nice to have a cohort, because you really did feel like you were in it together.”

Theme Two: Increased Use of Discourse in the Classroom

As each of the teachers shared their experiences of learning in the iSMART program, the theme of using discourse in the classroom for the first time and finding success with their students was evident. All four teachers shared that this was a pivotal change in their teaching practice and it occurred during their first semester in the program. As soon as they discussed this method of instruction in their online coursework, which occurred in their science methods course, they implemented it in their face-to-face classrooms with little-to-no issues. Finding success quickly in this area aiding in their self-efficacy in both the iSMART program and in their teaching practice.

All four teachers are currently using discourse in some capacity at this point. The three teachers still in the classroom have evolved in their teaching strategies with discourse, developing new instructional practices and grouping strategies with the discourse, and the fourth teacher, Misty, is using discourse in her professional development activities with the teachers she works with. As the data analysis began in this area, twelve sub-themes developed that focused on utilizing discourse within the face-to-face classroom. Those sub-themes are listed in Table 7 on the next page. Student engagement, questioning strategies and inquiry-based learning were most discussed with respect to facilitating discourse in the classroom. One thing that was articulated by all four teachers was that the coursework in the other courses supported this practice, whether they were analyzing articles for their math content course focusing on proportional reasoning in the middle grades or the course that focused on identifying issues in mathematics education.

Table 7

Subtheme Totals Per Teacher Supporting Theme #2: Increased Use of Discourse

Code	Total	Ann	Reagan	Taylor	Misty
Facilitating Discourse	165	23	47	75	23
Grouping Strategies	19	3	13	2	1
Inquiry Based Learning	68	22	25	16	13
Instructional Strategies	61	5	26	20	10
Use of Investigations	59	19	17	15	9
Ownership of Learning	18	4	5	7	2
Perturbation	13	2	4	4	3
Questioning Strategies	77	5	25	21	25
Safe Environment	45	6	16	20	3
Struggle	14	8	6	0	0
Student Engagement	190	20	50	89	31
Student Thinking	98	28	34	15	90

Grouping Strategies. Ann stated that the first year in iSMART was a process of getting the cohort to really understand what discourse is. In the proportional reasoning course (CUIN 7332), Ann spoke about the Oil Spill assignment and it's impact on her learning which led to a greater understanding of facilitating discourse in her own class. She talked about how watching the video of Peggy Lynn guiding her students trough the inquiry lesson using oil spill simulations gave her insight into how she could increase inquiry and discourse in her own class. Specifically, she enjoyed the fact that Peggy Lynn ended up where most teachers would start, clarifying the definition of direct variation and reworking the line of best fit. Allowing for mistakes, anticipated struggle, corrected misconceptions using student generated results and consistent probing and questioning was key to a successful lesson based on what she was learning. She began to apply these principles in her own class over time and have found them instrumental in getting her students to learn on a deeper level.

Ann also used the experiences of being grouped and regrouped continuously in her iSMART classes so she could relate to her own students and how she grouped them in her own classroom. She became much more attentive to detail on how she grouped students strategically after that experience. The continual experience of working with different teachers with different strengths and weaknesses provided her a rich forum for developing her own skills as an educator. Ann talks about how her questioning strategies played a part in developing her students' thinking in their lab reports over the years: "I can see that [generating thoughtful questions] playing a part in my lab reports. I give them guidelines for how to write an analysis, how to write conclusion, but when they try to make that ... It's also maybe no so much a question but application of what was a real world application of this lab? Why did we do this? What does it seek to gain? Because I'm looking for their input there. Other times I like to play devils advocate a little bit. " It is this type of questioning that Ann believes has strengthened her teaching capacity over time and given her the ability to take her students' thinking to a higher level.

Visible Student Thinking. Misty was also heavily influenced by the coursework of CUIN 6326, as well as the professor's pedagogy surrounding discourse as her professor modeled it on the online environment. She was intrigued immediately with the idea of discourse and how to increase it in her own classroom. With the challenge of looking at the 5E lesson cycle and how discourse can be integrated into each 'E', Misty's way of looking at the typical lesson cycle was forever changed. She began using the elaborate section to infuse discourse to extend her student's thinking and learning. This was a new concept for her and something that she quickly applied to her face-to-face classroom practice with much success.

Misty focused on bridging both discourse and constructivism in her understanding of how to create a strong learning environment for her students using the 5E model, which she referenced many times throughout her coursework. The role of discourse in instruction in terms of constructivism means that the learning process is linked to social interaction. She believed that the students should be given opportunities for discourse with their peers. All of these components of students centered learning are aligned with constructivism and the 5E model. She stated, "If you focus on the components of the 5E model and constructivism, they inherently imply that the learning and methods for learning have to be student centered. Discourse will make a difference, a positive difference in terms of the student creating meaningful knowledge."

Misty in her interview spoke about questioning strategies in discourse and how to facilitate those questions in the different stages of discourse. She believed that discourse is part of making sense of what the students just did by talking about what was happening why it was happening. Constructivistic learning involves allowing the students to debrief in terms of dialogue with peers. Since the student is still in the raw stages of constructing their new knowledge, it should be open-ended allowing students to reflect in an environment where they don't feel they will be criticized. Although students at this point should not be evaluated on what they are saying, the teacher should step in to help clarify ideas. Discourse helps the student develop their understanding and ability to elaborate, both key elements in constructivistic learning, where the students create their knowledge.

Misty also is now focusing on online questioning strategies to assist those who struggle with face-to-face classroom interactions. This is what she transferred from her online interactions during her time in iSMART. She is finding ways for those students,

who are shy or unsure of their knowledge, to express themselves in an environment where they feel 'safe' and they are willing to share their thoughts and knowledge…like she did in iSMART. She explains what that means for the face-to-face classroom and what parameters need to be set up for the safety of the student, teacher, and the class as a whole:

> "So, even now there is a focus on how to help teachers with developing appropriate and the right questions for online discussion boards. One of the things we see in our sessions is that …is that they have to be very purposeful about your questions because otherwise there will be, ummm…. well, you don't want just yes or no questions. If you truly want to engage your students in a discussion then you have to craft those questions that will allow for rich discussions. In my classroom it wasn't until the end of it that I started being more purposeful about bringing in discourse. Providing that experience for our teachers, and then empowering them to experience it themselves in their classroom…. and then what would it look like for your students that is the goal we are trying to reach now. Now one of the things that we do now is to make sure that we are building communicators in our students. One of the trainings that we promote is using discussion boards to give you a way of not only engaging the student who maybe doesn't participate in the face-to-face conversations but giving those students another way of speaking up on their own time and in their own way through an online discussion board."

For Misty, the shift in use with discourse started happening when she begin seeing a growth in her self-efficacy during her classroom observations after she became a

science content instructional coach. One of the things she thought was a challenge was that teachers could have planned great lessons, yet she would still see kids not engaged in the instruction. So, when she did her literature review for her Capstone Project, the culminating program activity for the iSMART program. She focused on how to engage students where there is that lack of motivation to learn despite all of the planning and everything a teacher could have done.

Grouping Strategies. While Reagan has integrated discourse into her mathematical pedagogy on a daily basis, it is her grouping strategies that really changed her teaching pedagogy the most. Her student desks are always grouped in some way, mainly in groups of four. She believes that student conversation should be maximized and teacher talk minimized with a focus on using technology in each lesson. The use of technology brings a lot of discussion around the questions themselves and how the students answer it. For on the spot questioning and probing, Reagan uses the Navigators, and finds the TI-Inspire calculators easier to use with that technology added on. Her students remain in groups because of this technology and because of this they do a lot of talking. She tells her students, "Think first. Now that you've had a minute to think, talk to your tables, what did you guys come up with?" Then she has her students share out as a class. “That's all I ever do now. Regardless of how we should be doing things [according to district policy] I will allow of for them to be talking to each other, discussing things. I am a believer in that they need to be talking to each other and having the discussions and investigations. Very rarely are you ever in my classroom when it is quiet.”

In setting up that type of environment, Reagan believes that it begins on the first day of school and evolves from there. With a focus on student centered learning, Reagan has the students develop the rules for the classroom. This enables her to see the things that they view as important for the learning environment. She believes that they are going to get the most out it when they put the most into it. She believes it is important to give up control issues with her students, and allowing her students to do the heavy lifting. She believes kids should be doing most of the talking and that she should not be the main person taking over but letting the kids do that as well. She is okay with trying to do something different. She believes that when you get to the point of trusting your students in the discussions and content then they start to feel more comfortable as individuals being able to speak up as opposed to just the student, and the teacher.

In a different assignment for CUIN 6346, Reagan explains her process of drawing students out in conversation. A process that has developed since that course when she first learned about discourse in the classroom: "When I am giving them think time or letting them talk with their groups…I come around and say, "oh that is a great idea you have, when I call on you I want you to share it with the class, would you be okay with that?" So it is not just asking them what is the right answer. Because they are not always going to have the right answer, nor do they want to share it because they do not think it is the right answer. So leaving questions that are more open ended so there is no wrong answer and calling on those to speak at that point that may not have as much confidence actually builds their confidence. Just trying to keep a safe environment in the classroom to where they know that when they do speak up and they do speak out they are not going to be laughed at or ridiculed…. that anything they say isn't necessarily right or wrong.

In CUST 6311, Education in a Multicultural Society, Reagan discussed using grouping strategies with her students in the assignment, Studying Practice (Stages 1-4). This course was taken during her fourth semester in iSMART and displayed the growth in her use of discourse with her students, but also shows how she is reflective towards areas that still could be developed further: "While students were working in their groups, I circulated the room to visit with the groups and ask individual students to explain how to model each problem. We will come together as a class and I will ask for volunteers to share their solutions. In their groups, students will be asked to use the models to add 1/10 and 2/5, 1/6 and ½, ½ and ¾. I like to accept everyone's thoughts when we are sharing out in the class, and there is no risk in giving an answer. When you can emphasize that right or wrong answers do not exist when brainstorming, students will offer many different ways of looking at problems."

I came back to it later on in the lesson when discussing equivalency, but now see that it would have made a stronger impact if I would had addressed it when given the lead-in by the student. Before students create their end products, we will discuss as a class how fractions are used in real-life and add fractions. I will ask the groups to come up with a conclusion for the statement: What is the relationship between the number of separations on the answer fraction strip and the denominators of the fractions added? I will be looking for students to be talking about factors or multiples. A connection should be made between LCM and the number of separations on the answer fraction strip. Each of the groups will need to put their conclusion into words. Students should also demonstrate on their fraction strips what is happening (students can divide their ½ shaded fraction strip and 1/5 shaded fraction strip into ten segments)." Reagan was intentional

with both her lesson setup and questioning strategies to probe her students further in their understanding.

Instructional Strategies. Out of all the teachers, Taylor focused the most on discourse and how she could improve her instructional strategies in order to increase student engagement through the practice of discourse. Out of all the teachers in this research study, Taylor focused the most on discourse in each piece of her coursework when she could. The research from her literature review led her believe that in order "to change the classroom, you must change the way the teacher views discourse and argumentation. Additionally, Taylor supported her work with the research of Sadler (2006), that to understand argumentation fully, discourse in the classroom must be discovered and established as with any communication used to make conclusions and plausible solutions for a problem. She continued saying that, " it is then that interaction with peers is not just the manner in which students speak to each other, but it is the process in which they learn. As a subset of discourse, argumentation is not argument for the sake of confrontation, but a manner of communication in which claims are supported by evidence and evidence is validated by a consensus of peers" (Tippett, 2009).

In her discourse assignment for CUIN 6326, Taylor reflected on her students' ability to engage in discourse and what she needs to do in order to facilitate the process with them. Having a routine of discourse is hugely important, because her students did not know how to talk in class or about what they should talk about. She felt that it was almost like they don't have the words, or they were not sure how to form the words to be able to express themselves in class. Taylor felt that they had not been taught to talk/argue/

express their learning in a class environment. She is passionate about teaching students this skill because it is invaluable, especially in our technological age.

In CUIN 7334, Taylor embraced the way her professor modeled, and was challenged by the questioning strategies:

> "Here is the thing, it was so brilliantly done. I don't "know if it was a mistake or not. But what happened, what happened…. She [the instructor] does it so well so I don't know if it was a … I don't know. What happened was, is that we were given a problem and she picks these problems with intent. Then we can't come to the solution. As the cohort...or as my group of 5.... or whoever was working together...if we couldn't find the answer when she would come to us [online]… I do this too because I loved it, it was so brilliant... She comes and says, "Okay, well, since we're having a hard time agreeing we're going to step away from this problem and well talk about it next week." She did that over and over again. I found that even within my cohort, these women and these men, they were professionals just like me. We'd been in the business for a while. We were like, "No we want the answer." Then she came back, a week, 2 weeks later...whenever we met and she would say, "Okay, you remember that angst that you felt? Do you remember that feeling?" "Yes." "Okay, I want you to remember that feeling and this is what it felt like. This is why." We [would] talk about the anx of that problem and then maybe approach the problem again. Sometimes we did and sometimes we got so busy we would forget what problem we were so frustrated about and never went back to it. Most of the time it was okay."

Taylor also reflected on her practice when she completed the Studying Practice Assignment (Stages 1-4) for CUIN 6311, she realized that as she was engaging with her students to discuss questions pertaining to the lesson, her struggling students were not willing to speak up and engage in the conversation. At that point, she changed her questioning strategy with her students, a principle which had been taught and modeled during her coursework in CUIN 6326. It is this change in awareness that marked a shift in her practice so that her students were pushed to share their thinking and take ownership of their learning in her classroom. She reflected that as her students answered questions on the notes page, she noticed that her students did not realize where she was in the lesson.

This is the place in the lesson that she would stop talking and start writing the questions on the board so that struggling students could find their place. This influences how Taylor creates a 'safe environment' so that students feel free to share what they are thinking without fear of receiving condemnation for having the 'wrong' answer, a skill that taught in CUIN 6326 when her professor was discussing the necessary components of a classroom that facilitate strong discourse. She explains her process:

> Many times they will not answer because they are afraid of being wrong. So, fully knowing that there is a definite RIGHT and WRONG, I allow some room for incorrectness with the intent of leading them to correctness within the period. I encourage my students to add to what they know. In the process of note taking, talking, and learning, I want them to add to what they know and construct their knowledge from our class discussions.

Taylor's experiences with collaboration have also pushed her to use collaborations with her face-to-face class interactions now as well. She modeled this after her CUIN 7334 professor specifically. She spoke about the professor's instructional practices in the online environment and how she now uses them with her own students, "you knew exactly what she was doing when she was questioning you in a class and it may have frustrated you at that point in time but you knew exactly what she was getting at...if she was like, "Well we'll regroup and then talk about the angst when" and I loved that. That's something that has been so life changing for my teaching practice and me. It is such an amazing thing for my teaching career at this stage."

Perturbation. Reagan spoke about the egg in the jar activity and her personal experience with 'perturbation', a concept introduced to her by her professor during her first semester in iSMART and the struggle that ensures when students are taking ownership of their learning. She explained that she felt that she experienced everything as a middle school student would. She was intrigued by the experiment and had seen it before, but never tried it herself. Her team continually went back and forth with there ideas of what was happening, not seeing each other's points at times, but by the end of it all, they had a very solid understanding. She was even able to come up with an explanation as to how the egg is pushed back out of the jar, thus being able to take ownership of her learning.

"Through discourse", she states," you are conveying your opinions using language to communicate. Language stimulates thinking. Without discourse I wouldn't have been able to learn from my team. Without putting myself out there and fully believing in my naïve theory, I would have never seen the error in my ways. Enter social

interaction. Understanding the rules, procedures and structure of argument and debate is key to generating productive discourse between students, classmates and the teacher."

Reagan also stated that the egg in a jar activity showed her how perturbation could bring a new level of discourse in the classroom. She spoke about the concept and how that experience has directly impacted her classroom, especially with PAP/GT students and the need to question her students at a rigorous level in order to find innovative ways to challenge them. This activity was the catalyst for more activities that would bring about perturbation with her students, now that she has experienced it organically herself. She believes that to think about something and to really question the why behind it, the why something happens is important. She stresses to her students now, "What if something happens or what if I tell you it works this way…what are you going to tell me? Some of them don't like it at all. Some of them just want to stay in that, I achieve sort of idea…but some of them will jump right in and they feed from it and grow from it."

Reagan recalled the importance of creating perturbation, in one of her technology based assignments with her students. In exploring the concept of perturbation, Reagan decided to use technology to help create that state, which, in turn, created an environment that facilitated learning at a deeper level. She used the game of Guestimate with her students to illustrate the concept in her class. Guestimate involves partners multiplying numbers to reach a product of 100. Any digits can be to the right of the decimal; 100.4 and 100.009 are both winners. Student 1 provides a number, and Student 2 has to multiply that number by a factor to reach 100. They go back and forth building off their

number until there is a winner. This creates the disequilibrium of how to reduce a number higher than 100.

The support of a computational tool (the calculator) assisted in the problem solving through trial and error for her students. After Reagan sketched a few models of 0.3×0.5, 0.2×0.2, and 0.1×0.7, one student exclaimed, "It finally makes sense! I get it – you're not taking a whole amount of something. The multiplication means 'of', so you aren't taking one full three tenths, you're only taking half. And you're only taking seven tenths of one tenth!" With his explanation, more ohhhhhh's were heard from the students. He was able to point at the model, showing the whole amount of 0.1, and then the portion that we were using…the seven tenths.

The students enjoyed several aspects, such as being able to use the graphing calculators, playing a game as well as the "torture" of being confused when figuring out how to reduce the value of a number by using multiplication. Guestimate successfully created disequilibrium in their mind, and they were ready to explore why they were getting smaller products when they multiplied by numbers between 0 and 1. They had proof it worked, by using decimals models on 10×10 grids, they were able to see why it worked that way. Reagan found that after using Guestimate and the modeling, her student were able to pick up on the actual rules of multiplying decimals very easily. They were comfortable getting a small answer such as 0.056 when multiplying 0.7 and 0.08. They had the game and the models to think back to, to help with the reasoning of their products.

Taking on that role of a student, as Reagan did in the egg in a jar activity from CUIN 6326, Misty gained a great deal of insight and understanding into how discourse

and perturbation would impact her learning in a constructivistic environment. She was able to have that experience as a student and, analyze how that learning would ultimately have an effect on her students. According to constructivistic learning, discourse is the part where the student gets to explain or engage in with peers about what they explored or investigated. She learned that the experience or exploration they will be talking about has to be common experience for all the students involved as the egg in the jar was for her. This exchange of language and dialogue will give the students an opportunity to connect their prior knowledge to the input they just received. This new understanding of elaborate section changed Misty's classroom immediately. Misty spoke about naivety in understanding investigations and its affects on knowledge construction and discourse in the activity involved an egg in a jar, similar to Reagan.

At first I thought, 'Oh, I've done something like this before, I think I will have no problem understanding what's going on.'" This was a naïve idea for her, because she came to find out that she really didn't understand what was going on. Similar to the way her students had thought about activities she has presented to them. It wasn't until she went through all the scaffold methods of constructivism that she gained a better understanding of what was happening during the experience. She worked together with her fellow iSMART classmates to engage in discourse about the activity. Through that process, her misconceptions and lack of clarity was made clear and she was able to take ownership of her understanding by the end of the investigation.

Theme Three: Use of Technology in the Face to Face Classroom

One of the program outcomes of iSMART is that the mathematics and science teachers become more proficient in the use of technology in their face-to-face classroom.

Given the amount of data and its analysis, the third theme is the use of technology in the face-to-face classroom. All four teachers shared that as they moved through the program they were challenged by both their instructors and colleagues to increase the use of technology in their classroom. All four teachers are currently using technology in their classrooms at some level. One teacher has had three job promotions, and recently a fourth, since this research was completed. She now is responsible for leading four different teams in the technology department of the largest school district in Texas. The other three teachers are using technology in their classroom daily and two of them have Navigator and Probes sets in their classrooms that they use. As the data was analyzed in this area, four sub-themes developed that focused on technology in the classroom. Those sub-themes are listed in Table 8 below.

Table 8

Subtheme Totals Per Teacher Supporting Theme #3: Use of Technology

Code	Total	Ann	Reagan	Taylor	Misty
Digital Stories	5	0	1	0	3
Robotics	11	11	0	0	0
Technology Grants	37	20	9	0	8
Technology in F2F	117	14	34	21	38

Robotics Program. The one area of technology that has really grown for Ann, and the GT Academy she teaches at, is her robotics club. Robotics was born out of the Technology Grant that she wrote for CUIN 6346, Teaching Secondary Math with Technology. Her Robotics Club has grown tremendously every year since she started it that first year with her technology grant money, which is pretty amazing considering the fact that when you walk into her school building you see all of the state trophies in math

all lined up in the case next to the front door. She has had to compete with that large math club every year for participation numbers. Despite that, she is the one of the only, if not the only, Robotics Club from a Texas public school competing in Nationals at LEGOLAND California.

She also has coding for the sixth graders, which is for the intro for Robotics, so she grooms those sixth graders for Robotics. She has about 45 students in each of the two clubs. Year after year, the Robotics Club wins awards and it has been a 'mind-blowing experience' for her in terms of what the kids can do. She has also been very impressed by the level of parental and community support she has had, despite the fact that she has had little to know funding from the District. She explained that her season begins with the first competition in First Lego League (FLL), which means that the Robotics students are competing from August until March, nonstop. Their final major competition major is Robofest, which is at Lawrence Tech in Michigan.

One of the most difficult parts of this process, surprisingly, has been that she has not been able to give elective credit for robotics, because doing that would hinder her eighth grade numbers and her priority is eighth grade science,. If she had a robotics elective, it would throw her numbers off, and she would have to give one of her GT classes to another teacher. It is pretty amazing that without elective credit, Robotics Club has experienced exponential growth and all of this since Ann wrote that first grant for Robotics while in CUIN 6346, Teaching Secondary Math with Technology. The initial grant was for the initial Lego Kits. Once she was awarded the funds she was able to purchase the kits and the club just blew up the next school year. She realized she needed to not only get trained herself, but also needed to recruit other teachers to help out with

the student interest load. This would require more money, which meant writing more technology grants.

Writing Technology Grants. Since that first grant Ann has become proficient in writing technology grants since iSMART and credits CUIN 6346 and her professor for that course with the self-efficacy and tools to continue down that path. She shared in her interview, "I'm not a very good writer, but I'm good at asking for money." She has personally brought in over $15,000 over the last couple of years to her campus for Robotics and Coding. She received another grant for Robotics recently and recalls, "It was like a Shark Tank platform where people voted and you had to go through these rounds, and I just let the kids go for it. I just filled out the paperwork, and I'm like, 'These kids are here to tell you that we need this equipment.' It was great. We got it, and that was three thousand dollars." She is currently writing one for physics to obtain wireless microscopes because that is what her 6th grade Coding students want to be able to utilize in their investigations. She believes if her students want to learn how to do something, she will ask for it.

Technology in Face-to-Face Classrooms. Misty is finding new ways to increase positive student engagement in the digital world. For her, part of the initial fear was that I didn't know how to give my kids the tools to communicate appropriately online. She saw that there was value in it but I didn't know how to provide that experience for the kids. She also saw that is was helping the kids…which this is the other piece that she now helps teachers with…digital citizenship and the classroom. She explained that it is important in the digital classroom to help students understand how to be good

communicators online, know where things are there, and why they are posted there...and ultimately that they are there forever…it is part of your digital footprint.

Misty also used technology in the face - to - face classroom to take the next step in moving to teacher leadership…the development of science probes-similar to Paige Keeley Probes. She wanted to her campus to make their own version so she set up a Dropbox where they could submit all of those and it became a campus thing. At planning meetings, the conversation became, "just check the Dropbox, I put it in there. It just really changed the workflows for sharing of resources at the time." looking at making judgments about what technology to use and when. That was part of my intro into education technology. If it wasn't for that program, I don't know where I would have gotten the avenue into opening up that door. It was part of we were trying to find solutions for how to present and share knowledge with each other in engaging ways.

The byproducts of that learning were just as valuable for Misty as the actual vision for the program: "It was like there was some byproducts that I didn't anticipate as part of the core of what the vision was for the program, but it just made it so much valuable for me because I was growing in more ways that I initially intended to get out of the program, but then I started finding tools, technology tools, that advanced efficiency even in my district at the time." It was during this time that Misty began to transition her pedagogy from teacher to teacher leader. Her focus at the time was about solving a challenge for teachers and what they needed to do for student learning. She did professional development sessions on using Dropbox for collaboration. She remembers that at one school the entire computer lab was filled of teachers and the technology team for the district came through, looking to see what was going on. She shared what she

had learned about in the iSMART program and how it had provided a solution there and could in the district. After that in her district, she became known as the science go-to tech person for enhancing efficiency and productivity.

Her continued growth in the area of technology led to her leading more professional development on technology, as well as work efficiency with technology. The Dropbox professional development was one of the four workshop sessions that she did. She also did professional development on: project based learning, digital story telling, and using technology to increase student engagement in teaching standards. All of her sessions started with her old face to face classroom lesson plans and notes that she brought back in as signature lessons for the 8th grade district curriculum that she is currently working in. She would model the lessons for her teachers as a Saturday session, while also bringing in elements of peer review, critical thinking, and feedback.

When she transitioned to her current role as an education technology specialist, she began to see how well prepared she was in comparison to the rest of her district because of the training iSMART was affording her in technology. Misty specifically attributes this preparedness to all the web tools that she had learned to use during her time in iSMART in the different courses. Several courses required her to not only use the technology as a platform for receiving the course information, but also for her to deliver her course products as her assessments. She was stretched to use a variety of Web 2.0 tools instead of just one or two tools. She believed that this was the biggest piece of being able to bring those tools into the educational technologist role because her role now is also a coaching role--coaching teachers on how to integrate technology and the effective uses of technology into the classrooms. She now makes sure that she focuses

her coaching on one of three things: a) helping teachers become more proficient with their technology, b) enhance their instruction with technology, or c) helping teachers engage their students with technology.

Misty's growth grew even further, when in her research she started seeing that technology was one of those tools that could really help engage students and help teachers free up some of their time to become more efficient so they could free their mind to focus on how to solve problems and other challenges in the classroom. She began this pilgrimage of research, first, in her literature review for her capstone project by focusing on different ways that people were leveraging technology to improve instruction. After that, she began applying that research with her fellow instructional coaches so they could begin the shift of trying to bring in good uses of technology in order to free up some of their time to work on other challenges that they had in their work.

Finally, Misty used technology to assist in writing curriculum with various teachers in her district. During her time in iSMART, she was learning about how technology and various tools can facilitate collaboration and communication. It 'opened up new worlds' that she hadn't expected. In her district there were specialists that needed to collaborate and work on developing assessments or developing a curriculum document and they were in different locations, so because of the program, that's how she ended up, moving towards developing her area of expertise in technology. By creating Dropbox accounts for everyone to share files, she became the point person that was setting up that for her team and eventually her district.

Theme Four: Integration of Math and Science in the Classroom

Integration was a strong reason each teacher applied to the iSMART program. All of the teachers were able to integrate math and science concepts from the iSMART program as they were engaging with the content and they felt as they were they were growing in their knowledge of how to effectively engage students while doing this. A breakdown of the subthemes is listed in Table 9 on the next page.

Table 9

Subtheme Totals Per Teacher Supporting Theme #4: Integration of Math and Science

Code	Total	Ann	Reagan	Taylor	Misty
Integration	126	29	16	39	43
Research Based Strategies	34	6	4	6	0
STEM	24	12	4	8	0

STEM Content. "I'm a true math/science teacher, like give me a hundred problems to solve." That is how Ann describes herself. She works extremely hard to integrate the math concepts into her science units as she works with her PAP/GT students. She stated that the mathematics teachers at the GT Academy continually come to her and thank her for assisting them in preparing the students for the abstract concepts such as slope and linear equations found in Algebra I in 8th: Not only do the teachers recognize her ability to integrate the two contents to a greater degree, but her students do as well, now that she has moved up to the 8th grade content level. She shared that her students are thankful that she can teach them about slope and linear equations, and she is too…because she has kids that are taking three different math classes: eighth grade math, algebra one, and geometry. Her ability to be fluent in all three is crucial to their success in her science courses. Ann explained, in her first interview that in 8th grade every single

unit, with the exception of geology, has heavy math and kinesthetics and because of this, collaboration with the mathematics department is crucial in order to facilitate learning for the students on a deeper level.

For Ann, this is the third year of trying to integrate the math and science curriculum intentionally. Over the course of the past three years, she has found that integration is a challenge for some of her teachers and she is struggling to figure out how to move her teachers to the next level. She walked away from iSMART with a better understanding of how to lead her teachers in the area of cultivating relevancy with integration, as well as the need for developing more inquiry and discovery opportunities which ultimately comes back to her primary goal for her learning in iSMART." Her goal was to achieve a greater depth of incorporating the two [science and math] and to do this by applying research, current research" to her classroom practice. Using Davidson et al. (1995, p. 226) as her model she quoted him in her CUIN 7334 paper, "integration is needed to…develop relevancy and applicability of the discipline to the existing student experience and that students must see the two subjects as a relevant part of their world." Ann felt it was important to integrate not only math and science but also several subjects in order for depth to occur among our student body.

Ann has found that in order to increase the engagement with STEM activities it is important to really just find a way to be imaginative with classes. As Ann stated, the teachers focusing on STEM content at her school were having conversations about integrating the topics with math teachers in order to support science in that manner, in other words, getting their advice. They were struggling, even as young as sixth grade, with density, because the students had not had decimals. It was important to collaborate

for the benefit of the students in order to develop the STEM program and teachers' self-confidence to teach eighth grade because her school trying to focus on STEM integration.

Research Based Strategies. The reason Misty originally applied to the iSMART program was partly due to the cross-curricular approach to teaching science concepts: When she started looking into the iSMART program, she saw that the program was very good about outlining what the expectations were, even though it was the first cohort. The reflective teaching components, along with the cross-curricular & integration approach to teaching science concepts that could support each other were her reasons for initially applying to the iSMART program.

In her Integration Interview Assignment for CUIN 7334, Misty found that the students she interviewed were afraid of integration because it sounded like additional work. She explained that the student interviews were the most eye opening. She felt like the students had a true innocence about integration, in that reading articles or an outside source did not influence what they knew about integration. Their comments were raw and unedited. What bothered her most are the comments regarding integration were the comments that talked about how integration would, "make it harder for them to learn science and math". The responses they gave were their own thoughts and could not have come from anyone else, thus she found them to be very insightful and genuine. She realized from the beginning of her first student interview that she had to revise her line of questioning. She supported this belief in her coursework by using one of the research articles from the iSMART courses by Davison, Miller & Metheny (1995, p. 95) who purported that "a more pervasive problem is that integration means different things to different educators."

Misty stated that her eyes were open when one of the student's response to the first questions she asked made her "freeze" in her tracks and at that point she had to revise the line of questions she had prepared for him. This student began telling her that he did not know what the word integration meant; he knew what desegregation meant and the word integration sounded like the opposite of that. He continued to think about the word and stated that he thought it would mean combining the two subjects into one, which would mean learning both at the same time. From here he pondered if this would make both subjects that much harder. By him pointing out that the subjects would be harder, that let her know that he already felt that they were challenging subjects. Misty felt that the comments by the students forced her to start thinking about the logistics of an integrated science/math class. This pushed her thinking in this area about what research had been done (or needed to be done) to address this issue and how would this issue impacted math and science instruction and their integration. This led her to research the models of integration and she found that the articles selected for the iSMART courses helped her understand what integration is and what it would look like in a classroom. However, when she began her interviews for CUIN 7334, she began to realize the people that will be affected by integrating science and math seemed to open a Pandora's box of questions on her part.

For her Technology Grant Misty planned a lesson on Moon Phases, which was rooted in research based strategies and integration principles. She planned the lesson on the concept of moon phases because of the depth of struggle her students were going through in order to understand the scale factor involved. Misty pointed out in her technology lesson, "models used in the classroom sometimes lead to misconceptions

about the size and relative distances of the moon, earth, and sun." She addressed this issue with the use of the Ipad because with the use of the Ipad she could "focus on a topic in science that can be integrated with math to enhance the understanding of both subjects."

Using research-based strategies, she found that topics falling under space science are usually a challenge for students to master because they are considered abstract. It is hard for students to understand the concept when it is something that is not right in front of them and tangible. An integrated approach using a math concept such as scale factor can help students create scale representations of these objects. Using the full moon phase as the medium for teaching scale factor helped students see how math connects to their real world. Furthermore, a scale representation also led the way for students to learn about the other moon phases.

Using children's literature in the science classroom has been a way to integrate three different disciplines for Taylor. Taylor used the Martini & Abell (2000) article as her research based strategy for an integration lesson that she wrote. This article addresses lacing children's literature throughout the curriculum as a means to enrich and enhance a math or science concept. Taylor took one of her all-time favorite series of children's math books' Sir Cumference and the First Round Table (A Math Adventure) (Neuschwander and Geehan, 1997) [there are five other cleverly titled books in the series] to implement this strategy in her own classroom. In her Video Critique for CUIN 7334, Taylor, using the Martini & Abell (2000) article as a research based strategy, stated that, "literature based mathematics has the ability to engage students, encourage creativity and sense-making, and can reduce anxiety." She stated, "It's a lot less

intimidating to read a silly book about the volume of a cone in the Sword in the Cone (Neuschwander and Geehan, 2003) than to tackle it without a frame of reference that the book provides."

Taylor also shares that her students appreciates it when they can reinforce their math skills in her class within a student-centered environment, where students are able to share their ideas and thoughts in a collaborative manner while in a science class in order to bring alive aspects of the STEM program. It was from speaking with her students that anytime they were able to have math activities that are learner-centered, collaborative group interactive, moving and/or exchanging ideas, that the learning is more meaningful to them. They much prefer a student-centered learning environment. Taylor reflected on this as her vision for an integrated science classroom.

Theme Five: Transfer of Content Knowledge to the Face-to-Face Classroom

The transfer of content knowledge is prevalent for all four teachers in various ways through a variety of methods. The idea of exploring and creating in math through the use of the 5E lesson-planning model affected each teacher's practice. Each teacher addressed the increase of understanding in proportional reasoning content knowledge, as well as science content knowledge in different ways. Several assignments that were taught and discussed in the online setting during various content courses were found useful in strengthening not only the content knowledge of the teacher, but once implemented in the face-to-face classroom, successful in developing content knowledge of students. Each teacher expressed that they were able to utilize the activities from the iSMART program almost immediately in their face-to-face classrooms. Many of them are still implementing those activities, such as the OREO activity, each year to this day.

Table 10 lists the subthemes for theme five: Transfer of content knowledge to the face-to-face classroom and can be found below.

Table 10

Subtheme Totals Per Teacher Supporting Theme #5: Transfer of Content Knowledge

Code	Total	Ann	Reagan	Taylor	Misty
5E Model	40	2	9	16	13
Assessment	31	6	13	10	3
Critters Assignment	14	4	5	0	3
Curriculum	26	4	3	6	7
Manipulatives	28	8	11	9	0
Math Content	95	36	42	16	2
Misconceptions	39	18	16	0	5
Oreo Activity	6	3	1	2	0
Problem Based Learning	29	6	13	8	2
Proportional Reasoning	86	11	34	22	19
Santa Claus Problem	5	4	1	0	0
Science Content	50	10	10	28	7
Standards	27	3	2	20	2
Student Knowledge	104	12	42	41	9
TEKS	5	5	0	0	0
Transfer to F2F	83	19	23	38	3

The 5E Model. Reagan immediately implemented the 5E Model in her class after it was introduce to her that first semester in iSMART and found success with the concept of exploring, as well as creating those student explorations, not only in science, but in math. In her Discourse Assignment for the same course, Reagan talks about the use of the 5E model in a student-centered classroom and that the students need "buy-in for what they are learning about because very rarely are middle school self-motivated to learn. Teachers need to provide that authentic engagement activity that grabs their attention. If students are disengaged, they aren't learning." This led to one of the big 'a-

ha' moments for Reagan in using the 5E model: the idea of student exploration. She explained that her professor in CUIN 6346 just "kind of threw me in the water and said swim".

The idea has changed her practice ever since: "it wasn't anything specific to math or specific to science, but it was the idea of getting the students to explore more. Getting them to get that opportunity to try to figure it out on their own, without just spelling it out to them. Not just telling them "This is how it works," but setting them up to figure it out on their own. I got a lot of that out of the first semester. My professor did a lot, that's how he teaches science. He says, "Here's something, figure out what it is." You connect the dots, put it all together, and then you go "Oh, I get it!" I hadn't really taught that way in the past, even when I taught science. It was very much out-of-the-book, textbook teaching. I saw him teaching that way and I saw how much I could understand the content, so I thought my students could benefit from it, so I tried it."

For Misty the use of the Elaborate section of the 5E Model in a new and innovative way was what changed her practice. She had already used the 5E model in her classroom, but her professor's explanation of the Elaborate section (the fourth E) being considered a 'second Explore' changed her practice. He explained that the Elaborate section of the lesson should be 'when you apply what you should have learned right in that first Explore…therefore a second Explore.' This changed her approach designing lessons for her students so that now her second exploration is focused on applying the Explain section immediately. She was very curious and continuously thought about how her instructor was going to pull teaching a 5E model lesson off in an online environment. But he did. And he did it well. So she bought into it, which led her

more down the path of technology application in the face-to-face classroom. She believed that if her professor can do a 5E lesson online where her class needed equipment to test out things and share what they were doing in an online setting…than she could do it too. Her focus was increasing student engagement, so she targeted the standards were the hardest for students to master in science.

In a lesson she created for CUIN 6326 Misty describes how she utilized the 5E model with Moon Phases and scale factor in order to present a lesson that was truly integrated, but having an Elaborate #2. The Engage portion is where she first discussed with the students the terms diameter and radius. The Explore portion is where she had the students setting up ratios to compare the sun to the earth. In the Explain portion, students discussed their work and set up a proportion to scale down the sizes of the objects and students redrew their diagrams to the new scales. For the Elaborate portion, she elicited student responses about relative sizes between the objects. With the students' collaboration, the class defined scale factor and ratio. The use of the Ipad application assisted in randomly calling on students who will then used the Ipad to investigate how much bigger the sun is over the earth and moon. For the Evaluate portion, the students then engaged in discourse with her about what they would do if they were given even smaller paper. What if the paper only allowed for a Sun with a diameter of only 20 cm? Students had to have to apply what they learned about ratios and proportions to determine the appropriate distance between the Moon and Earth based on a given distance of 16 cm between the Earth and Sun. Again, the students redrew their diagrams based on the new diameters and distances. This lesson not only integrated math and science for her

students, but also technology, giving students a chance to elevate their understanding to a higher level.

Proportional Reasoning Content Knowledge. Ann considered herself both a math and a science teacher, but when she took her first course in the iSMART program her thinking was challenged in many ways. She specifically spoke a great deal about the computational assignments for the course that focused on proportional reasoning and how she was challenged her current mathematical knowledge. In one assignment that focused on visualizing various fractions from one diagram entitled, *Can You See It,* Ann expressed that it was extremely difficult for her to see 5/3 of 3/5 in the picture. She was able to see the majority of the fractions in the assignment, but she was not able to see how break up the diagram into the 40 sections based on the LCM until someone showed her.

Ann also expressed that throughout the entire course she found her content and pedagogical knowledge stretched in ways it had not previously been stretched. For example, in her work with interviewing students about their proportional reasoning skills, Ann learned that seventh graders were "confident in working with percentages and estimating" but she found that it was a struggle to analyze student work without the computations or students interviews with questions she chose. In hindsight, Ann learned the most from her mistakes with the questions. She believed that rewriting the questions with *how much* rather than *how many* would help the students develop relative thinking. How much focuses students' thinking on the part in relation to the whole rather than on an absolute quantity in and of itself.

In her fourth Self-Selected article, Reagan addressed the research that focused on who how students who build proportional reasoning knowledge through discovery as opposed to direct instruction. She wrote that the article reminded her CUIN 7334 Proportional Reasoning course in so many ways. She stated:

> It discussed different levels of proportional reasoning, just as we talk about in class. It focused on using proportional reasoning when it makes sense, testing the equivalence of two ratios and solving proportions to find an unknown. I was also surprised to read that students often applied unit-rate thinking to solve common ratio problems. My experience in the classroom has shown me that my students always fight having to find unit rates. I never realized how many different ways you can answer a ratio question, and I think it has started to become overwhelming. A question of a ratio can be so open-ended that I start second guessing if I'm stating it the right way – if I'm using the correct numbers to compare. I feel as if I'm in the middle of unpacking and repacking my knowledge of ratios! I was surprised to see that the ratio comparison questions were the most difficult for me to answer. I have always thought I had a strong handle on ratios. My students try two or three other ways to solve the problem [unit rates] first. They do not like having to work through the long division to find the unit rate, and they tend to get confused which number they are dividing into the other. Maybe I need to rethink the way I present unit rates, but I've rarely had success with getting students to use them.

Reagan's reflected that the most beneficial assignment for her from the iSMART program was actually the entire proportional reasoning course. However, if she had to

choose one assignment, it would be the Orange Juicy Problem. She chose that problem because that is “when a lot of us looked at it and we went ‘Oh!’" Reagan talks about the shift in her thinking about the content that was given during her time in CUIN 7334, “the Proportional Reasoning Course got us back into thinking you're a student again. You're putting yourself in your student situation, going into this thinking, "Oh, I already know math, this is going to be easy."

She realized quickly that in the iSMART program she was going to see mathematics from a new perspective and in a completely different way. It was very eye opening for her and it made a lot more sense to for Reagan. Integrating her prior content knowledge with the ability to question and draw conclusions has had the greatest impact. Instead of just accepting how things were done, she was getting to the why and from where they came from. The ideas behind the Proportional Reasoning activities and the moments she had with in class with her colleagues are what she is using in her classes most. Reagan agreed with the conclusion of the authors in her First Self-Selected Article, which was that the older students seemed to use proportional reasoning in non-proportional situations more than the younger students, resulting in fewer correct answers. She stated that she saw the iSMART cohort doing the same thing, “You get very comfortable using the formula to solve a problem; it turns into your default. You’ve done so well in the past with it, you do not even question if it’s appropriate.”

The Santa Claus Problem. Ann and Reagan both shared in their interviews that the Santa Claus problem had a deep impact on their practice. Since the teachers studied this problem in-depth for over a week, they found that they were able to take that problem, truly understand it, and apply the research based strategies from the article to

both their course work and her face-to-face classroom. They both found content and pedagogical knowledge embedded within the Santa Claus Problem that they did not know prior to studying it. Both teachers were able to grow in that content knowledge, as well as their pedagogical knowledge when they applied the research-based principles found embedded within this problem.

Ann explained in her second interview that when she was reading an article about the Santa Claus Problem where students had inaccurately applied proportional reasoning to a non-proportional problem she found herself doing the same thing as the students. The findings of the study, as she explained, were compelling as there was a very strong and deep-rooted tendency found among students to initially respond to the non-Proportional Reasoning problems with Proportional Reasoning answers. Additionally, the article went on the explain that the students tended to stick to the Proportional Reasoning model even when confronted with strong evidence that the model was incorrect for the given context. Ann recalled that it was the 'nightmare of the Santa Claus' because they focused on the problem for an entire week.

In her first Self-Selected article analysis, Reagan made an interesting connection to the Santa Claus problem that she has used with her students. She continued to reflect on the article and how it could impact her classroom practice by stating that the last surprise to her in the article was the mention of self-representations not effecting performance as not many students used them. She explained that she thought most students would draw a picture when solving proportional/non-proportional problems with shapes. She believes a picture is worth a thousand words when it relates to geometry and assumes "teachers would reinforce the use of pictures when working with elementary

school students since students haven't been introduced to many formulas". Given that the article stated that teachers needed to intervene early to help students better understand when something does or does not have a proportional relationship, the fact that the students did not use self-representations to help their solution reinforced the idea of early interventions.

Reagan had one final a-ha moment that she was able to transfer to her content understandings, as she explained in her summary. When she started writing her reflection, the fact that the circle was the easiest to solve still puzzled her. It wasn't until she started writing the last paragraph and she re-read the last section that she realized that all circles have to be proportional (just like all squares have to be). She wrote in her reflection "if the circle is anything else, it's an oval, and an oval is not proportional to a circle. The visual shape of the circle, forgetting about the confusing formulas, is the giveaway that the shape is proportional. A perfect example of how defaulting to formulas and not thinking through something can provide incorrect assumptions. Circles have never been easy for my students to work with. When you have to solve anything about it, you have to use pi and students always seem to confuse circumference and area. Working with circles all together has always been more difficult than rectangles or triangles. I've begun to second-guess my answers to proportional/non-proportional problems, which is a good thing because it is a check in my work."

So she drew an actual picture reflecting the question, and then she realized the question was relating to the perimeter of the field, not area. This meant that the total perimeter only increased by 3 times, so she calculated that the days increased by 3 times, not 9. At this point she was still uneasy, but she had a drawing and corrected logic to

back up her answer. Finally, Reagan wrote, “I enjoyed reading this article and found it relevant to what we’ve been studying in 7334. We were asked to solve the problem proposed in the article, and my first reaction was to multiply the days by 9. I thought back to the Santa Claus problem where each dimension increased by 3 times. You wouldn’t just multiply by 3, but you

Misconceptions. When it came to misconceptions, Ann believed that going through the coursework of iSMART her eyes were opened up to the value of using manipulatives and investigations in uncovering the misconceptions her students have. Ann also believes that is what made the transfer of the math content stick because when she became more open to the misconceptions that her students could arrive at she began to understand her math content in a new and deeper way. In her coursework Ann stated that, “I think the question was about the value of the sugar cube, and I guess I was wrong in my thinking just visualizing it, so after doing it. Doing it with my kids, it was like, "Oh my gosh. If I had this misconception." I had a lot of these eye-opening moments of misconceptions that I had personally, so that was probably one of the greatest things in uncovering those with my kids.” Ann has her own term for misconceptions now in her classroom…they are not be feared…but embraced and learned from. She calls them ‘bubble busters in her classroom now: “Misconception [are happening]. We joke around that I refer to them as my bubble busters. They know that the room is safe and the environment is safe to work through those misconceptions and they joke about some of them. We're always kind of questioning.”

When asked about her instructors and if they were able to gauge her understandings in class, Ann felt like they did a really good job of modeling how to

handle misconceptions. Two things come to mind for Ann as she did struggle a little bit with the math. First, she failed her midterm and it really uncovered a lot about how ill prepared she was as a teacher, and even as professional teachers. She knew her professor supported her but she struggled. The feedback she got from her professor was to redo part of the exam and take additional time to think through the questions, which is something she now does more with her students.

Misty, because of the iSMART program, started developing a whole set of science probes to find out what her students needed to be more successful in science. She started making her own for probes because she was being purposeful about misconceptions that her kids have. She realized this issue in the Proportional Reasoning (CUIN 7334) class where misconceptions were brought to the forefront as a need to always be looking for. The probes were developed out of a need to incorporate more writing. Even part of that was from being in iSMART, which made her be more open to the fact that her classroom was not just about science. It was more than that…and she needed to make connections to other contents and disciplines. They needed to see that connection--that relevance to their lives, which started beyond the misconceptions. It was the awareness of bringing in the math and the writing into the classroom.

The Critters Assignment. Ann and Misty both used the Critters Assignment from CUIN 6326 in their own classrooms and adapted it for the face-to-face classroom from the online setting. It was necessary to do teacher planning within their departments prior to implementing the activity. For Ann, she had her teachers go through the critters activity together first, in order to understand the activity and what misconceptions and student issues might arise prior to implementing it with the students. Then, they outlined

what the logistics would look like. For instance, every Friday the students would check on them and make their observations in their journals. They did it with seventh grade students and did it in their scientific methods unit, so the activity was implemented right at the beginning of the year.

The students had to keep journals and the teachers made folders for each student. The students were also put into collaborative groups and immediately, at the beginning of the year on Fridays, they were instructed to move into those groups for ten minutes and do their observations. This allowed the students to understand not only how to move to a small group setting quickly, but how to do the quantitative data with their observations through the Critter Project. Ann stated in her second interview that up until this past year her department was doing the critter assignment as part of their 7th grade curriculum.

Misty used the Critter Assignment as a way to meet state standards because currently in the 7th grade state standards students are expected to explore how organisms respond to stimuli. Given that the Critter Assignment is an exploration into how an organism responds to stimuli it was a natural fit. When the students were doing their tests for the activity, they were always looking for a response from them to a stimulus. This activity not only met the state standard, but it also provided the freedom to do any tests ones' imagination could create. The possibilities were endless and that is the sign of a great investigation and inquiry-based lesson. The inquiry has to come from the person doing the science.

Misty enjoyed the freedom that the Critter Project brought through the process of authentic experience and discourse. It pushed her thinking in her own classroom as she began to see that even her struggling students move into a more active role of discussion

with other students as they observed the critters and recorded those observations in their journals. Misty felt that using the Critters Assignment with those students enabled them to build self-confidence as they collaborated with their peers doing their observations and discoursing about their learning in a way other investigations had not previously been able to do. Misty also enjoyed the Critter Activity because it gave her an opportunity to have her students explore science inquiry. They could still be given the freedom to explore whatever tests they come up with, but in addition the project could be extended to discuss variables, controls, and in general what would make a good test. She liked that students create their own charts, a skill that they needed for science inquiry, as well as the recording of observations and reflections. According to Misty, "this was not a cookbook investigation since it allowed for the freedom to take it where you would want to take it." This activity also gave them time to discourse and allowed students to provide insight into the critters that other students maybe hadn't thought of yet. The beetles were also very cheap and very easy to maintain.

Misty reflected further on how the Critter Activity evolved as it entered into the district's curriculum as she realized the possibility of reaching all levels of students. This assignment was the first time she had used living organisms in the classroom in terms of critters. The experience with her science methods class, CUIN 6326, gave her a new approach to thread in observations of organisms throughout the entire curriculum by bringing in critters into the class. This led to a journaling activity for the 7th grade curriculum where when they came in, they had to make observations about their critters. Part of hers seventh grade curriculum at the time was students being able to make observations about internal stimuli, external stimuli and the opportunity to have a real

living organism, versus just reading about how mammals or how organisms respond, ended up being part of those explorations. That really changed how she thought about journaling and observations for her students. However, the one thing that she didn't anticipate is at the end of her unit was how to get rid of the critters. This led to a whole new piece of discussion surrounding invasive species. Now that's one of their eighth grade learning targets, and since it's at the end of the year, it is perfect timing for when they get to eighth grade. Having conversations about invasive species and how to release them became a new unit…and it pushed her thinking in how she was teaching science.

Theme Six: Transfer of Pedagogical Knowledge to the Face-to-Face Classroom

The teachers expressed that participating in iSMART didn't change their pedagogy overnight. However, it was a slow process of change and it was specific to the idea of getting kids to explore more in their investigations and through the use of discourse in the classroom. One thing that was of great importance was getting students to the place of trying motivation to figure knowledge out on their own, without giving them the answer. That was that the largest pedagogical shift for the teachers. This aspect of taking ownership of their learning was not only modeled for them during their first semester in CUIN 6326, but they began implementing it in their face-to-face classrooms soon after that. Ann recalled on this pedagogical practice, "I hadn't really taught that way in the past. It was very much out-of-the-book, textbook teaching. I saw them teaching it that way and I saw how much I would understand it, so I thought my students could benefit from that. I tried really to apply that in my classes."

Another aspect of the iSMART program that was utilized was the Video Critiques that they was asked to do during their time in iSMART. It was during those assignments

that the teachers would see what to do and what not to do with a class in terms of classroom management. The teachers felt that was a topic that was not addressed well-enough in pre-service preparations or in-service professional development, so having the experience of the video critiques allowed them to analyze teaching behaviors in a way they had not done previously. Taylor stated that, "anything that I found in iSMART, it just became a part of who I was as a teacher." This section will give exemplars of Theme 6 and the subthemes can be found below in Table 11 below.

Table 11

Subtheme Totals Per Teacher Supporting Theme #6: Transfer of Pedagogical Knowledge

Code	Total	Ann	Reagan	Taylor	Misty
Brain Based Learning	24	0	9	15	0
Constructivism	29	0	12	10	7
Differentiation	5	2	0	0	3
Feedback	27	0	5	20	2
Journals	18	8	3	9	0
Learning Styles	31	4	17	6	4
Learning Theories	42	2	11	35	3
Modeling	25	2	20	2	1
Multiple Intelligences	9	0	0	9	0
PAP/GT Students	33	12	6	13	0
Pedagogy	4	1	2	4	1
Reasoning Skills	29	8	14	4	3
Relevancy	40	8	16	14	2
Stations	8	0	0	6	2
Student Centered Learning	150	21	30	74	30
Transfer to F2F	83	19	23	38	3

Constructivism. For her final exam in EPSY 6340, Reagan wrote that constructivism is an appropriate construct to implement in the math classroom, if the pragmatic approach is taken as described by Perkins (1999). A characteristic of

constructivism is that learning occurs best in collaboration. She believes that almost all problems in math can be solved using different methods. As she has stated previously, when students share their solutions, the class can build an arsenal of problem-solving techniques to help out with future problems, as well as in other classes. She continued, "Many professional organizations have been working to get others to teach mathematics using the constructivist philosophy of learning. Constructivism has to do with the learner making sense of their world, and the learner is often engaged by a simple disequilibrium in their mind." She also addressed in her answer Dr. Ramsey's perturbation and the various ways to cause conflict in one's mind. Quoting Inch (2002) in her answer she stated " 'teachers should always be exposing students to new ideas that create discrepancies' (p.111), and I believe that they should also be there to help students resolve these discrepancies in meaningful ways." This use of constructivism and perturbation is consistent in her face-to-face classroom practice.

Reagan also selected an article to review in EPSY 6370 entitled "The Many Faces of Constructivism" by David Perkins. From this article Reagan was able to identify that even in a constructivistic classroom, there are different type of learners that need to be addressed and this is why there is variety in constructivism. This is another reason why Reagan differentiates her teaching methods, as well as allowing students to redo assignments if necessary. Using that understanding and her analysis of How Julie's Brain Works, Reagan talked about how teachers need to provide experiences for the student to learn. She also stressed the need for lessons to be engaging, with teacher-talk kept to a minimum. She understood the importance of student driven activity, including opportunities for students to provide feedback to each other. She stated, "With constant

feedback students can develop and elaborate on their learning quicker than relying on just teacher feedback." Reagan learned from this research that a lesson where the students are paired up, arguing the pros and cons of a certain problem solving strategy may work perfectly in her morning classes, but the design of the lesson may need to bring in more physical activity for her midday classes. This revelation boosted her confidence in knowing that her afternoon classes have a lack of energy that is not based on her class, but it is based on the chemical levels in the brain.. She reflected, "I've always wondered what caused that midday slump I find in my afternoon classes. Have I repeated my lesson period after period that by 2PM and I have no enthusiasm left in it? I evaluate the way I deliver the lesson and find that I'm more enthusiastic, trying to get my students to feed off of me. The article brought to light the scientific reasoning behind this slump, '…the nadir occurs 12 hours after the midpoint of last night's sleep.'"

Like Reagan, on her final exam for EPSY 6340, Taylor discussed constructivism and the struggles that she encounters with her students when she pushes their thinking. She feels that in science, ideally, constructivism is the "Vision 2" of her professor for CUIN 6326, AKA the 'Holy Grail,' of science teaching. She has found in her classroom that her students are so conditioned to "sit down, shut up, and do work" that they are flabbergasted when she won't just give them the answers! They are not too keen on days where she makes them talk about their learning and come up with their own answers. It becomes a battle of wills, they have no desire and she is very determined. She finds constructivism incredibly difficult and frustrating, but she loves the results when it is done. She believes, " it does take having a class that is willing to trust me, as the instructor and believe in me as their teacher, as well as be ready to take the risk of

failure". She found that "I had greater success with seventh graders than eighth graders. I would really love to see what kind of student this teaching would create from kinder to high school. Critical thinkers are tough to come by in middle school. It would be nice to see."

Feedback. Taylor also benefited greatly from the feedback from her instructors and this ultimately changed how she would assess her students in her own teaching practice. While working on her thesis work, her advisor spent a over a total of two hours over a period of several weeks helping her edit her thesis. She continued:

> The feedback and the comments that our instructors would give back to us on our papers was incredible and I loved it because it was very specific and it appealed to my meticulousness so that I can fix the problem that was there. I keep saying that to people, 'If I have an issue, there's a problem, let me know about it. I will fix it.' We don't, as a society, encourage each other in that way because again, if there's a problem, we see it as a character flaw instead there is an area that can be development.

Given all of the feedback that Taylor was given from her advisor and professors during the iSMART program, Taylor learned that feedback was important to the success of the students. In her work, she was more successful on assignments when her professors were more rigorous in their comments, even if the comments were harsh. Therefore, she transferred that pedagogical understanding to her classroom in an effort to assist students with their own coursework, as they are moving through high school and ultimately transitioning to college. In the classroom, she would initially show them the "slice and dice grade" but there was a "cushion within their grade book". She would offer

to her students the opportunity to redo the assignment based on the feedback she was giving them. Around 50% of her students would actually come back and tried again and she was really proud of them. She had a rubric with her written notes on the rubric, to show them what they needed to do in order to understand how to increase their understanding and not to just increase their grade.

Taylor developed a pedagogical practice of only taking grades on what they learned, which came from participating in in iSMART. Participating in iSMART also assisted in her developing the idea that the pathology of your learning should be reflected in your grades. Thus, Taylor explained that she didn't have enough grades for students to just blow off assignments, which is why she started giving feedback, doing detailed rubrics, and allowing student to redo assignments after having a conference with her. After the first major assignment in her class each year, students understood her process was about making them into better learners. Not only better learners, but also she was making them into learners who were taking ownership of their learning. Her students realized that she was invested in them when they saw the other teachers just accepting papers and not truly grading them with feedback…that is when her students really realized that they were learning at a deeper level in her class.

Teaching her high school students a new way to write didn't come easy and it took a great deal of patience and feedback, something that her professors had modeled for her as she went through the capstone writing process. She set up the submission process similar to what she experienced as she went through that writing process. She set up individual feedback conferences with every student she had. She did this to ensure that they knew exactly what they needed to work on prior to their final submission. The

conferences would 5 minutes. She would address structural issues like, "I need you to put the introduction and a good closing. I want to see what your resources look like." However, she would also point out formatting issues (and integrity issues) to help students in those areas as well, "Okay, you forgot to change your font so know that you cheated and cut and paste this so you have to come back. Make sure that it's all the same color because if you didn't change the font and there's different hyperlinks in there, I know number one that you copied and cut/paste, you cheated. She did that with each of her students when they submitted their paper. If they missed the mark, they had to resubmit a second time around, and it would be better. Her goal was that they learn from their mistakes so that when they have to do it for college, they would not make those same mistakes.

Student Centered Learning. Taylor spoke quite a bit about how her professor in CUIN 6326 modeled student centered learning for them throughout the course. At times she felt enlightened by his methods and, at times, she felt frustrated like her students would be later when she implemented the same tasks in her classroom. However, the modeling was continuous and beneficial in Taylor's eyes no matter what. One thing Taylor reflected on, with respect to modeling, was the Card Sorts that her professor introduced into the course. She wanted to implement those in her class, so she made her cards and she handed them to her students, but they kept asking her, "How do I do this? What am I supposed to do Miss Taylor? She felt like she was at a crossroads in her pedagogy with her students. She wanted to help, but she also wanted to change directions based on what she saw modeled in class. So she responded, "Mm-hmm (negative) you're on

your own." (Just like her professor modeled in class with her.) She continued to reflect on that first experience with Card Sorts and how her class got offended with her professor because he wouldn't help them figure out how to solve it. Some of them were able to get on board and help each other and they really love and appreciated it and then some didn't. But just like her professor, who didn't waver in his modeling with her class, neither did she. It was because of that experience that she was able to change her pedagogy. She may not have "always agreed with what he said or how he said it" but she "always could identify with what he did".

Her professor emphasized how the students needed to do the talking in order for that information to become their own. She recalls, "I think that set the tone for our cohort, one because we competed fiercely with each other to be the very best that we could and if somebody wasn't pulling their weight, we talked about it. There was conversation had. This helped her understand how to apply rigorous content and pedagogical strategies with her students through the use of student centered learning, mainly Card Sorts. In her second interview, Taylor continued to talk about how she has integrated this idea of 'play' in her classroom. She felt like her peers on her home campus didn't really appreciate the fact that her classes were fully engaged, but she truly felt that her students needed to have that time to talk about what they were doing. Referring back to the pedagogy she had learned in CUIN 6326, she shared that using Sorting Cards in her class helped take her students to a new level of understanding. It wasn't about just giving them another activity with the Sorting Cards, but how she gave them the activity.

In creating a student-centered environment, Reagan believes that "constructivist learning theory is key" and that the "student needs to take more control of his/her

learning so that the teacher is a facilitator, a guide, a reference point." However, when Reagan started with the program, her pedagogy was not based on student centered learning, " and it was very eye opening for her to be able to see other teachers' pedagogies in their classrooms, as well as how they handled things such as management techniques". She also benefited from seeing how the professors treated the cohort of students in iSMART, in the terms that they were their students.

Reagan learned during her time in iSMART that her teaching method was more direct method than in a student-centered method. She quickly realized that her direct teaching methods were not the best methods for students and she started adapting herself to what her professors were modeling for her. As she moved through the program, she began to see the shift in her practice and the effectiveness of student-centered instruction is. In her Studying Practice Assignment, Reagan spoke about how she uses a variety of instructional practices that were part of the content in the iSMART program and used to create a student-centered environment that fosters student engagement. She now intentionally seeks to build the lesson off her students' ideas and use their examples to better explain concepts. The open dialog of sharing experiences helps maintain engagement in the classroom as the students feel that it is their classroom as much as it is hers. Switching activities throughout the period also keeps the students engaged. She learned that teachers have a better chance of keep students' attention by taking the lesson and breaking it into ten-minute chunks.

Reagan has continued to develop her instructional strategies since iSMART because while she was in iSMART she was still a new teacher. She was just trying to get through it [the lesson, during her first two years of teaching]. She felt like she really did

not know how to do anything, considering that fact that the certification program was actually a two-week program and she didn't have a student teaching or shadowing experience. Her second year teaching she was given two contents to teach on top of trying to manage first time teaching responsibilities. Reagan stated in her midterm for CUIN 6326 that it is important for her to "create student-centered instruction as it meets everyone's needs." She believes that if instruction is just teacher-centered, then the students are only learning it in the strength of the teacher with little chance to ask for clarification. The focus should always be on the students rather than the teacher.

As she continued to write about her experiences in the classroom for the mid-term, she reflected on her time in iSMART to that point, 'I learn from my students every day how much of a difference it is making in their learning. A classroom consists of 20+ students and one teacher. Why should that one teacher have all the power and control in the classroom? Teachers exist for the students." Reagan now enjoys changing up her lessons every day, but per the suggestions from her content course instructors, she has made sure that the lessons are broken up into short blocks of time so that it is manageable for the students' to manage the learning. Her sixth grade classes are in a seventy-five minute block, which is a lot of time, since they are pre-AP students. Therefore, every ten to fifteen minutes she is changing up her lessons and doing something different with her students in order to keep the sense of urgency and student engagement piece going. She recounts, "There are days when I tell them, "Okay guys, this is going to be a long day. This is going to be thirty minutes; we're going to have to get through this. "

Since her graduation from iSMART Reagan has refined her practice, along with trying to balance district expectations, and teacher leadership responsibilities. She

reflected on her time, “It's an ongoing process [refining]. I am way more comfortable now just letting the kids go and try to figure it out. The balance between having to explain the why behind the content, just letting her students go and do, and then being able to bridge the gap. She has learned that her students can get only so far by just giving them the information. It is necessary to scaffold in all the questions and build in the knowledge through inquiry in order to ensure that they arrive where she wants them to in the end. Her kids are more excited about their learning, and they took more ownership to what they learned. Their learning tends to stick a little bit more than it did before

Research Questions

Both research questions corresponded with the themes that became evident after the data was coded and analyzed. The themes were developed from the responses of each of the teachers’ data analysis and represented as answers to each of the research questions. The relationships between the research questions and the themes are listed in Figure 3 on the following page.

Research Question 1: What transferred from the online program to the face-to-face classroom?

All of the participants shared their current perceptions about what transferred from the coursework and interactions to their face-to-face classroom practice. Each had aspects of the program that transferred from the six themes to varying degrees. All of the participants expressed that the most beneficial part of the program was the first semester that focused on content in both mathematics (the proportional reasoning content, focus on misconceptions, and the Santa Claus Problem) and science (Critter Activity, use of

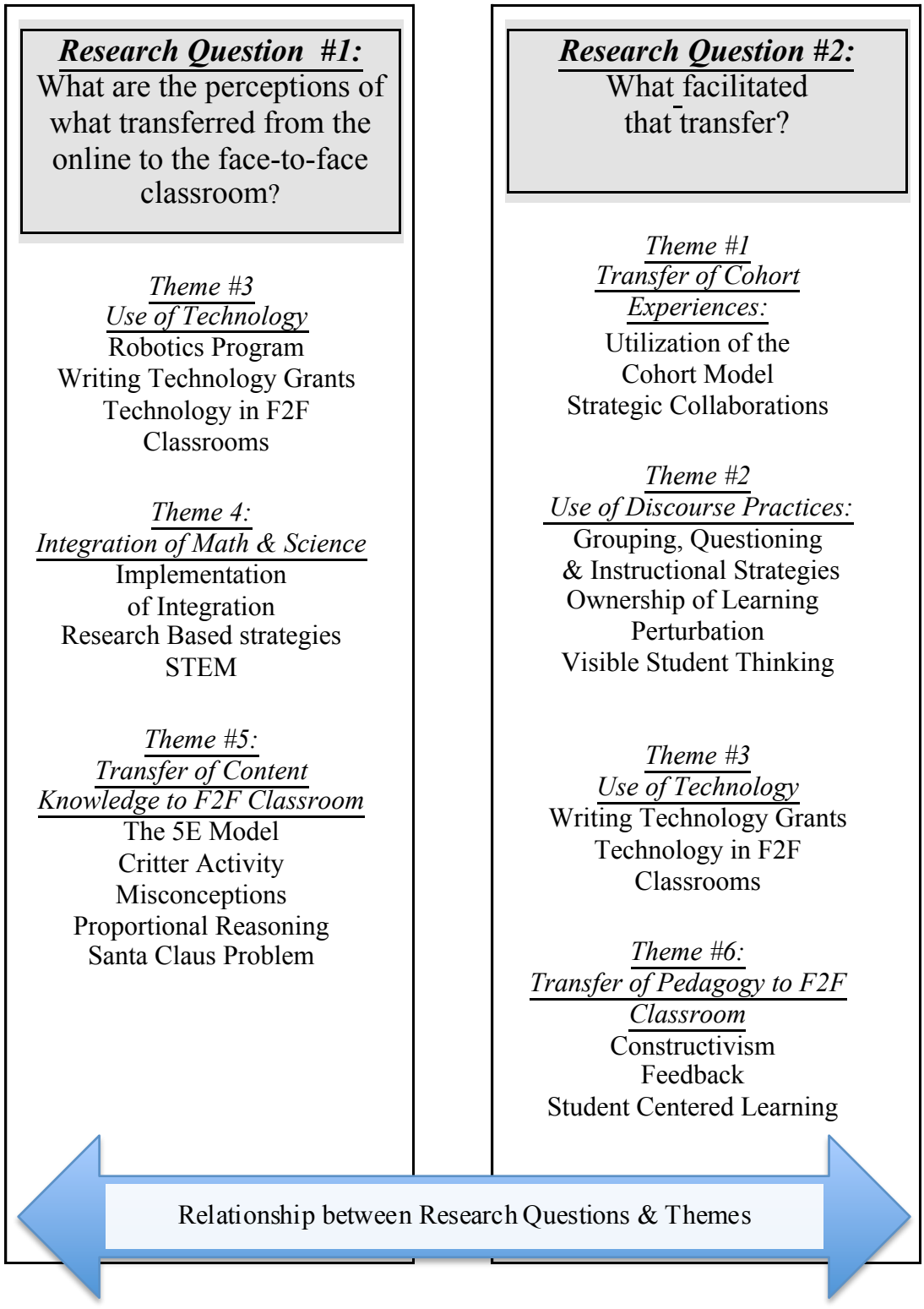

Figure 3. Relationship between Research Questions and Themes.

discourse and 5E model content). While two of the teachers felt strongly about the technological aspects of the use of technology, the other two teachers felt that the integration of the math and science content was more beneficial. It is worth noting that both of those courses came later in the program.

Research question 2: What facilitated that transfer?

With regard to how the professors presented the content in the courses, all of the teachers felt that the instructional strategies were transferrable to their face-to-face classroom practice. Additionally, the research-based strategies that were presented in each of the courses were used in facilitating the transfer of content to the teachers' classroom practice. As they began to identify areas of deficiency in their pedagogy during their online sessions with their classmates using the research based strategies, they were able to immediately implement them in their classrooms successfully and achieve growth in various areas.

With respect to theme #1: the transfer of the cohort, the teachers were able to utilize the both the experience of participating in a cohort model and being in color groups, as well as working in different groups online. They were also able to apply their experiences in moving through a program over the course of several years when they had students with which they would engage in that practice with as well. Additionally, as the teachers began to form strategic collaborations within their districts and schools they were able to utilize their experiences with their colleagues in the program from other Districts and possibly other states to enhance their understanding of how to function in that type of setting.

Not only did Theme 2: Use of Discourse Practices transfer from the online program to the F2F classroom, but it also served as a facilitator of that transfer once the teachers understood how to maneuver the sometimes choppy waters of discourse and argumentation. All of the teachers expressed that their experience the first semester with discourse was eye-opening. They were able to make a dramatic shift in how they led and structured their lessons almost immediately. Not only did they see their students begin to hold themselves accountable in how they discussed the content within the class, but the teachers began to question and group their students more effectively. When the teachers began questioning their students at a deeper level and were willing to allow students a chance to question each other they found that they had richer classroom discussions and greater success with their students. As they moved through the program the teachers learned more about other facets of education including: a) educational psychology, b) brain based learning, c) multiple intelligences, d) how to create perturbation with students, and e) visible students thinking. All of this added to their understanding of how to increase student engagement and facilitate a student-centered classroom while capitalizing on higher ordered thinking skills.

The teachers also felt very strongly that Theme #6: the transfer of pedagogy to the F2F classroom not only a strong theme for them during their time in the iSMART program, but the sub-themes also served as a facilitators of transfer. A common trend among the teachers involved the continual use of the constructivistic classroom environment, even in the online setting, by their professors aided in their understanding of how to better cultivate that environment in their classroom. Through the use of video and research articles that the teachers were assigned, the teachers felt that they benefited

from an in-depth study across multiple courses of how to structure a student-centered classroom based on constructivistic thinking. Additionally, three of the teachers spoke about how important the feedback process during the program was to them and how they transferred that to their own practice. One teacher in particular implemented it not only in her practice, but implemented a Capstone Project, similar to what the iSMART program engages in, so that her students would be more prepared for what college would require them produce. Ultimately, all of the teachers understood more deeply how important feedback was because of the level of feedback they were given, thus treating their students as they were treated.

Summary

In this chapter, the data collected from this study was presented. As each of the teachers reflected on their experiences during their time in the iSMART program, their responses were analyzed, along with the body of their coursework. From this data, six main themes emerged from the descriptions of their experiences, supported by their coursework. The first theme that because evident was the transfer of the cohort model and included four subthemes: a) authentic experience, b) building relationships, & c) collaborations. The second theme that surfaced from the experiences shared by the participants was the use of discourse practices in the face-to-face classroom, and included seven sub-themes: a) investigations, b) ownership of learning, c) perturbation, d) questioning strategies, e) safe environment, f) student engagement, & g) student thinking. The third theme that developed was the integration of math and science in the classroom, and contained three sub-themes: a) research-based strategies, b) STEM, & c) understanding of integration. The fourth theme was technology use in the face-to-face

classroom, and contained the following four sub-themes: a) digital stories, b) robotics, c) technology grants, & d) technology application in face-to-face. The fifth theme that evolved from the data analysis was the transfer of content knowledge to the ace-to-face classroom. This theme contained 16 sub-themes and the most prevalent were: a) Critter assignment, b) proportional reasoning content, c) misconceptions, d) Santa Claus problem, & e) use of the 5E Model. The sixth theme was the transfer of pedagogy to the face-to-face classroom. This them also contained 16 themes and the most prevalent were: a) constructivism, b) feedback, c) modeling, & d) student centered learning.

Within each of the six main themes, commonalities emerged the participants' lived experiences. All of the participants had a positive experience of learning both mathematics and science content the first semester during iSMART and felt that those courses were the most beneficial. They also believed that the use of technology throughout the program stretched their thinking in how to utilize it in their own classroom. They also felt that the focus on research-based strategies, as well as the professors' modeling of their instructional strategies in the online setting was an effective part of the learning. They were able to take that part of instruction, while not necessarily intentional, and apply it to their own practice. Each teacher, as shown through the data, recognized the need to present mathematical and science concepts in different ways to help students better understand and attain mastery while allowing time for students to practice and ask questions during instruction. Thus, the teachers also shared that now, because of iSMART, they are more open to the way they ask questions with their students. Collectively, the teachers expressed that they were also more willing to try new things in their classroom now because of their time in the program, such as using new

grouping strategies. Each teacher expressed that they felt that their time in the iSMART had been beneficial and transformative. They did not regret the decision they made to apply, engage in, or graduate from the program.

Chapter V

Interpretation, Discussion, and Implications

The essence or nature of an experience has been adequately described in language if the description reawakens or shows us the lived quality and significance of the experience in a fuller or deeper manner [van Manen, 1990, p. 10].

In this phenomenological study that focused on the experience of teachers that participated in the fully online Masters program, iSMART, teachers were defined as teachers who had graduated from the first cohort of the program. These teachers were middle school mathematics and science teachers who had at least two years of teaching experience prior to entering the iSMART program and were committed to integrating math and science in their face-to-face classroom. By choosing a phenomenological research approach the researcher was able to gain rich data through the exploration of the how and why each of the teachers perceived transfer from their prior participation in the iSMART prior and how that participation affected their classroom practice. The theoretical framework that guided this research study came from transfer literature, and more specifically the transfer literature that focused on the teaching and learning of educators. The researcher collected data from four teachers, which included each teacher's entire body of iSMART coursework available, iSMART surveys, and two individual interviews with each teacher. The researcher used the two following research questions to guide the study:

For middle grades mathematics and science teachers in an online M.Ed. program, what are the perceptions of:

1. What transferred from the online program to the face-to-face classroom?
2. What facilitated that transfer?

In order to gain the most insight into the lived experiences of the teachers, two interview protocols were developed. Analyzing the course document documents for each teacher created the first interview protocol. However, the first interview protocol was the same for each teacher and specific questions were not addressed unless the teacher addressed them first in the interview. The second interview protocol was specific to each teacher and was based on the first interview transcript analysis and both the primary and secondary course document analysis. During the content analysis on the course documents specific to each teacher while creating the second interview protocol, (Carspecken, 1996), the researcher was able to extract more data into what the teachers learned and transferred during the courses of the iSMART program. This was based on instructional strategies found in the transfer of learning literature in the theoretical framework and located in Table 12 below in order to answer research question #2: What facilitated the transfer of learning from the online program to the face-to-face classroom?

A third course document analysis was conducted after the second interview transcript analysis had been done. From the data obtained during the analysis of each teachers' body of coursework, surveys, and individual interview transcriptions, the researcher illuminated six themes that described the teachers' perceptions of transfer from the online program, as well as what facilitated that transfer.

This chapter discusses the findings that emerged through the current study, and how the literature correlated with, the transfer of learning from online setting to the face-to-face classroom practice of mathematics and science teacher. This chapter also provides implications for practice within the field of teacher education, as well as recommendations and considerations for future research.

Table 12

Instructional Strategies That Contribute to Transfer of Learning

#	Instructional Strategies that Contribute to Transfer of Learning	Research Supporting the Use of The Strategy
1	Sets expectations or states purpose for content/pedagogy	Hill, et al., 2008; Guskey, 2000
2	Activates prior knowledge	Lobato, 2003; Halpern & Hakel, 2003; Bransford, Brown, & Cocking, 2000; Bransford & Schwartz, 1999
3	Addresses misconceptions	diSessa & Wagner, 2005; Singley & Anderson, 1989
4	Prompts learners to content/pedagogy characteristics	Haskell, 2001; Brouwer & Korthagen, 2005
5	Uses context-rich examples	Gick & Holyoak, 1983; Reed, 1993
6	Provides oral/written feedback specific to teachers' use of content/pedagogy	Bransford & Stein, 1993
7	Provides opportunities for teachers to practice employing the content/ pedagogy in relevant ways	Konkola et al., 2007; Benander & Lightner, 2005; Halpern & Hakel, 2003; Perkins, & Salomon, 1994
8	Engages teachers in dialogue or discussion	Cobb, 1994; Brown, Collins, & Duguid, 1989; Greeno, Moore & Smith, 1993; Lave, 1988
9	Provides constructivist opportunities & collaboration	Rittle-Johnson, 2006; Curry & Sumrall, 2006; Beach, 1999; Macaulay & Cree, 1999
10	Allow for self-reflection & metacognition	Bransford, Brown, & Cocking 2000; Canton, 1998; Perkins & Salomon, 1994; Gick & Holyoak, 1980, 1983
11	Models content/pedagogy in the same way teachers are expected to use it	Wilson, 1993; Lave & Wenger, 1991
12	Provides support/encouragement related to teachers' use of content/pedagogy	Baldwin & Ford, 1988

Discussion of Findings - Essence of the Experience

In recent years, there has been a shift in education to the online environment. Given this shift in teaching and learning from the face-to-face classroom to the online environment, there is a need to understand the lived experience of middle grades mathematics and science teachers as they engage in online learning and subsequently transfer that learning to their face-to-face classroom. Understanding how these teachers of mathematics and science content acclimate themselves to the environment, as well as transfer their learning to their face-to-face classroom is a crucial piece to constructing high-quality professional development for both pre-service and in-service educators. Research reveals that instructional practices of the instructor can facilitate transfer to a greater degree (Guskey, 2000). Additionally, the ability to collaborate with peers (Lowery, 2002) and the contextualization of the content within the online setting (Haskell, 2001) will either accelerate or hinder transfer with online learners. In this research study, the online learning of in-service middle grades mathematics and science teachers that graduated from a fully online M.Ed. program was studied.

The two research questions used in this study served as a guide to examine the perceptions of transfer from the online program to the face-to-face classroom by the teachers. The first research question examined how each of the teachers perceived what transferred from the online program to the face-to-face classroom. Although each of the teachers had different experiences while in the iSMART program, taught different grade levels, as well as content, a commonality appeared in that the teachers perceived that they were able to transfer their learning almost immediately to their face-to-face classroom, especially from their first semester. The program challenged the teachers to see beyond

what was currently being done at their campuses in an effort to push the boundaries with research-based strategies (Baldwin & Ford, 1988). Several of the teachers began new initiatives within their districts that changed the way their districts operated technologically, thus operating at the displacement level of transfer (Haskell, 2001).

Additionally, the professors of the iSMART program modeled various research-based strategies (Lave & Wenger, 1991; Wilson, 1993), such as the use of constructivism and discourse during their courses, that were utilized either by the teachers almost immediately in the face-to-face classroom at the application level (Haskell, 2001) by all four teachers. In doing this, the teachers were also able to increase their understanding of various pedagogical understandings that the professors both modeled and presented in relevant and appropriate ways (Wilson, 1993; Lave & Wenger, 1991) during the synchronous sessions, such as the use of manipulatives and Card Sort activities. Additionally the teachers felt that the feedback (Bransford & Stein, 1993) they received on coursework completed during the iSMART program assisted in developing both content and pedagogical knowledge and strategies (Lowery, 2002) that they have been able to implement in their classrooms (Brouwer & Korthagen, 2005).

The teachers were also able to transfer that knowledge, at the application level (Haskell, 2001; Calais, 2006), to the face-to-face classroom with little to no change from the online environment, as with the pedagogical understandings and the use lesson planning strategies, such as the 5E model. The teachers were excited that each week their classroom was changing because they were seeing growth in their self-efficacy and in their students. The teachers who successfully implemented these changes also found that they were able to increase student centered learning and engagement, which led to an

increase in student knowledge and student thinking (Tschannen-Moran, Woolfolk-Hoy, & Hoy, 1998). In some instances, students discovered new approaches to their learning and took ownership of their learning to a greater degree, which in turn increased student achievement and persistence (Ross, 1995). Once this began to occur the teachers moved to the near transfer level (Haskell, 2001), as they began to implement more challenging tasks and projects with them (Lowery, 2002).

Several of the teachers changed the way they facilitated their day-to-day teaching practice because their experience with using discourse in their own coursework during the iSMART program (Cobb, 1994; Lave, 1988). This led several teachers to understand the need to present their students with coursework that promoted perturbation in order to challenge their thinking through the use of problem based learning, investigations, and inquiry based learning (Guskey, 1998). Finally, in order to set the stage for facilitating discourse in their classroom, the teachers stated that 5E Lesson planning (Hill, et al., 2008; Guskey, 2000), coupled with observing their professors setting a safe environment, using strategic questioning and grouping strategies (Rittle-Johnson, 2006; Scott & Baker, 2003), while capitalizing on providing authentic experiences that were linked to past learning experiences (Freed, 1998) were important aspects that they transferred from their coursework and experiences while in the program. Despite whether the teacher was a mathematics or science teacher, they expressed the ability to transfer content and pedagogy to their face-to-face classroom with little to no hindrance (Pugh & Bergin, 2006, Bandura & Cervone, 1983).

The second research question focused on what facilitated the transfer of learning from the online program to the face-to-face classroom. Several of the teachers in the

program expressed that they were able to benefit from participating in a cohort model, as they had looped with several groups of students either during the time of iSMART or since graduation. The experience of participating in a cohort model allowed them to understand how to meet the needs of individual students that struggled or needed individual help in various ways to a greater degree when necessary (Halpern & Hakel, 2003; Perkins & Salomon, 1994). Additionally, it allowed them to capitalize on student's prior knowledge in an effort to be able to teach with greater depth given the knowledge the teacher had about the capabilities each student had, thus pushing student thinking further each year the teacher had that student (Lobato, 2003; Halpern & Hakel, 2003). Although most of the teachers had familiarity with using technology, most did not use technology in their classroom in an integrated manner, but were seeking to do so prior to entering the program and wanted to increase their personal teaching efficacy in that area (Baldwin & Ford, 1988; Ashton & Webb, 1986; Mezirow, 1981;

All four teachers expressed that during that first semester they were able to transfer their understanding of discourse, whether they were teaching mathematics or science, given that this concept was taught in the science methods course. This concept transferred to the face-to-face classroom followed each of Guskey's (2000) five levels of transfer as the teachers moved through the program: a) near, b) routine/lateral, c) vertical, d) integration, & e) renewal (Haskell, 2001). Each of the teachers stated that they transferred their understanding of how to utilize discourse in their classroom for the first time during their first semester. Starting at the first level, near transfer (Haskell, 2001), the teachers discussed that as soon as they explored this method in their online coursework they implemented it in their face-to-face classroom practice with little-to-no

issues. As the teachers moved to the second level of transfer, routine/lateral transfer (Guskey, 2000), they began to make small changes in the way they were both planning and presenting their lessons using discourse.

The fact that they found success quickly in this area was also aiding in their self-efficacy in both the iSMART program and in their teaching practice by overcoming factors that could make learning difficult for students (Ashton & Webb, 1986). This increase in self-efficacy while using discourse strategies with their students provided another level of transfer, the vertical level (Rebello, Cui, Bennett, Zollman, & Ozimek, 2007), as they began to understand how discourse strategies impact the learning of their students and they were adapting that learning to better both themselves and their students (Curry & Sumrall, 2006). This further allowed three of the teachers to move to the integration (Guskey, 2000) level of transfer by evolving their teaching strategies with discourse and developing new instructional practices (Halpern & Hakel, 2003), such as higher order questioning and grouping strategies (Beach, 1999) with the discourse. One teacher moved to the fifth level of transfer, the renewal level (Guskey, 2000), by applying the use of discourse to professional development activities with the teachers she works with.

Following the same pattern as the use of discourse, constructivism was another aspect of the program that was taught in the courses as a concept, but also experienced by the teachers as the same time. This double effect produced a higher level of transfer as the teachers were able to engage with constructivism in different ways without hindrance because of the experiences they were having in class, which brought about a new level of understanding. Because of the collaborations the teachers were having in class (Rittle-

Johnson, 2006), they were not only learning better, but they were learning with teachers from other content areas and grade levels which enhanced their understandings and increased their self-efficacy at the same time. This transferred to the face-to-face classroom because the teachers were constantly in a state of perturbation in the problem, which was intentional and transferred to how they saw their own classroom.

They were no longer afraid of what their students would do if they were to set forth a new idea that would create discrepancies in their students' minds. They had the capacity and self-efficacy (Zimmerman, 2000) to be there for their students to help them resolve discrepancies in meaningful ways. That use of constructivism and perturbation was consistent in their face-to-face classroom practices and helped them identify the different types of learners that needed to be addressed because they were constantly working with different types of learners in their own program (diSessa & Wagner, 2005). It was this type of re-shuffling in the grouping strategies and variety in constructivism that developed their ability to differentiate their teaching methods and provide student-centered lessons with their own students (Benander & Lightner, 2005).

Limitations of the Study

This study analyzed the perceived transfer of four graduates from an online M.Ed. program in education through the use of multiple interviews and course document analysis. As with any study, there were limitations that were present with the research. There are several factors that may impact the emergence of differing themes in future studies. This study included all females. Having a study that may include a male perspective could lead to different results in the research. Other factors that could alter the results of the research may include the location of the university that offered the

degree. The university used in this research is in a southern state in an area affected by poverty. The racial, cultural backgrounds of the students and parents might produce alternate research results. Race was not a part of the researcher's results.

Time constraint of the research was another limitation that may have influenced the study. By having a somewhat limited timeframe available may have resulted in inadvertently restricting the population. During the recruitment process, there were several iSMART graduates who were interested in participating in the research but there did not commit to a time or date for an interview, even with the researcher providing a flexible schedule.

The experience of the researcher regarding the research process or with interviews is a limitation to the study. Prior to this study, the experience the researcher had relating to phenomenological research was nonexistent. A researcher with more experience conducting phenomenological interviews may have been able to extrapolate more from the data gained from the teachers.

Implications of the Study

Spanning four cohorts, The iSMART program has provided a vehicle for 96 in-service middle grades mathematics and science teachers to attain their M.Ed. The online component is new territory for mathematics and science teacher educators to forge, especially in content courses. However, given that our society is becoming more technologically focused every day, it is important for teacher educators, alongside those who offer professional development, to find avenues to bridge the face-to-face instruction with success of educating teachers online. It is also important to continue to the work of researching how various instructional practices are affected by the online environment

with respect to how they will transfer to the face-to-face classroom, especially with the middle grades mathematics and science teacher (eg. the use of manipulatives and hands-on investigations). This research study seeks to add to that body of research.

Additionally, this research study focused solely on in-service teachers. While research with in-service teachers is of great importance, it is necessary to understand the specific needs and ability to transfer those instructional practices, content knowledge, & pedagogical understandings with pre-service teachers in an online setting. Given that they would not have had previous experience in a face-to-face classroom to draw upon while they are in the online setting, as an in-service teacher would have. It will be important to consider what modifications in curriculum would be necessary when constructing course content with respect to pre-service teachers in order to be sensitive to those needs but also to not lose the rigor of a program that contains the content and pedagogical understanding necessary for the pre-service teacher. With this research study showing that the instructional practices in an online setting parallel face-to-face instructional practices, it is now even more relevant to attend to how specific mathematics and science content can be interwoven into this puzzle.

Summary

As education moves more into the online educational setting, it is important for the education of middle grades mathematics and science in-service teachers to follow that trend. Prior education of mathematics and science teachers has included the use of manipulatives and inquiry based learning through the use of labs and investigations. A shift to online learning would be influenced by these methods, as teaching with the methods are effective instructional practices for the face-to-face classroom. Finding

ways to both model and communicate this type of content knowledge, in both relevant and engaging ways, with mathematics and science teachers in the online setting is important if transfer of learning is to be achieved. Thus, the perceptions of middle grades mathematics and science teachers' perceptions of what transferred from participating in an online program and what facilitated that transfer are important when considering the online education of teachers.

This study revealed that the in-service teachers perceived that the iSMART courses presented content knowledge that transferred to their face-to-face classroom, as well as the professors' pedagogical understandings that were both modeled and displayed during their time in the iSMART program. Additionally, the use of technology added to their understandings of how to facilitate technology in strategic ways in the face-to-face classroom environment. The understanding of what the integration of math and science is, while still a challenge for all of the teachers, has been implemented in various ways both during and since graduation from the iSMART program. The experiences that the teachers' had facilitated a transfer of learning to the face-to-face classroom through the use of discourse, actively engaging in a cohort model and collaborating, through the use of technology, and through the use of various pedagogical understandings that were presented during the coursework. This research will further add to the growing body of research in the area of online learning for teachers—in an effort extend their knowledge of effective teaching practices in order to increase their capacity as teachers—for the betterment of their students and future students alike, so that they have the proper training and resources to learn.

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Appendix A

IRB Approval Letter

UNIVERSITY of HOUSTON

DIVISION OF RESEARCH

November 3, 2015

Kimberly Hicks
c/o Dr. Jennifer Chauvot
Dean, Education

Dear Kimberly Hicks,

The University of Houston's Institutional Review Board, Committee for the Protection of Human Subjects (1) reviewed your research proposal entitled "MATHEMATICS AND SCIENCE TEACHERS' TRANSFER OF ONLINE LEARNING TO A FACE-TO-FACE CLASSROOM ENVIRONMENT" on August 21, 2015, according to federal regulations and institutional policies and procedures.

At that time, your project was granted approval contingent upon your agreement to modify your protocol as stipulated by the Committee. The changes you have made adequately fulfill the requested contingencies, and your project is now **APPROVED**.

- **Approval Date: November 3, 2015**
- **Expiration Date: November 2, 2016**

As required by federal regulations governing research in human subjects, research procedures (including recruitment, informed consent, intervention, data collection or data analysis) may not be conducted after the expiration date.

To ensure that no lapse in approval or ongoing research occurs, please ensure that your protocol is resubmitted in RAMP for renewal by the deadline for the **October, 2016** CPHS meeting. Deadlines for submission are located on the CPHS website.

During the course of the research, the following must also be submitted to the CPHS:

- Any proposed changes to the approved protocol, prior to initiation; AND
- Any unanticipated events (including adverse events, injuries, or outcomes) involving possible risk to subjects or others, within 10 working days.

If you have any questions, please contact Samoya Copeland at (713) 743-9534.

Sincerely yours,

Dr. Lorraine Reitzel, Chair
Committee for the Protection of Human Subjects (1)

PLEASE NOTE: All subjects must receive a copy of the informed consent document, if one is approved for use. All research data, including signed consent documents, must be retained according to the University of Houston Data Retention Policy (found on the CPHS website) as well as requirements of the FDA and external sponsor(s), if applicable. Faculty sponsors are responsible for retaining data for student projects on the UH campus for the required period of record retention.

Protocol Number: 15455-01 Full Review: X Expedited Review: ___

316 E. Cullen Building Houston, TX 77204-2015 (713) 743-9204 Fax: (713) 743-9577

Appendix B

Post-Graduation Survey

UH- iSMART Post-Program Survey [Distributed in Qualtrics]

1. Full name:
2. What school will you be working at for the 2015-2016 year?
3. If you are not at a school., please describe your current employment position. (Please explain why you are no longer teaching.)
4. When you were in the iSMART program you were a _____ (math, science or both) teacher
5. What cohort of the iSMART program were you in? (I, II, III or IV)
6. How many total years (not including the 2015-2016 year) have you been teaching in the K-12 setting?
7. Describe your employment/career path since graduating from iSMART.
8. Do you believe that iSMART has had an impact on your career trajectory since graduation? (Yes or No)
9. Please give examples of how the iSMART program has had an impact on your career trajectory since graduation.
10. To what extent (if any) do you attribute the change to your experiences within iSMART?
11. Since iSMART, in what ways (if any) have you taken on teacher leadership responsibilities? (List by year.)
12. What OTHER ADDITIONAL NEW responsibilities have you taken on since you have graduated from the iSMART program? (Please list as many as you can by ACADEMIC year.)
13. Would you be interested in participating in a research study about iSMART? (Yes, No, Maybe)

Appendix C

Recruitment Email

iSMART GRADUATES

Dear recent graduates of iSMART,

I hope this is finding you well and enjoying the new school year. I was wondering if you could take some time to fill out a post-program survey for iSMART that the research team would like to gather some information with. Additionally, there is an opportunity for you to participate in a research study about your learning in the online component of the iSMART program at the end of the survey. The survey should only take you about 15 minutes and if you are interested in helping out with the research study please check yes at the end of the study.

Your decision to either help or not help with our research study will not affect your relationship with the school or the iSMART program in any way. Additionally, if you check yes and find that you can't help out, you can choose to decline the offer later on. We would just like to get an idea of who is willing and able to participate in a study about how you have learned and how you have transferred that learning to your face-to-face classroom. So, if you can and are willing to help…let us know!!!

Thanks in advance for helping with the survey, as always!

Sincerely,

Kimberly Hicks
iSMART Researcher

This project has been reviewed and approved by the University of Houston Committees for the Protection of Human Subjects (713) 743-9240

Taking part in this study is completely voluntary. You may skip any questions that you do not want to answer. If you decide not to take part or to skip some of the questions, it will not affect your current or future relationships with the University of Houston. If you decide to take part, you are free to withdraw at any time.

Appendix D

Interview Protocol #1

All Teachers

Interview Protocol #1

TOPIC DOMAIN 1: Experiences in the Classroom Setting of an Online Program - iSMART

Lead-off Question:

Talk to me a little bit about how your experience of learning and contributing IN the context of the online program iSMART was.

Possible Follow-up Questions:

- What do you believe contributed to your freedom of sharing in your online classes?
- Can you give me an example of how you were able to share with your classmates and it was received?
- What do you believe hindered you in your freedom to share in your online classes?
- What happened when your freedom to share was hindered?
- How did you adjust your perception of your instructor and classmates after that experience?
- How has that affected your instructional strategies with your own classroom?
- Did you see a change in your sharing between the first semester and second semester? First year and Second year?
- If yes, why and was it is both classes? If not, which one and what do you think contributed to you moving forward in that class?
    - Think about your experiences collaborating with the other students in your cohort. Did you transfer anything that you learned from them to your face-to-face classroom?

TOPIC DOMAIN 2: Coursework in the Classroom Setting of an Online Program – iSMART

Lead-off Question:

You were in the iSMART Program for two years and took a number of courses. Can you share with me some of the highlights in coursework and some of the missteps from your perspective?

Possible Follow-up Questions:

- In which classes did you feel you could share your beliefs without reservation and why?
- In which classes did you feel you could discuss topics without criticism and why?
- In which classes did you feel that there was a variety of activities that were helpful or applicable for your curriculum and why?
- Did you find certain coursework helpful to use with your students?

- Was course content aligned with the course assignments and did you find that it assisted in your teaching assignment?
- How is preparing for an online class different than a traditional class?
- Looking over the two years that you were in iSMART, which assignment do you feel challenged you the most as an educator?
- Which assignment challenged you the most in your content knowledge?
- Which assignment challenged you the most in your pedagogical knowledge?
- Which assignment changed you the most as a person working with children?
- If you could modify one assignment, what would it be and why?
- Which assignment changed YOUR CLASSROOM the most…it had the greatest impact on your students.
- From what courses did you transfer your learning to your face-to-face classroom?
- From what assignments in those courses did you transfer that learning?
- How did you utilize that learning? Give examples from your classroom teaching.
- How did your students respond to those face-to-face classroom experiences?
- Think about your experiences in the cohort model of the iSMART program, did you utilize your experiences in that form of a program in your face-to-face classroom?
- Think about your experiences in Blackboard Collaborate and the online classroom environment. Did you transfer any of your classroom environment experiences to your face-to-face classroom environment?
- Think about your experiences with your professors and their individual pedagogies and/or teaching strategies. Did you transfer what they used in their online classroom to your face-to-face classroom environment?
- Think about your experiences collaborating with the other students in your cohort. Did you transfer anything that you learned from them to your face-to-face classroom?

TOPIC DOMAIN 3: Transfer of Learning - Experience in the Online Program – iSMART instructors' instructional practices

Lead-off Question:

I am interested to know about what you learned from your instructors' modeling face-to-face instructional practices in an online setting. Can you tell me more about how you learned from your instructors' modeling instructional practices in the online setting?

Possible Follow-up Questions:

- Was it difficult to take what they were doing in the online setting and then utilize that in your face-to-face classroom?
- You mentioned that _____ assignment was important to you. Can you tell me more about that?
- I am interested in hearing about how your instructors' modeled inquiry-based lessons in the online setting during their instruction. Did you feel that they did

this adequately in order for you to understand how to do this in your face-to-face classroom?

- How do you feel they could have modeled this better for you and your classmates to understand this?
- Do you feel that you had ample opportunity to reflect on your teaching practice in deep and meaningful ways in your coursework with your instructors and colleagues in the online classroom setting?

TOPIC DOMAIN 4: Transfer of Learning – Feedback and Evaluation of The Teaching Practice

Lead-off Question:

It is important to make sure that the coursework you take is applicable to what you are teaching in your classroom. Can you tell me more about how have benefited from the iSMART coursework?

Possible Follow-up Questions:

- Based on what the teacher's answers are from the first interview these questions will be modified.
- How has feedback from the instructors' impacted your teaching practice?
- Did you feel that you had ample opportunity to reflect on your teaching practice in deep and meaningful ways in your coursework and in the feedback from your instructors?
- Do you feel like your instructors' guided you in the development of ideas that were discussed in the coursework so that you could implement new ideas in your own classroom?
- Did your instructors' modeled ideas and concepts for you that you were then able to transfer to your face-to-face classroom?
- Did your instructors' try to gauge your previous knowledge when introducing new concepts in their classroom?
- Did they vary the instructional practices that they used to teach the concepts within the iSMART programs?
- Do you feel like you can evaluate your own teaching practice better because of the iSMART program?
-

TOPIC DOMAIN 5: Course CUIN 7334- Developing Proportional Reasoning Skills

Lead-off Question:

Let's focus first on specific courses that I would like more information about. Let's talk about CUIN 7334, proportional reasoning. Which you took your first semester. Dr. Chauvot made specific pedagogical decisions throughout her course. Can you walk through how those impacted your practice? This is what I mean. In the first session, she had you submit your answers independently/anonymously and thne discuss your solutions in small groups (and

in a different order). Then at the end of the class she asked you to reflect on how those instructional decisions translated to instruction of middle school science and math classrooms. Now that you are in a supervisory role, how do you transfer that pedagogy of the first class to your current role?

Possible Follow-up Questions:

- **August 25th PowerPoint:**
  - Problems Discussed: Running Laps / Density/Santa Claus / Hospital Problem / Garden Plot / Dissolving Problem
  - *Specific Pedagogical Decisions Made And How They Influence The Current Practice Of The Teachers*

- **September 1st PowerPoint:**
  - Discussed the summary stats from the August 25th Problems
  - Dissolving
  - Big Ideas in PR: Using August 25th Problems:
    - **i.** Proportional/Non-Prop Reasoning
    - **ii.** Covariance
    - **iii.** Multiplicative Reasoning vs. Additive Reasoning
  - ***How do you feel about the Big Ideas in Proportional Reasoning now? How to do/did you translate (translated) them to your practice?***
  - ***How did Chauvot's thoughts about analyzing student thinking impact your practice?***
  - First time Chauvot discuss the nature of qualitative tasks versus quantitative tasks and the benefit to student's reasoning skills

- **September 8th PowerPoint:**
  - Orange Juicy, Running Laps and Carafe problem
  - Thompson article
  - Can You See It
  - Additive vs. Multiplicative Reasoning
  - Unitizing---ways to chunk quantities

- **September 15th PowerPoint:**
  - ***Hamed***
    - *Misconceptions. Did you ever encounter the misconceptions that Hamed was talking about?*
    - *To what extent do you feel that Hamed's lesson is learner centered?*

  - ***Orange Juicy Problem:***
    - Dr. Chauvot stated that some teachers were 'fooled by the kids' reasoning….did this push your own reasoning?
    - In what ways?

        - Also this problem showed how the use of non-examples or counter examples is beneficial as a good teaching strategy…did this problem help you to see the beneficial use of this strategy in your own practice?
        - This also brought forth the use of covariation and Dr. Chauvot talked about other examples. What do you think about covariation now? Then? Tell me about your thoughts.

    - ***Qualitative Tasks:***
        - used to focus students thinking on reasoning rather than computing or right numbers.
        - Did you incorporate them into your practice?
        - Can you give me an example? Some people called this reasoning and not mathematics, were you in this group? Why or why not.
        - Were you uncomfortable with the ambiguous nature of the non-numeric problems?
    - ***Multiplicative vs. Additive Reasoning***
    - ***Unitizing…***
        - Can You See It asked you to shade different rectangles based on different wholes and parts.
        - Was that difficult for you to do initially?
        - Did you come to an awareness and understanding after a short period of time or was it still uncomfortable for you?

- ***September 22th PowerPoint:***
    - Types of Ratios using Candy Bar problem
    - Characteristics of Proportional Thinkers
    - Van de Walle definition of a ratio
    - 4 components of Proportional Reasoning

- ***September 29th PowerPoint:***
    - Graphing Lesson
    - Qualitative Graphs
    - Look a Like Rectangles Activity
    - Judson Article
    - Criteria for Evaluating Educational Research: Worthwhileness / Coherence / Competence / Openness / Ethics / Credibility

- ***October 6th PowerPoint:***
    - Graphing Misconceptions
    - Judson article about educational research
    - Criteria for Evaluating Educational Research: Worthwhileness / Coherence / Competence / Openness / Ethics / Credibility
    - Langrall & Swafford article
    - Dwyer article
    - Summary of Langrall & Swafford PowerPoint (problem types)

        - *Part-part-whole:* subset of a while is compared with its complement
        - *Associated sets*: two quantities are associated by context but not ordinarily associated
        - *Well-known measures…rates as ratios….growth/shrink*
    - Different Problem Types---Elicit Different Solution Strategies---Diffferent Conclusions About Children's Thinking.
    - Levels of Solution Strategy
    - 4 characteristics of proportional thinkers from 9/22
- Koellner-Clark & Lesh article
        - The Footprint problem
        - Development of PR through 5 phases: internalization, Qualitative reasoning, additive reasoning pattern recognition/ multiplicative reasoning (ratio as an entity)

- **October 20th PowerPoint:**
    - Koellner –Clark article
    - Bright article
    - Midterm review
    - Photocopier, most square (garden plot), running laps, basketball shots, most square 2 problems
    - Which would students perform better on?
    - Possible task-based interview tasks?
    - ***How did this thinking about students thinking impact your practice?***
        - Different kinds of items and different methods of assessments will reveal different information of students thinking.
        - Different contexts will also elicit different kinds of thinking
        - Different variables will elecit different kinds of thinking.

- **November 3rd PowerPoint:**
    - The Card Sort Activity.. how did that impact your thinking on problem type?
    - Cramer Article on Problem Type
    - Chapin Article
    - Van de Walle and ratio

- **November 10th PowerPoint:**
    - Hospital problem
    - Boston article and discussion
    - Cramer article and definitions: missing value problems, numerical comparison problems, qualitative predication and comparison problems
    - Cramer & Post: ***Problem difficulty—***context matters, the nature of the numerical relationships matter, success rate of missing value and numerical comparison problems was low.
    - Solution strategies: Unit rate, factor of change fraction, cross product
    - For Proportional Reasoning:

- Teach about different strategies that can be used…critique the strengths and weaknesses of different ones.
- Instruction: should always start with familiar contexts and move to less familiar
- Begin with intuitive strategies (unit rate, and factor of change)

- **November 17th PowerPoint*:***
  - Oil Spill Activity--*What were your biggest take aways from this activity? Did you use it in class or did you use any of the pedagogy?*
  - 5E lesson for Oil Spill
  - Cramer and Post problem types again
  - Problem Difficulty
  - Solution strategies from prior week

- December 1st PowerPoint:
  - Peggy Lynn Direct vs. Indirect proportion
  - Inverse Variation: fulcrum
  - *Viewing Tube experiment: How was this experience for you?*
  - Connecting Experimental to Theoretical

TOPIC DOMAIN 6: Transfer of Learning – Reflection on Practice

Lead-off Question:

It is important to make sure that the coursework and your interactions in those courses are applicable to what you are teaching in your classroom. Can you tell me more about how your interactions with your instructors and colleagues have changed your face-to-face classroom practice?

Possible Follow-up Questions:

- How has feedback from the instructors' impacted your teaching practice?
- Think about your experiences with your professors and their individual pedagogies and/or teaching strategies. Did you transfer what they used in their online classroom to your face-to-face classroom environment?
- Think about your experiences collaborating with the other students in your cohort. Did you transfer anything that you learned from them to your face-to-face classroom?
- Did you feel that you had ample opportunity to reflect on your teaching practice in deep and meaningful ways in your coursework and in the feedback from your instructors?
- Did you feel that you had ample opportunity to reflect on your teaching practice in deep and meaningful ways in how you applied what you saw and understood through your interactions with your instructors and colleagues and in the feedback from your instructors?

- Do you feel like your instructors' guided you in the development of ideas that were discussed during the sessions in the online setting so that you could implement new ideas in your own face-to-face classroom?
- Did your instructors' model ideas and concepts in such a way that could you visualize how it should be contextualized to transfer to your face-to-face classroom?
- Did your instructors' try to gauge your previous content and pedagogical knowledge when introducing new concepts in their classroom?
- Did they vary the instructional practices that they used to teach the concepts within the iSMART programs so that you could do the same with your face-to-face classroom?
- How has feedback from the instructors' impacted your teaching practice?
- What do you believe hindered, if anything, your freedom to share in your online classes?
    - What happened when your freedom to share was hindered?
    - How did you adjust your perception of your instructor and classmates after that experience?
    - How has that affected your instructional strategies with your own classroom?
    - Did you see a change in your sharing between the first semester and second semester? First year and Second year?
    - If yes, why and was it is both classes? If not, which one and what do you think contributed to you moving forward in that class?
- Do you feel like you can evaluate your own teaching practice better because of the iSMART program?

Appendix E

Interview Protocol #2

Ann

TOPIC DOMAIN #1: Growth As A Teacher Leader

Lead-Off Question:

Tell me more about your growth as a teacher leader during your time in iSMART. You mentioned in our last interview that during your time in iSMART you moved from 6th grade science up to 8th grade science. Can you tell me about that experience? In addition to that change, you also took on teacher leadership responsibilities by accepting the department head position for the GT Academy with your district, correct? Can you tell how your time in iSMART facilitated your pedagogical growth of being a teacher leader during that period of your career?

Possible Follow up Questions:

- In what ways did iSMART facilitate that an increase in your self-efficacy?
- You mentioned that moving from teaching 6th grade to 8th grade brought on the additional responsibility of teaching in a state tested year. In what ways did iSMART assist you in your content knowledge growth for both yourself and the teachers that you were serving as department head?
- What do you think was the single most transferrable thing from the program to your work with teachers?
- Now tell me what the single most transferrable thing is regarding your work as a teacher in a tested year.
- Can you pinpoint where in the process you started to see your mindset shift and your pedagogy change from teacher to teacher leaders?
- Stemming from that, what articles from your coursework do your remember being of importance in your development in either role?
- What aspects of the technology class with Dr. Chauvot were most influential in your pedagogical shift to your current role?
- You also stated that FBISD was shifting the focus in the classroom from teacher talk to student talk by emphasizing a division of the class to have the following sections: 5-10 minutes student-to-student discussion (math talk), 20-30 minutes of lesson (including guided practice/independent practice) and 5-10 minutes of formative assessments. This structure encourages students to investigate and explore, work collaboratively, use manipulatives, and share/explain their thinking, which is parallel to iSMART's focus of limiting teacher-talk and maximizing student-talk. What is the FBISD focus as of today?
- You mentioned to me that you felt that 8th grade has done a good job of modeling the co-teaching method and communication, but it is not trickled down yet.
    - Has that changed at all with your lower grades?
    - Has there been a shift in your lower grades at all?
- What do you think was the single most transferrable thing from the program to your work with teachers?

  - Can you pinpoint where in the process you started to see your mindset shift and your pedagogy change from teacher to teacher leaders?
  - Stemming from that, what articles from your coursework do your remember being of importance in your development as a teacher leader?
- You spoke about misconceptions and how iSMART opened your eyes to misconceptions. Tell me more about how your growth in the area of misconceptions has developed you into both a stronger teacher and a teacher leader.
  - Have you worked with your teachers on misconceptions and/or shared the materials from iSMART with them?
- Last time we spoke you mentioned that you had substantial increases in your state scores.
  - What courses work helped with that?
  - What would you attribute specifically?
  - Assignments?
  - Readings?
  - Group work?
- I want to read to you a selection from your work and I want you to reflect on your own words. This is from your summary of the Taylor and Jones self-selected article. Read selection:

> *The results of the study "revealed there was a significant correlation between proportional reasoning ability and students' understanding of surface area to volume relationships". Significant improvement was gained on the post-test when compared to the Proportional Reasoning Assessment and the pre-test. Research suggests that "only after students attain a multiplicative proportional reasoning ability level are they then able to understand surface area to volume ratios". Students clearly gained this understanding by exploring the ratio during the summer camp. For example students were asked to calculate the surface area and volume of 3 cubes increasing in size. When asked to choose the cube with the greatest surface area to volume ratio, students incorrectly chose the largest cube. These students lacked covariance, seeing surface area and volume as a proportional relationship. I was surprised to learn just how vast this topic is in relationship to several branches of science. Why is it lacking from our curriculum? I play to gain more understanding of the relationship and how to implement into my lessons. Then perhaps present this to the science curriculum department in our district. Post small group discussion thoughts… I look forward to picking my colleagues knowledge base and thinking through some of the assessment questions*

  - My first question is: Did you pick you colleague's brains about their knowledge base and assessment questions?

    - Secondly, did you inquire about why this topic was lacking from your curriculum?
    - And last…Did you begin to weave it into your lessons?
- Did you follow through on presenting this issue to your curriculum department in your district? You mentioned in your post-program questionnaire that your self-efficacy has increased substantially since iSMART and because of that you have taken on leadership responsibilities and grown in your practice. You credited iSMART for receiving your promotion to Math Department Head and all for the face that FBISD is emphasizing student discussion in the breakdown of the 'standard' math lesson format. Is there anything else you would attribute iSMART for with regards to your career?
- Do you feel like you can evaluate your own face-to-face teaching practice better because of the instructional practices that were embedded in the online component of the iSMART program?
- We also spoke about your future plans and you thought that you might make a move at some point. What are your plans for next year?

TOPIC DOMAIN #2: Use of Technology in the Classroom/Integration/STEM

Lead-off Question:

How do you see the influence of iSMART coming through in your classroom today? In the area of technology use? Integration or STEM? The reason I ask is that the last time we spoke you mentioned that initially you were teaching both math and science and I am curious if you draw upon that experience and the experience of iSMART in your day to day teaching to enhance your mathematics teaching for your students.

Possible Follow Up Questions

- How do you see the influence of iSMART coming through in your classroom today? In the area of technology use? Integration or STEM?
- The reason I ask is that the last time we spoke you mentioned that initially you were teaching both math and science and I am curious if you draw upon that experience and the experience of iSMART in your day to day teaching to enhance your mathematics teaching for your students.
- Do you any of your leadership skills with your teachers stemming from your time under the different teacher educators working with iSMART?
- How did the focus on STEM with iSMART influence or was there not an effect on robotics.
- Did you learn anything new about STEM during your time in iSMART?
- You mentioned that you enjoyed the technology portion of iSMART. Your presentation was technology based as well. I am curious if you have students present their work in class using technology frequently now.
- Grants…lets talk more about them.
    - When you did your first grant for Dr. C what your thoughts/emotions?

  - You did your first grant with Reagan, correct?
  - It was for a robotics kits? Specifically what did it include?
  - Was that the first time you were involved with robotics?
  - What did you do with the grant items?
  - Did you use the lesson that you and Reagan created on Robotics?
- You mentioned last time we spoke that you saw a correlation between the success of the robotics club and your growth as a teacher during your time iSMART. Can you tell me more about the how do you see the influence of iSMART correlating with that success?
  - What courses work helped with that?
  - What would you attribute specifically? Assignments? Readings? Group work?
  - Did you develop any leadership skills that you used with your teachers…. stemming from your time under the different teacher educators working with iSMART?
  - How did the focus on STEM with iSMART influence or was there not an effect on robotics.
  - Did you learn anything new about STEM during your time in iSMART?
- In your Integration interview project you stated this**:**

  I personally feel this is the level we are currently at the GT Academy. We realize this is a start for us, and we need to do more integration. This is our 3rd year and our goal this year is to start developing and integrating curriculum. Time of course if of the essence, when or how this will happen is yet to be determined. I know Ms. Priest is thinking of ways to bring us together as a team.

  - How do you feel about integration now?
  - What level do you believe your classes are at?
  - How about the department?
  - Each grade level?
- You also stated that you learned this from the experience:

  I explored 5 different perspectives on integration of science and mathematics. I learned that our goal for integration at the GT Academy needs to focus on scientific processes and common language. If we can work on those two areas, then the content will fall into place. I feel the interviews reflect our efforts over the past years to implement themes and align curriculum. I am struggling to embrace certain research we addressed in class for example- Judson et al states

  > *"…at the middle school level, the physical separation of science and mathematics instruction and frequent lack of communication between science and math teachers may lead to fragmentation of concepts in students' minds. On the other hand, if integration were a priority, students would not be required to attend separate math or science classes but rather would enroll in a doubly long integrated course."*

> *I feel it is important to integrate not only math and science but several subject area in order for depth to occur among our student body. I do agree with the fact that some content is applicable in a specific subject, however; scientific processes can be used to create commonalities. In order for students to view the two subject areas as a relevant part of their world, educators must provide more inquiry and discovery opportunities.*

  - What are your thoughts now regarding what you learned about integration?
  - Have you evolved in this area compared to what you wrote in this statement?
- TEKS Analysis Assignment. You wrote that:

> *Your definition of math and science integration would entail teaching the two courses as if they were one. That would mean that when teaching students how to calculate speed, mathematical concepts such as fractions and proportions would apply. What teaching about spring and neat tides in eight groups. Students would learn about geometric concepts such as right angles.*

  - Are you teaching in this manner in your classroom?
  - Again did you propose anything to your district for this?
- Do you use the BWISM model and/or the Davison et all definitions of integration of science and mathematics in your teaching practice?

TOPIC DOMAIN 3: Cohort Model of iSMART and Collaboration effects

Lead-off Question:

> *Reagan mentioned in her interview that you encouraged her to apply to the program and that the two of you went through it together. The cohort model is one of the aspects of the iSMART program that is essential to the success of the program. Do you feel that Reagan and you had an even stronger connection as your were both from the same district and same campus?*

Possible Follow-up Questions:

- In what ways did your relationship impact of your understanding the content that you received from iSMART?
- Did the relationship impact your teaching assignment, either in content knowledge and pedagogy?
- Did you work together on your assignments outside of the program?
- Are you two still working together closely?
- You also mentioned that the cohort model impacted your growth and understanding because of the relationships you built during the time your time in the program. Specifically, the fact that several teachers were from FBISD allowed you to learn from what they were going through and learning as you

worked together closely with them on assignments. She also mentioned that those teachers and yourself set up a Google drive to share work and papers. What other ways did you collaborate and share?
    - What other things did you learn from them in the area of content?
    - In the area of pedagogy?
    - Do you still collaborate with any of them outside of Reagan?
- Have you transferred what you learned about working in collaboration on assignments to working in collaboration on planning or assessment writing with your content or grade level team at your school?
- Did you use any other technological methods of sharing or planning when you were in iSMART? Did what you do in your collaboration impact the district in lasting ways?
- You mentioned that you have taught students for multiple years.. Because of this you had many of the same kiddos for extended years in class and in robotics. Now that you have been through a program with a cohort model, have you seen any influence on how you build relationships, teach your content, or assess students that you have had previously?

TOPIC DOMAIN 4: Growth in Content Knowledge and Pedagogy

Lead-Off Question:

When I asked you about the greatest take away from the first year of your program, you mentioned it was the activities that you engaged in. Are you still using any of those activities in your class today? What about the pedagogical understandings that came from the class?

Possible Follow-up Questions:

- You mentioned in our last interview that the Proportional Reasoning class had a 'deep impact' on you. Instead of just accepting how things were done, you were getting to the why and from where they came from. You were beginning to question and understand the depth of mathematics. Are you using any of the content and pedagogical understandings that came from that class with your students?
- You spoke about misconceptions and how iSMART opened your eyes to misconceptions. Tell me more about how your growth in the area of misconceptions has developed you into both a stronger teacher and a teacher leader.
- Have you worked with your teachers on misconceptions and/or shared the materials from iSMART with them?
- In your science courses, you stressed that student exploration was a big 'a-ha' moment for you. Ramsey just 'kind of threw you in the water and said swim'. …. In what ways do you model that in your class today? Can you give me an

example of something you did recently that was based on his model of student exploration and student ownership?

- What aspects of student exploration do you believe have been successful for you in your classroom and what do you believe you still need to refine?
- Let's talk more about student discourse. You mentioned that one of the biggest 'takeways' from the iSMART instructor's instructional practices was that they facilitated student (teacher's) discourse. You spoke about how that was a theme now in your practice as a teacher in your last interview. You also mentioned that the Oreo activity was a springboard for that each year. Where else did you infuse student discourse in your classroom?
- You mentioned that as great as grouping students and student discourse is….at times it can be difficult to implement student exploration with the limitations imposed by the district. How do you believe you have mitigated those channels to the benefit of your students?
- How have you grown in your grouping strategies?
- You mentioned that one of the biggest takeaways from the iSMART instructor's instructional practices was that they facilitated student (teacher's) discourse. You spoke about how that was a theme now in your practice as a teacher in your last interview. Where else did you infused student discourse in your classroom?
- How have you grown in your discourse strategies?
- Another instructional practice you mentioned was inquiry based learning. You also mentioned that you have taken it even one step further by provided students with menus and grouping them in different and unique ways. You gave me one example last time that was about sunshine. Can you give me another one that links the ways and methods that the iSMART instructors modeled inquiry based learning for you and you have modified it for your students in new and more rigorous ways
- I am interested in hearing about how your instructors' modeled inquiry-based lessons in the online setting during their instruction. Did you feel that they did this adequately in order for you to understand how to do this in your face-to-face classroom?
- How do you feel they could have modeled this better for you and your classmates to understand this?
- Do you feel that you had ample opportunity to reflect on your teaching practice in deep and meaningful ways in your coursework with your instructors and colleagues in the online classroom setting?
- What have been the effects of those different grouping and discourse strategies on your practice over time?
- You mentioned you were a hands-on learner, so courses that contained things like inquiry based learning was effective for you…but you struggled in other courses. How has that impacted how you modify your instructional strategies for different students in your own classes? Can you give me another example where the iSMART instructors modeled something in such a way that you were able to modify it for your students in your own class?

- In your assignment over discourse, you wrote about being 'perturbed' by the egg in a jar activity and thankful for it. **read quote*** How often do you 'perturb' your students?
- I want to read to you a selection from your work like I did in with the proportional reasoning assignment and I want you to reflect on your own words. This is from your summary of the Muller self-selected article. Read selection:

> *In summary, pointed out that the "influence conditions" – the thoughtful set up to the program, had a great deal of importance in promoting a culture of reasoning. With the appropriate environment in place students were consistently asked to justify and defend their arguments and were asked to consider if their ideas made sense. Time for students to reflect is a reoccurring theme this semester in both math and science class. I wonder if I promote this when I read through conclusions on student lab write ups. With this reflection in place students were asked to go back and correct any misconceptions. Often a step not revisited in the norm classroom, but the after school program provided both the time and safe environment for reasoning to build in the teachers. When arguments were co-constructed (influence of others in the group) it deepened student reasoning. This program shared similarities to working in our small groups and then sharing large group to gain more insight and understanding*

  - Did you implement this into your practice as you intended?
  - Do you still believe this to be true?
- When I asked you about evaluating your own teaching practice you said you do not video yourself. Have you videoed yourself since we last spoke?
- Last time you told me that your chemistry unit was the one you are most proud of. Is that still true?
- In your video critique over the HIV lesson, you spoke about the teacher providing an authentic experience at the beginning of the lesson by having the students mix liquids. Can you tell me of a time recently that you had your students engage in an authentic experience and what the context was and the result?
- On your initial survey you were asked to think about a time within your experiences that you had an a-ha moment. This is what you wrote:

> *I do not think I can narrow this down to one experience. I can honestly say that 'aha' moments happen quite often even after 11 years of teaching. I experience 'aha' moments from various sources. Most of the time 'aha' moments come directly from students. Several come from my colleagues, my mistakes, and experiences outside the classroom.*

  - Tell me about an a-ha moment with your students
  - Tell me about an a-ha moment with your colleagues
  - Tell me about an a-ha moment that happened within an experience outside the classroom but was related to science or math.

- You were also asked about how you felt about learning something new in mathematics or about mathematics teaching. Here is what you wrote:

  > *Students are full of knowledge that they love to share. If you listen closely you will learn amazing things from them. Working with a team is beneficial to pull knowledge and share ideas. Making mistakes is always difficult, but can be easily turned around as a learning experience Looking for science outside the classroom is the most impacting for me. Actually seeing what we are studying in 'real life' has a powerful effect.*

  - Have you had an experience with students sharing something recently that you did not know already?
  - Have you recently made a mistake that led you to an awareness or understanding of something new?
  - Have you come across something in real life outside of the classroom that you brought back into your classroom that was successful and unexpected?
- For your issues paper you studied the necessity of fostering scientific literacy via the nature of science. In your presentation you connected iSMART to your topic via CUIN 7340 and CUIN 7322.
  - You credited MATH CUIN 7340 with
    - An increase in awareness and understanding of NOS
    - The need for curriculum reform
    - Corresponding research
    - Personal change
  - You credited SCIENCE CUIN 7322
    - Delving into the national standards
    - History of science education
    - Issue with 'school' science
    - Scientific literacy
    - A look at NOS through Gould

    You also said that nature of science education is dependent on culture and society and is not dependent on content but context based situations. (See conclusion of paper)
- In the critter activity, you mentioned that you were apprehensive to engage in that activity? Can you elaborate on that statement for me?
- Exploration in science inquiry based on having the freedom to do any tests you wanted. How did this change your teaching practice and pedagogy?
- Throughout your documents, I see you notating the concept of the variable in science and its use in the classroom. Can you tell me more about this connection to mathematics and how you felt about integrating that math concept into a science lesson?
- Did you use any aspects of this project in your class:
  - Freedom to explore whatever tests they come up with
  - Extended to discuss variables, controls and what makes a good tests

- Students could create own charts
- Record observations
- Reflections on their experiences
- Student discourse to share what they are experiencing throughout the process

- I have a couple of questions regarding the Math and Science in the News assignment. First, regarding having students generate questions. You wrote in your summary:

> *The question should have read- write two more **mathematical** questions that could be generated from this article. Only one student generated a mathematical question. What ratio of chemical do most people have? (1:1). All other student generated questions were of science context.*

  - My questions is this, have you done any work like this since that assignment? In either math content or science?
  - My second question is about analyzing student work. You said:

> *I learned that seventh graders are confident in working with percentages and estimating. It is a struggle to analyze student work without the computations or student interviews with questioning. In hindsight, I learned the most from my mistakes with the questions. Rewriting question 2 for example with how much rather than how many would help students develop relative thinking. "The question "How much of each?" focuses students' attention on the part in relation to the whole rather than on an absolute quantity in and of itself." (Langrall et al) Using math and science news articles is a beneficial way to integrate the two subject areas and use current research. I would use this again next year, my timing and context was on the mark but with revisions to the students questions.*

  - Have you learned anything more about analyzing student work since this assignment that you would like to share?
  - Have you used this assignment again, as you said you would?

- In your analysis of the self-selected article: Moon phase as a context for teaching scale factor you wrote:

> *After students learn light travels in a straight line, they start to question how this process works? Scale factor eventually emerges through student questioning. Students are provided with the diameter of each celestial body. Students are also provided the scale factor for the Sun in relation to the supplied graph paper. This is another point that I disagree- the teacher supplied the biggest learning aspect for the lesson, just handed it over to them without student discovery. When student apply the scale factor ration, it becomes simple math calculations. Ms. H even directs students to the correct estimation. This makes the math seem a bit cleaned-up. The teacher actually supplies the Sun scale factor twice through out the lesson. When*

discussing this article in small group, I asked the 2 math teachers if they would supply the scale factor number for the Sun, they both agreed that they would not. I can speak for FBISD, that scale factor is not incorporated in the moon lesson, which is disappointing that we are not in line with National Standards. What I can gain from this article is how sensitive the teacher is to each small step with student thinking. It also provided insight to possible student misconceptions. Moon phases was recently moved to 8th grade from 7th – it would be interesting to see how 8th graders would approach this investigation given their background knowledge, which unfortunately lacks in scale factor.

- Has the FBISD standard changed to be more in line with the National Standard?
- Have math teachers at your school become aware that this is a way to integrate the curriculum of math and science standards?
- If so, in what ways does this play out in activities for the student?

- In the Wrapper self selected article. You talked about accelerating the high school curriculum and the effects on middle school students. Here is what you wrote:

Accelerating the science curriculum is of particular interest to me at this very moment. I teach at a Gifted and Talented Academy. This was/is Fort Bend's golden child, a private setting within a public school. This is the third year and all of a sudden the district is holding us back, high school credit wise. In a nutshell our middle school students gain their foreign language credits, Algebra I, and so on. When a student earns 5 or more high school credits in middle school then technically they are supposed to be in high school. I hope you understand our dilemma- right now we are offering zero period Biology to 8th graders. That means a nearby high school teacher comes to our middle school an hour before school even starts to teach 30 students. These 30 students are also enrolled in 8th grade science! Why is science any different than the common math track of offering Algebra I in 8th grade? I feel this is all hush-hush and nobody will give me the straight story. I plan to tackle this right after I give birth to our third child, continue my master degree and manage to keep up with 2 preps this year…just had to get that off my shoulders. Did I mention that I love my job, these kids are truly a pleasure to teach and I want to offer them a accelerated science curriculum!

  - Has anything changed in the curriculum options for your students as you had hoped since the time you wrote this?
  - Do you have any additional thoughts about this?

- I noticed you had written you had a hard time with the can you see it? Activity. Can you tell me about that? You wrote:

Very difficult for me to see 3/5 of 8. I want to have 8 total but not possible.
Not seeing 8 although I made 40 sections 8 in each bar.

- Now tell me about your experience with the fraction models. I noticed you wrote out 'how many 1/3s in ¼ for ¼ divided by 1/3. Tell me about your process in coming to understand division of fractions.
- Tell me about the Santa Claus problem from CUIN 7322. You wrote you did the same thing as the students. Tell me about what you did and what you learned.
    - Did you not initially understand the problem before discussing it in class?
    - How did discussing it in class bring you to a point of understanding?

Appendix F

Interview Protocol #2

Misty

TOPIC DOMAIN #1: Growth As A Teacher Leader

Lead-Off Question:

Tell me more about your growth as a teacher leader during your time in iSMART. You mentioned that you were promoted to the position of instructional coach during your time in iSMART. What do you think was the single most transferrable thing from the program to your work with teachers in that capacity? You also stated that you felt that your time in iSMART increased 'your confidence in explaining to others my understanding of how students learn best'. Can you tell me about that experience?

Possible Follow-up Questions:

- Now tell me what the single most transferrable thing is regarding your work as an educational technology specialist. Can you pinpoint where in the process you started to see your mindset shift and your pedagogy change?
- Stemming from that, what articles from your coursework do your remember being of importance in your development in either role?
- How did iSMART facilitate your pedagogical growth of being a teacher leader during that time?
- You mentioned you were a first generation student and for a while struggled with self-efficacy. Do you remember when the first time was that you noticed your self-confidence was starting to change?
- How did iSMART facilitate that increase in self-efficacy in moving into those roles, as you stated in our first interview together?
- You also mentioned that you are a curious learner. You like to thinker with things and learn. Tell me how you utilized that mindset in your classroom within your pedagogy and how it is utilized now in your current position.
- You also mentioned that it is very important for you to share what you know. What has pushed your thinking on this and how has the program shaped your views in this area?
- Let's focus first on one specific course that I would like more information about. Let's talk about CUIN 7334, the proportional reasoning course which you took your first semester. Dr. Chauvot made specific pedagogical decisions throughout her course. Can you walk through how those impacted your practice? This is what I mean. In the first session, she had you submit your answers independently/anonymously and the discuss your solutions in small groups (and in a different order). Then at the end of the class she asked you to reflect on how those instructional decisions translated to instruction of middle school science and math classrooms. Now that you are in a supervisory role, how did you transfer that pedagogy of the first class to your current role in guiding teachers to make some of the same decisions you did in that class?

TOPIC DOMAIN #2: Use of Technology in the Classroom/Integration/STEM

Lead-off Question:

How do you see the influence of iSMART coming through in your classroom today? In the area of technology use? Integration or STEM? The reason I ask is that the last time we spoke you mentioned that initially you were teaching both math and science and I am curious if you draw upon that experience and the experience of iSMART in your day to day teaching to enhance your mathematics teaching for your students.

Possible Follow Up Questions:

- How do you see the influence of iSMART coming through in your classroom today? In the area of technology use? Integration or STEM?
- The reason I ask is that the last time we spoke you mentioned that initially you were teaching both math and science and I am curious if you draw upon that experience and the experience of iSMART in your day to day teaching to enhance your mathematics teaching for your students.
- Do you any of your leadership skills with your teachers stemming from your time under the different teacher educators working with iSMART?
- How did the focus on STEM with iSMART influence or was there not an effect on robotics.
- Did you learn anything new about STEM during your time in iSMART?
- You mentioned that you enjoyed the technology portion of iSMART. Your presentation was technology based as well. I am curious if you have students present their work in class using technology frequently now.

TOPIC DOMAIN 3: Cohort Model of iSMART and Collaboration effects

Lead-off Question:

Casey mentioned in her interview that she encouraged you to apply to the program and that the two of you went through it together. The cohort model is one of the aspects of the iSMART program that is essential to the success of the program. Do you feel that you and Casey had an even stronger connection as your were both from the same district and same campus?

Possible Follow-up Questions:

- In what ways did your relationship impact of your understanding the content that you received from iSMART?
- Did the relationship impact your teaching assignment, either in content knowledge and pedagogy?
- Did you work together on your assignments outside of the program?
- Are you two still working together closely?

- You also mentioned that the cohort model impacted your growth and understanding because of the relationships you built during the time your time in the program. What other ways did you collaborate and share?
- What other things did you learn from them in the area of content? In the area of pedagogy?
- Have you transferred what you learned about working in collaboration on assignments to working in collaboration on planning or assessment writing with your content or grade level team at your school?
- Did you use any other technological methods of sharing or planning when you were in iSMART? Did what you do in your collaboration impact the district in lasting ways?
- You mentioned that for 4/5 years you taught both $6^{th}/7^{th}$ grade. Because of this you had many of the same kiddos for two years. Now that you have been through a program with a cohort model, have you seen any influence on how you build relationships, teach your content, or assess students that you have had previously?

TOPIC DOMAIN 4: Growth in Content Knowledge and Pedagogy

Lead-Off Question:

When I asked you about the greatest take away from the first year of your program, you mentioned it was the activities that you engaged in. Are you still using any of those activities in your class today?

Possible Follow-up Questions:

- You mentioned in our last interview that the Proportional Reasoning class had a 'deep impact' on you. Instead of just accepting how things were done, you were getting to the why and from where they came from. You were beginning to question and understand the depth of mathematics. Are you using any of the content and pedagogical understandings that came from that class with your students?
- You spoke about misconceptions and how iSMART opened your eyes to misconceptions. Tell me more about how your growth in the area of misconceptions has developed you into both a stronger teacher and a teacher leader.
- Have you worked with your teachers on misconceptions and/or shared the materials from iSMART with them
- In your science courses, you stressed that student exploration was a big 'a-ha' moment for you. Ramsey just 'kinda threw you in the water and said swim'. …. In what ways do you model that in your class today? Can you give me an example of something you did recently that was based on his model of student exploration and student ownership?
- What aspects of student exploration do you believe have been successful for you in your classroom and what do you believe you still need to refine?

- Tell me more about the Paige Keeley Science Probes and student discourse
- What aspects of the technology class with Dr. Chauvot were most influential in your pedagogical shift to your current role?
- Last time we spoke you mentioned that you had substantial increases in your state scores. What courses work helped with that?
    - What would you attribute specifically?
    - Assignments?
    - Readings?
    - Group work?
- Tell me more about digital stories and the impact on your practice.
- Tell me more about the critter activity. You briefly mentioned it in our last meeting as it being one of the first activities to push your thinking. How was it in your classroom. Walk me though it.
- Now let's talk more about student discourse. You mentioned that one of the biggest 'takeways' from the iSMART instructor's instructional practices was that they facilitated student (teacher's) discourse. You spoke about how that was a theme in your practice as a teacher in your last interview. You also mentioned that the Oreo activity was a springboard for that each year when you were in the classroom. Where else did you infuse student discourse in your classroom?
- You mentioned that one of the biggest takeaways from the iSMART instructor's instructional practices was that they facilitated student (teacher's) discourse. You spoke about how that was a theme now in your practice as a teacher in your last interview. Where else did you infuse student discourse in your classroom?
- What have been the effects of those different grouping and discourse strategies on your practice over time?
- During your EPSY courses a large part of the curriculum focused on preferred methods of learning. How has that impacted how you modify your instructional strategies for different students in your own classes? Can you give me another example where the iSMART instructors modeled something in such a way that you were able to modify it for your students in your own class?
- In the assignment over discourse, the goal was to reach perturbation with the egg in the jar activity. How often do you 'perturb' your students?
- In your video critique over the HIV lesson, you spoke about the teacher providing an authentic experience at the beginning of the lesson by having the students mix liquids. Can you tell me of a time recently that you had your students engage in an authentic experience and what the context was and the result?
- You mentioned in through out your course documents that your self-efficacy has increased substantially since iSMART and because of that you have taken on leadership responsibilities and grown in your practice. You credited iSMART for receiving your promotion to Instructional Coach and now Instructional Technology Specialist. Is there anything else you would attribute iSMART for with regards to your career?
- I am interested in hearing about how your instructors' modeled inquiry-based lessons in the online setting during their instruction. Did you feel that they did this adequately in order for you to understand how to do this in your face-to-face classroom?

- How do you feel they could have modeled this better for you and your classmates to understand this?
- Do you feel that you had ample opportunity to reflect on your teaching practice in deep and meaningful ways in your coursework with your instructors and colleagues in the online classroom setting?
- In the critter activity, you mentioned that you were apprehensive to engage in that activity? Can you elaborate on that statement for me?
- Exploration in science inquiry based on having the freedom to do any tests you wanted. How did this change your teaching practice and pedagogy?
- Throughout your documents, I see you notating the concept of the variable in science and its use in the classroom. Can you tell me more about this connection to mathematics and how you felt about integrating that math concept into a science lesson?
- Did you use any aspects of this project in your class:
    - Freedom to explore whatever tests they come up with
    - Extended to discuss variables, controls and what makes a good tests
    - Students could create own charts
    - Record observations
    - Reflections on their experiences
    - Student discourse to share what they are experiencing throughout the process

TOPIC DOMAIN 5: Transfer of Learning from Various Course Documents

Lead-off Question:

Talk to me a little bit about these specific course documents and what you learned during your time in that course.

Possible Follow Up Questions:

- Math and Science in the News Assignment. Read statement on Page 2:

    They did have questions about the validity of the statements posed in the article. From a science perspective, their criticalness of the article was wonderful because being critical of research is an important part of inquiry. The students were engaged from the very beginning, as soon as we read the title of the article. They were so interested in the article they were oblivious to the math that was coming afterwards. Based on the reaction and feedback of the students, magazine articles are an engaging way to get students to do math! Articles can be found that are relevant to the student which in turn will engage students with the math that will be learned.

    - ***How did you use this 'a-ha' moment in your class?***

  - You also mentioned: " based on these results, the ability to reason proportionally was very low in this class. I wanted to pose problems that called on sense making which was my goal with number 1."
  - You have mentioned sense making in several different places (CUIN 6326 Video Critique, critter experience, and your Capstone). Tell me about how you have developed that in your students and the effect that iSMART had on that push to do so.
- Proposal Defense
  - How did this study impact your practice?
  - Tell me more about dividing up your lessons to build a more student focused lesson. How do you do that now in your classroom? Can you give me a specific example using grouping strategies and classwork?
- Task based interview
  - What did you learn about interviewing that you have used again in your career or classroom?
  - Have you interview again?
  - Your interview questions:
    - What does it mean to you to integrate science and math?
    - If it were successful, what is your idea of how it would look in the classroom?
    - Do you believe they are related?
    - In what ways do you think it would be beneficial to students to integrate both?
    - In what ways do you think it would be detrimental to students?
    - What are the issues that teachers identify as challenges to motivating their students in science and how do they cope with those issues?
- From midterm:
  - Do you still believe that student centered learning includes a way of instruction that helps student construct knowledge for them.
  - Students centered means differentiated learning for all students, which as educators should be our goals if we want learning for all.
  - Read excerpt about *authentic experience* as it relates the learning to something that is meaningful from the test.
  - Do you remember a time that this has happened as a result of iSMART?
  - Read except about social interaction
  - Read excerpt about true learning from test:
  - Careful planning: learning and instructional planning becomes student centered.
- Video Critique
  - Social interaction-discourse versus discussion. Have your views changed or evolved?
  - Sense Making: teacher did not influence the students' sense making. Have you developed your ability to guide and not influence?

  - This lesson had a component of inquiry that the students were interested in and they were engaged to try to find…the source of transmission (component of inquiry)
  - The weaknesses were the lack of teacher facilitating discourse among the students instead the teacher gave the answers.
  - ***Revisions to the lesson. Have you had an experience since iSMART where you have either evaluated or re-evaluated your lesson or another teachers' lesson in this manner?***
- Critter Experience: You were apprehensive?
  - Exploration in science inquiry based on having the freedom to do any tests you wanted.
  - How did this change your teaching practice and pedagogy?
  - Uses of variable in science…tell me more and how you felt about integrating that math concept into a science lesson.
  - Did you use any aspects of this project in your class:
    - Freedom to explore whatever tests they come up with
    - Extended to discuss variables, controls and what makes a good tests
    - Students could create own charts
    - Record observations
    - Reflections on their experiences
    - Student discourse to share what they are experiencing throughout the process
- Technology Proposal
  - Scale Factor: Integration… did you use that lesson and how did it work out in the classroom?
  - What were the misconceptions?
  - Stick Picks and Bloom's Taxonomy: tell me about them and how they increase rigor.
  - Did you use them and in what way?
  - What ways did you implement the iPADs in your classroom?
- Canary in the Mine…Addressing the Achievement Gap in Science:
  - lack of student motivation and teachers' needing to increase the motivation within the 4 walls of their classroom by empowering students and engaging them and making learning their own.
  - Expand on that thought.
- Cultural Politics and Education: Chapter 1
  - Read last paragraph….what are your beliefs now?
  - How has this belief shaped your pedagogy today?
- ELSC 6370
  - Did you use validity analysis skills in your work since iSMART?
- Questionnaires
  - Tell me more about:
    1. Nasa summer of Innovation Program?
    2. District's Research Initiatives Committee
    3. Being granted Clickers for your classroom

4. What do you believe now about an elementary iSMART cohort. Read statement highlighted.
5. Do you still believe that math does not change like science does?

Tell me about your issues paper not being a lit review.

Appendix G

Interview Protocol #2

Reagan

TOPIC DOMAIN #1: Growth As A Teacher Leader

Lead-Off Question:

Tell me more about your growth as a teacher leader during your time in iSMART. You mentioned in your follow up survey that were promoted to department head at the GT academy, as well as team leader for the 6/7 grade teachers. You also stated that you felt that your time in iSMART increased 'your confidence in explaining to others my understanding of how students learn best'. Can you tell me about that experience?

Possible Follow up Questions:

- How did iSMART facilitate your pedagogical growth of being a teacher leader during that time?
- How did iSMART facilitate that increase in self-efficacy as you stated?
- You also stated that one of the goals of the department was the try one new piece of technology a month and report positives and negatives in the department meetings. Is that still happening?
- You also stated that FBISD was shifting the focus in the classroom from teacher talk to student talk by emphasizing a division of the class to have the following sections: 5-10 minutes student-to-student discussion (math talk), 20-30 minutes of lesson (including guided practice/independent practice) and 5-10 minutes of formative assessments. This structure encourages students to investigate and explore, work collaboratively, use manipulatives, and share/explain their thinking, which is parallel to iSMART's focus of limiting teacher-talk and maximizing student-talk. What is the FBISD focus as of today?
- What do you think was the single most transferrable thing from the program to your work with teachers?
    - Can you pinpoint where in the process you started to see your mindset shift and your pedagogy change from teacher to teacher leaders?
    - Stemming from that, what articles from your coursework do your remember being of importance in your development as a teacher leader?
- You spoke about misconceptions and how iSMART opened your eyes to misconceptions. Tell me more about how your growth in the area of misconceptions has developed you into both a stronger teacher and a teacher leader.
    - Have you worked with your teachers on misconceptions and/or shared the materials from iSMART with them?

TOPIC DOMAIN #2: Use of Technology in the Classroom/Integration/STEM

Lead-off Question:

How do you see the influence of iSMART coming through in your classroom today? In the area of technology use? Integration or STEM? The reason I ask is that the last time we spoke you mentioned that initially you were teaching both math and science and I am curious if you draw upon that experience and the experience of iSMART in your day to day teaching to enhance your mathematics teaching for your students.

Possible Follow Up Questions:

- How do you see the influence of iSMART coming through in your classroom today? In the area of technology use? Integration or STEM?
- The reason I ask is that the last time we spoke you mentioned that initially you were teaching both math and science and I am curious if you draw upon that experience and the experience of iSMART in your day to day teaching to enhance your mathematics teaching for your students.
- Do you any of your leadership skills with your teachers stemming from your time under the different teacher educators working with iSMART?
- How did the focus on STEM with iSMART influence or was there not an effect on robotics.
- Did you learn anything new about STEM during your time in iSMART?
- You mentioned that you enjoyed the technology portion of iSMART. Your presentation was technology based as well. I am curious if you have students present their work in class using technology frequently now.

TOPIC DOMAIN 3: Cohort Model of iSMART and Collaboration effects

Lead-off Question:

Ann mentioned in her interview that she encouraged you to apply to the program and that the two of you went through it together. The cohort model is one of the aspects of the iSMART program that is essential to the success of the program. Do you feel that you and Ann had an even stronger connection as your were both from the same district and same campus?

Possible Follow-up Questions:

- In what ways did your relationship impact of your understanding the content that you received from iSMART?
- Did the relationship impact your teaching assignment, either in content knowledge and pedagogy?
- Did you work together on your assignments outside of the program?
- Are you two still working together closely?

- You also mentioned that the cohort model impacted your growth and understanding because of the relationships you built during the time your time in the program. Specifically, the fact that several teachers were from FBISD allowed you to learn from what they were going through and learning as you worked together closely with them on assignments. You also mentioned that those teachers and yourself set up a Google drive to share work and papers. What other ways did you collaborate and share?
- What other things did you learn from them in the area of content?
- In the area of pedagogy?
- Do you still collaborate with any of them outside of Ann?
- Have you transferred what you learned about working in collaboration on assignments to working in collaboration on planning or assessment writing with your content or grade level team at your school?
- Did you use any other technological methods of sharing or planning when you were in iSMART? Did what you do in your collaboration impact the district in lasting ways?
- You mentioned that for 4/5 years you taught both $6^{th}/7^{th}$ grade. Because of this you had many of the same kiddos for two years. Now that you have been through a program with a cohort model, have you seen any influence on how you build relationships, teach your content, or assess students that you have had previously?

TOPIC DOMAIN 4: Growth in Content Knowledge and Pedagogy

Lead-Off Question:

When I asked you about the greatest take away from the first year of your program, you mentioned it was the activities that you engaged in. Are you still using any of those activities in your class today?

Possible Follow-up Questions:

- You mentioned in our last interview that the Proportional Reasoning class had a 'deep impact' on you. Instead of just accepting how things were done, you were getting to the why and from where they came from. You were beginning to question and understand the depth of mathematics. Are you using any of the content and pedagogical understandings that came from that class with your students?
- You spoke about misconceptions and how iSMART opened your eyes to misconceptions. Tell me more about how your growth in the area of misconceptions has developed you into both a stronger teacher and a teacher leader.
- Have you worked with your teachers on misconceptions and/or shared the materials from iSMART with them
- In your science courses, you stressed that student exploration was a big 'a-ha' moment for you. Ramsey just 'kinda threw you in the water and said swim'. ….

In what ways do you model that in your class today? Can you give me an example of something you did recently that was based on his model of student exploration and student ownership?

- What aspects of student exploration do you believe have been successful for you in your classroom and what do you believe you still need to refine?
- Let's talk more about student discourse. You mentioned that one of the biggest 'takeways' from the iSMART instructor's instructional practices was that they facilitated student (teacher's) discourse. You spoke about how that was a theme now in your practice as a teacher in your last interview. You also mentioned that the Oreo activity was a springboard for that each year. Where else did you infuse student discourse in your classroom?
- You mentioned that as great as grouping students and student discourse is….at times it can be difficult to implement student exploration with the limitations imposed by the district. How do you believe you have mitigated those channels to the benefit of your students?
- How have you grown in your grouping strategies?
- You mentioned that one of the biggest takeaways from the iSMART instructor's instructional practices was that they facilitated student (teacher's) discourse. You spoke about how that was a theme now in your practice as a teacher in your last interview. Where else did you infused student discourse in your classroom?
- What have been the effects of those different grouping and discourse strategies on your practice over time?
- You mentioned you were a hands-on learner, so courses that contained things like inquiry based learning was effective for you…but you struggled in other courses. How has that impacted how you modify your instructional strategies for different students in your own classes? Can you give me another example where the iSMART instructors modeled something in such a way that you were able to modify it for your students in your own class?
- In your assignment over discourse, you wrote about being 'perturbed' by the egg in a jar activity and thankful for it. **read quote*** How often do you 'perturb' your students?
- In your video critique over the HIV lesson, you spoke about the teacher providing an authentic experience at the beginning of the lesson by having the students mix liquids. Can you tell me of a time recently that you had your students engage in an authentic experience and what the context was and the result?
- You mentioned in your post-program questionnaire that your self-efficacy has increased substantially since iSMART and because of that you have taken on leadership responsibilities and grown in your practice. You credited iSMART for receiving your promotion to Math Department Head and all for the face that FBISD is emphasizing student discussion in the breakdown of the 'standard' math lesson format. Is there anything else you would attribute iSMART for with regards to your career?
- I am interested in hearing about how your instructors' modeled inquiry-based lessons in the online setting during their instruction. Did you feel that they did this adequately in order for you to understand how to do this in your face-to-face classroom?

- How do you feel they could have modeled this better for you and your classmates to understand this?
- Do you feel that you had ample opportunity to reflect on your teaching practice in deep and meaningful ways in your coursework with your instructors and colleagues in the online classroom setting?
- In the critter activity, you mentioned that you were apprehensive to engage in that activity? Can you elaborate on that statement for me?
- Exploration in science inquiry based on having the freedom to do any tests you wanted. How did this change your teaching practice and pedagogy?
- Throughout your documents, I see you notating the concept of the variable in science and its use in the classroom. Can you tell me more about this connection to mathematics and how you felt about integrating that math concept into a science lesson?
- Did you use any aspects of this project in your class:
    - Freedom to explore whatever tests they come up with
    - Extended to discuss variables, controls and what makes a good tests
    - Students could create own charts
    - Record observations
    - Reflections on their experiences
    - Student discourse to share what they are experiencing throughout the process

TOPIC DOMAIN 5: Transfer of Learning from Various Course Documents

Lead-off Question:

Talk to me a little bit about these specific course documents and what you learned during your time in that course.

Possible Follow Up Questions:

- Regarding the concept of equity, I want to read you a couple of quotes from your work. This is from your Studying Practice Stage 1: Reflection.
    - Read Quote at Top of Page
- Now I want to read you this quote from Studying Practice Stage 4: Self-Analysis.
    - Read Quote.
    - You mentioned that you struggled with 1) including real world examples and using manipulatives. Do you still? How have you evolved since then? How have you developed equity in your classroom since you were in iSMART?
    - You also mentioned that reflecting on your lessons is something that you wanted to make a concerted effort to do. Have you?
    - Read quote
    - You mentioned in your reflection on Phase 1 and Phase 2 that in order to achieve an equitable classroom you still needed to work your use of

manipulatives in the classroom and the amount of teacher talk during the lesson. Read quote.
    - Self-analysis: When a student makes a mistake, you said it is ok because you foster an environment that is safe. Can you tell me more about what that looks like today?
- Respond to these quotes about students' mathematics abilities and number sense.
    - Read quotes…paper clipped together.
- Proposal Defense
    - How did this study impact your practice?
- Lesson Cycle for CUIN 6346
    - You wanted to create perturbation, similar to the egg in a jar activity in Dr. Ramsey's class and you also stated that the purpose of the activity wasn't to multiply numbers, but to build number sense. Thus you purposely selected a calculator to help build a strong foundation of multiplying rational numbers. Can you tell of a time recently where you purposely selected something for your lesson to direct your students in their learning?
- Question #4: All for Student-Centered Learning
    - Read quote
    - Tell me more about dividing up your lessons to build a more student focused lesson. How do you do that now in your classroom? Can you give me a specific example using grouping strategies and classwork?
- Summary and Reflection ---The False Crisis in Science Education
    - Read quote page 1 about TIMMS testing
    - Read quote page 3 about inquiry and discovery
- Summary and Reflection--Creating New Inequalities
    - Read quote page ` about what students' are being taught
- Chapter 1—Cultural Politics and Education
    - Read quote---Education is failing our children and who determines what our children need to know.
- Chapter 2—Cultural Politics and Education
    - Read quote over equal access and equal $
- Task Based Interview Project**:**
    - What did you learn about interviewing that you have used again in your career or classroom?
    - Have you interview again?
- A personal interpretation of Learning:
    - iSMART impact on your definition of learning.
    - Can I get that graphic from you?
    - Reflection….quote
    - Key ingredients….quote
    - Understand how a person learns…read quote. What are your beliefs now?
- Behaviorism
    - Application to your classroom. You stated you were brainstorming ways to incorporate positive and negative reinforcements along with stronger rewards and consequences. You also stated you also saw the correlation

between effective classroom management and true learning, and that behaviorism was a start to effective classroom management. How have you incorporated aspects of behaviorism in your classroom this year?

- Video Critique
  - Sense Making: teacher did not influence the students' sense making. Have you developed your ability to guide and not influence?
  - This lesson had a component of inquiry that the students were interested in and they were engaged to try to find…the source of transmission (component of inquiry)
  - The weaknesses were the lack of teacher facilitating discourse among the students instead the teacher gave the answers.
  - ***Revisions to the lesson. Have you had an experience since iSMART where you have either evaluated or re-evaluated your lesson or another teachers' lesson in this manner?***
- Canary in the Mine:
  - *Addressing the Achievement Gap in Science:* lack of student motivation and teachers' needing to increase the motivation within the 4 walls of their classroom by empowering students and engaging them and making learning their own. Expand on that thought.

Appendix H

Interview Protocol #2

Taylor

TOPIC DOMAIN 1A*:* Growth As A Teacher/Pedagogy In The Area Of Discourse/Argumentation

Lead-off question:

Let's talk more about student discourse and its effects on your teaching practice. You mentioned that one of the biggest takeways from the iSMART instructor's instructional practices was that they facilitated student (teacher's) discourse. You spoke about how that was a theme now in your practice as a teacher in your last interview. Where else did you infuse student discourse in your classroom?

Possible follow up questions:

- In CUIN 6311 while doing research for your paper, you learned about sense of community as a first step to discourse. Can you tell me how you implemented that in your class with discourse? Read quote.
- In CUIN 7340, what have you learned about discourse since you wrote your statement for stage 1. Read to her.
- In CUIN 6535, Your research question for your capstone was:
    - In what ways does argumentation as a classroom practice influence science learning?
    - Have you made any significant 'a-ha' discoveries in your classroom since you wrote you paper?
- You statement was: _____Read Statement. Do you still agree with this thought? In what ways do you see this still in your practice?
- Another instructional practice you mentioned was inquiry based learning. Can you give me another example where the iSMART instructors modeled inquiry based learning in such a way that you were able to modify it for your students in your own class
- In CUIN 6326: Your video critique,
    - You talked about two different activities: the Oreo activity and the transmission of an STD activity. You stated that the Oreo activity was an activity you great for skill building and was skills based. It also required students to measure and record data.
    - Have you used the Oreo activity since iSMART?
    - You spoke about how passing the contagion around the class facilitated discourse and the debrief of the lab also provided a time of argumentation for the students. Many times in your documents you speak about times like this being 'great' for your students as they get to 'play' and get into the activity. Can you tell me how this type of instruction has evolved for you since iSMART?
    - Read quote from mid-term exam on page 3 about learner centered instruction. Do you still agree with this, why or why not?
    - Dr. Ramsey and discourse. Tell me more about it. (pg. 12 & 13)

- How has your understanding of constructivism with an emphasis on discourse , utilizing brain based learning, and facilitating learner centered instruction changed? Read quote on page 4 of midterm.
- Tell me more about Wong's Feedback and how you integrated that process and what you learned from her into your practice and classroom. (pg. 20 of interview)
- CUIN 6326, regarding project based science you said….read quote on discourse analysis assignment. What assignments have you used in the past year that focusing on this manner of teaching? How have you been able to develop a routine of discourse in your students at a deeper level? What do you wish you could have been able to do better in this area? Read quote on back of page….

TOPIC DOMAIN #1B: Growth As a teacher/pedagogy in other areas

Leadoff question:

You also mentioned that you were an alternate to be a part of the iSMART program. So, when Dr. Chauvot awarded you your position in the program you knew that you were going to do everything you had to do to earn you spot. H do you think the circumstances and your tenacity about the program affected your teaching practice and how you view your students?

Possible Follow Up Questions:

- As I have gone through your course documents, I have seen a change in you as an educator and a mom. You have become very aware of the relationship component in teaching because of the needs of your daughter. Can you tell me more about how your coursework in 6311 developed you into a more well-balanced educator...an educator who is tenacious about seeing her students come to the understanding of how to think and process?
- In 6311 you discuss a lot about how your vision of equity for your classroom has changed and that the differences in your practice are subtle. Read quote.
- You also talked about coding your own classroom and that at the time it was hard to get your students to talk about content when they are concerned they will get the answer wrong. Did you find ways to develop discourse in this area?
- You spoke about your beliefs regarding learning. Read quote.
- In CUIN 6334 when you did your student interviews, you spoke about the uneasiness of evaluating your students' math skills at the time. How have you grown since you conducted those interviews and have you spent time focusing on math in that manner in your classroom since?
- In CUIN 7322 you spoke about the importance of brain based learning being a central part of what is needed to effectively teach and reach students….can you tell me in what ways you have used this in your classroom since iSMART?

- In CUIN 7334, you completed the TEKS Analysis and believed that in order to integrate the science and math TEKS together, it would take a complete overhaul of the system starting at the legislature. How do you feel now
- In your integration interviews, 2 of your questions were: (read questions)
    - What do you believe now?
    - How does that look in your most recent classroom?
- EPSY 6340: Learning views over the life span. How has this been reflected in your teaching and how did iSMART help you to understand your own teaching style? Where are you now in terms of teaching style? Read quote.
- The Santa Claus Problem: you discussed that this problem was pivotal regarding getting students to a point of frustration in their discussion of the problem. DO you do this in your class?
- In your interview you stated that one of the first tings and most critical things that you took away from the iSMART program and thus it changed your teaching was the ability to learn from mistakes and fails. (p9) can you tell me how you passed this on to your students in your practice?
- You also mentioned worthwhile tasks as being another thing you took away from the iSMART program. How have you implemented those in your classroom?
- Have you videoed yourself since we last spoke?

TOPIC DOAIN 2: Use of Technology in the Classroom/Integration/STEM:

Lead-off Question:

Now I would like to talk about the technology Grant that you submitted for Dr. Chauvot's class. Tell me a little about it. Was that your first grant What were your initial thoughts?

Possible Follow Up Questions:

- Your grant was written for the acquisition of iPads to use in your classroom, correct?
- Specifically what were your goals?
- What did you do with the grant items?
- Did you use the lesson that you submitted?
- Do you still use the technology
- Have you submitted any additional grants since that one?
- How do you see the influence of iSMART coming through in your classroom today? In the area of technology use? Integration or STEM?
- The reason I ask is that the last time we spoke you mentioned that initially you were teaching both math and science and I am curious if you draw upon that experience and the experience of iSMART in your day to day teaching to enhance your mathematics teaching for your students.

- Do you any of your leadership skills with your teachers stemming from your time under the different teacher educators working with iSMART.
- Did you learn anything new about STEM during your time in iSMART?

TOPIC DOMAIN 3*:* Cohort Model Of iSMART And Its Collaboration Effects

Lead-off Question:

You mentioned in your interview that you have looped in teaching science content in such a way that you have taught several groups of students multiple years. The cohort model is one of the aspects of the iSMART program that is essential to the success of the program. In what ways, do you feel that your experiences within a cohort model and within color groups aided in your teaching of looping student groups?

Possible Follow Up Questions:

- In our last interview you spoke about changing content every year….talk to me about flexibility in change and the impact of that on your practice and pedagogy.
- You mentioned that your most successful year was a looped year. What do you attribute to that success?
- What would you apply from that year to your other years in order to see additional success in those years? P. 4 of interview.
- When you made the move to HS you experienced the effects of a cohort model all over again, but this time it was at a different campus. Tell me about the difference.
- You mentioned that your chemistry classes (students were sophomores) were 'way too comfortable with me".
    - What do you attribute to that?
    - What would you have done differently? P. 6
- Read cohort model quote from EPSY 6340 midterm.
- You mentioned in your goal statement that you can only reach the goal being your best through reflective teaching. How has having the same classes of students highlighted some of the areas that needed to be strengthened and/or some of the areas that were strong in your teaching practice?
- In your questionnaires you spoke about connecting past learning to new learning… one example you gave was using the triangle formula for science equations. Tell me about how that concept impacted your teaching students you had multiple years.
- Tell me about participating in the Regional Collaborative. Did you do anything else like that?
- In what ways did your relationships with your colleagues impact of your understanding the content that your receiving from iSMART?
- Did the relationships impact your teaching assignment, either in content knowledge and pedagogy?

TOPIC DOMAIN 4: Transfer of Learning from Various Course Documents

Lead-off Question:

Talk to me a little bit about these specific course documents and what you learned during your time in that course.

Possible Follow Up Questions:

- Task Based Interview Project**:**
  - What did you learn about interviewing that you have used again in your career or classroom?
  - Have you interview again?
  - A reminder of your interview questions:
  - What does it mean to you to integrate science and math?
  - If it were successful, what is your idea of how it would look in the classroom?
  - Do you believe they are related?
  - In what ways do you think it would be beneficial to students to integrate both?
  - In what ways do you think it would be detrimental to students?
  - What are the issues that teachers identify as challenges to motivating their students in science and how do they cope with those issues?

- From Midterm:
  - Do you still believe that student centered learning includes a way of instruction that helps student construct knowledge for themselves?
  - Read excerpt about *authentic experience* as it relates the learning to something that is meaningful from the test. Do you remember a time that this has happened as a result of iSMART?
  - Read except about social interaction
  - Read excerpt about true learning from test:

- Video Critique
  - Sense Making: teacher did not influence the students' sense making. Have you developed your ability to guide and not influence?
  - This lesson had a component of inquiry that the students were interested in and they were engaged to try to find…the source of transmission (component of inquiry)
  - The weaknesses were the lack of teacher facilitating discourse among the students instead the teacher gave the answers.
  - ***Revisions to the lesson. Have you had an experience since iSMART where you have either evaluated or re-evaluated your lesson or another teachers' lesson in this manner?***

- Canary in the Mine:
  - *Addressing the Achievement Gap in Science:* lack of student motivation and teachers' needing to increase the motivation within the 4 walls of their classroom by empowering students and engaging them and making learning their own. Expand on that thought.

- Intergration Models:
  - Do you use the BWISM model and/or the Davison et all definitions of integration of science and mathematics in your teaching practice?
  - You mentioned in your article summary on the moon and scale factor article that you discussed the article with your group in the context of the BWISM. How have you seen aspects of that model in your classroom since iSMART?
  - You also mentioned in that article summary that the presentation of the math lesson was a 5E model and that you were encouraged because there were multiple opportunities for the students to be engaged because the activities were learner-centered. Can you share with me some of the more recent successful learner-centered science and/or science with math integrated activities you have used in your classroom

Appendix I

Consent Form

UNIVERSITY of HOUSTON
A CARNEGIE-DESIGNATED TIER ONE PUBLIC RESEARCH UNIVERSITY

UNIVERSITY OF HOUSTON
CONSENT TO PARTICIPATE IN RESEARCH

PROJECT TITLE Mathematics And Science Teachers' Transfer Of Online Learning To A Face-To-Face Classroom Environment

You are being invited to take part in a research project conducted by Kimberly A. Hicks from the Curriculum & Instruction – Math Education department at the University of Houston. This research project is being conducted under the supervision of Dr. Jennifer Chauvot.

NON-PARTICIPATION STATEMENT

Taking part in the research project is voluntary and you may refuse to take part or withdraw at any time without penalty or loss of benefits to which you are otherwise entitled. You may also refuse to answer any research-related questions that make you uncomfortable.

PURPOSE OF THE STUDY

You are being asked to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. Please read the following information carefully. Please ask the researcher if there is anything that is not clear or if you need more information.

The purpose of this study is to gain understanding of science and mathematics teachers' perception of their ability to transfer their online learning experiences over the course of an online graduate program that focused on the integration of science and mathematics in the middle grades. Understanding and describing this ability to transfer this learning in various coursework is the first step to creating meaningful learning environments and designing effective courses for teachers of science and mathematics in order to develop both their pedagogical and content knowledge to effect change in their face-to-face classroom. The length of time the subject's participation will last is 6 months and the analysis of the data will last for a year.

STUDY PROCEDURES

You will be one of approximately 4 subjects invited to take part in the first part of this project.

The research project will involve at least 3 phone and/or face-to-face interviews about your current teaching practice that will last no longer than 60 minutes in duration per session.

You will be provided with a series of dates that you will be able to choose from to in order to schedule your interviews according to your schedule. If additional interviews are necessary, a minimum of two weeks notice will be given before scheduling additional time.

CONFIDENTIALITY

Every effort will be made to maintain the confidentiality of your participation in this project. Each subject's name will be paired with a code number by the principal investigator. This code number will appear on all written materials. The list pairing the subject's name to the assigned code number will be kept separate from all research materials and will be available only to the researcher. Notes, interview transcriptions, and any other identifiable information will be kept in a locked file cabinet in the personal possession of the researcher.

RISKS/DISCOMFORTS

There are no foreseeable risks involved in this study.

PUBLICATION STATEMENT

The results of this study may be published in scientific journals, professional publications, or educational presentations; however, no individual subject will be identified.

AGREEMENT FOR THE USE OF AUDIO TAPES

If you consent to take part in this study, please indicate whether you agree to be audio/video taped during the study by checking the appropriate box below. If you agree, please also indicate whether the audio/video tapes can be used for publication/presentations.

- o I agree to be audio taped during the interview.
  - o I agree that the audio/ video tape(s) can be used in publication/presentations.
  - o I do not agree that the audio/ video tape(s) can be used in publication/presentations.
- o I do not agree to be audio taped during the interview.

SUBJECT RIGHTS

1. I understand that informed consent is required of all persons participating in this project.

2. I have been told that I may refuse to participate or to stop my participation in this project at any time before or during the project. I may also refuse to answer any question.

3. Any risks and/or discomforts have been explained to me, as have any potential benefits.
4. I understand the protections in place to safeguard any personally identifiable information related to my participation.

1. I understand that, if I have any questions, I may contact Kimberly A. Hicks at (713) 743 - 0958. I may also contact Dr. Jennifer Chauvot, faculty sponsor, at (713) 743 – 0958..

2. **Any questions regarding my rights as a research subject may be addressed to the University of Houston Committee for the Protection of Human Subjects (713-743-9204). All research projects that are carried out by Investigators at the University of Houston are governed be requirements of the University and the federal government**.

SIGNATURES

I have read (or have had read to me) the contents of this consent form and have been encouraged to ask questions. I have received answers to my questions to my satisfaction. I give my consent to participate in this study, and have been provided with a copy of this form for my records and in case I have questions as the research progresses.

Study Subject (print name): _____

Signature of Study Subject:_____

Date: _____

I have read this form to the subject and/or the subject has read this form. An explanation of the research was provided and questions from the subject were solicited and answered to the subject's satisfaction. In my judgment, the subject has demonstrated comprehension of the information.

Principal Investigator (print name and title):_____

Signature of Principal Investigator: _____

Date:

Appendix J

List of Secondary Codes by Teacher

Table J1

Liat of Secondary Codes By Teacher

Code	Total	Ann	Reagan	Taylor	Misty
5E Model	40	2	9	16	13
Analysis of Practice	32	0	19	9	4
Assessment	31	6	13	10	3
Authentic Experience	24	3	4	13	4
Brain Based Learning	24	0	9	15	0
Cohort Model	65	15	21	25	4
Collaboration	66	17	19	13	17
Constructivism	29	0	12	10	7
Critters Assignment	14	4	5	0	3
Curriculum	26	4	3	6	7
Differentiation	5	2	0	0	3
Digital Stories	5	0	1	0	3
Discourse	165	23	47	75	23
Equity	18	0	1	16	1
F2F Experience	3	0	3	0	0
Feedback	27	0	5	20	2
Grouping Strategies	19	3	13	2	1
Inquiry Based Learning	68	22	25	16	13
Instructional Strategies	61	5	26	20	10
Instructor Feedback	14	0	2	10	2
Integration	126	29	16	39	43
Interviews	36	2	5	4	26
Investigations	59	19	17	15	9
Issues in Education	38	0	7	30	1
Journals	18	8	3	9	0
Learning Styles	31	4	17	6	4
Learning Theories	42	2	11	35	3
Manipulatives	28	8	11	9	0
Math Content	95	36	42	16	2
Misconceptions	39	18	16	0	5
Modeling	25	2	20	2	1
Multiple Intelligences	9	0	0	9	0
Oreo Activity	6	3	1	2	0

Code	Total	Ann	Reagan	Taylor	Misty
PAP/GT Students	33	12	6	13	0
Problem Based Learning	29	6	13	8	2
Pedagogy	4	1	2	4	1
Perturbation	13	2	4	4	3
Professional Develop.	10	2	1	4	3
Proportional Reasoning	86	11	34	22	19
Questioning Strategies	77	5	25	21	25
Reasoning Skills	29	8	14	4	3
Reflection	8	1	2	3	2
Relationships	17	3	9	4	0
Relevancy	40	8	16	14	2
Research Based Strategies	34	6	4	6	0
Robotics	11	11	0	0	0
Safe Environment	45	6	16	20	3
Santa Claus Problem	5	4	1	0	0
Science Content	50	10	10	28	7
Self Efficacy	31	10	7	11	3
Standards	27	3	2	20	2
Stations	8	0	0	6	2
STEM	24	12	4	8	0
Struggle	14	8	6	0	0
Student Centered Learning	150	21	30	74	30
Student Engagement	190	20	50	89	31
Student Knowledge	104	12	42	41	9
Student Thinking	98	28	34	15	90
Teacher Leadership	29	2	0	0	0
Technology Grants	37	20	9	0	8
Technology in F2F	117	14	34	21	38
TEKS	5	5	0	0	0
Transfer to F2F	83	19	23	38	3

Appendix J

Analyzed Course Documents By Teacher & Course

Table J1

Analyzed course documents for Ann by course.

Teacher	Course	Total	Name of Document
Ann	CUIN 6311	1	Issues Paper: Scientific Literacy via NOS
	CUIN 6365	1	Capstone Paper
	CUIN 7322	4	Article 1 Summary
			Article 2 Summary
			Article 3 Summary
			Article 4 Summary
	CUIN 7334	9	Self Selected Articles 1 -4
			Orange Juicy Problem
			Can You See It? Problems for Sept. 8
			Return to the Santa Claus Problem
			TEKS Analysis Assignment
			Math & Science in the News
			Midterm Submission
			Problems for September 15
			Integration Interview Assignment
Ann	Surveys &	6	Initial Survey Math
	Interviews		Initial Survey Science
			Initial Survey Integration
			Post-Program Survey
			Interview I
			Interview II
Total For Ann:		21	

Table J2

Analyzed course documents for Reagan by course

Teacher	Course	Total Documents	Name of Document
Reagan	CUIN 6311	5	Studying Practice Stage 1
			Studying Practice Stage 2
			Studying Practice Stage 3
			Studying Practice Stage 4
			Responses to Lesson Cycle Feedback
Reagan	CUIN 6326	3	Midterm Submission
			Discourse Assignment
			Video Critique for Midterm
Reagan	CUIN 6328	1	The AEIOU Experience
			Lesson Cycle Review of Literature
			Lesson Cycle Reflection
			Plass and Connell Discussion Questions
			Plass Definitions
			Responses to Lesson Cycle Feedback
Reagan	CUIN 6365	4	Interview Transcription
			Interview Protocol
			Proposal Draft 1 & 2
			Proposal 2
Reagan	CUIN 7322	8	The False Crisis In Science Education Summary
			Cultural Politics & Education Ch. 1
			Cultural Politics & Education Ch. 2
			Cultural Politics & Education Ch. 3
			The Canary in The Mine Summary
			How Julie's Brain Learns Summary
			Color Group's Discussion Post over Readings
			Creating New Inequalities Summary

Teacher	Course	Total Documents	Name of Document
Reagan	CUIN 7334	6	Integration Interview Project Part 1-3
			Integration Interview Project 4-5
			Self Reflection Articles 1
			Self Reflection Articles 2
			Self Reflection Articles 3
			Self Reflection Articles 4
Reagan	CUIN 7340	2	The Saber Tooth Curriculum Reflection
			Number Sense: What Do We Know Paper
Reagan	ESPY 6340	4	Initial & Final Learning Statement
			Final Exam Submission
			Learning Theory Lesson Reflection
Total For Reagan:		42	

Table J3

Analyzed course documents for Taylor by course

Teacher	Course	Total	Name of Document
Taylor	CUIN 6311	6	Studying Practice Stage 1- Reflections
			Studying Practice Stage 2 – Teaching Practices
			Studying Practice Stage 3 – Lesson Plan
			Studying Practice Stage 4- Analysis
			Studying Practice-Reflections on MQE Coding
			Issues Paper: Discourse in Special Education
Taylor	CUIN 6326	6	Discourse Analysis
			Flip Notes
			Video Critique Assignment
			Video 1 Flip Notes
			Midterm Response:
			Discourse & Constructivism
Taylor	CUIN 6346	2	Technology Proposal
			Technology End of Year Report
Taylor	CUIN 6365	7	Interview Protocol
			Interview Transcription
			Prospectus-Argumentation
			Capstone Project
			Chapter 5
			Presentation for Thesis
			Auxiliary Document for Thesis
Taylor	CUIN 7322	3	The Mismeasure of Man
			How Julie's Brain Works
			Reflection on the History of Education

Teacher	Course	Total	Name of Document
Taylor	CUIN 7334	5	TEKS Analysis Assignment
			Task Basked Interview Assignment
			Video Critique
			Self-Selected Article Summaries 1 -3
			Self-Selected Article Summary 2
			Self-Selected Article Summary 3
Taylor	ESPY 6340	4	Final Exam Submission
			Learning Theory Lesson Reflection
			Initial & Final Learning Statement
Taylor	Surveys &	9	Goal Statement
	Interviews		Initial Survey – Math, Science
			Initial Survey – Integration
			Initial Survey Science Part II
			Initial Survey Science Part III
			Post Program Survey
			Interview I, II
Total for Taylor		42	

Table J4

Analyzed course documents for Misty by course

Teacher	Course	Total	Name of Document
Misty	CUIN 6326	3	Critter Log
			Summary of Critter Experience
			Mid Term Submission
Misty	CUIN 6346	1	Technology Proposal
Misty	CUIN 6365	6	Interview Protocol
			Interview Reflection
			Interview Transcription
			Thesis Proposal
			Questions RE: Qualitative Analysis
			Capstone Project
Misty	CUIN 7322	1	Canary in the Mine Summary
Misty	CUIN 7334	3	Math and Science in the News
			Task Based Interviews
			Interview Analysis
Misty	EPSY 6340	1	Final Exam Submission
Misty	Surveys &	3	Post Program Survey
	Interviews		Interview I
			Interview II
Total for Misty		18	

Appendix L

List of Secondary Themes

Table L1

List of Secondary Themes 1-4

Number	Theme	Subtheme
1	Transfer of the Cohort Experience	Authentic Experience
		Building Relationships
		Collaborations
		Use of the Cohort Model
2	Use of Discourse Practices In the Classroom	Investigations
		Ownership of Learning
		Perturbation
		Questioning Strategies
		Safe Environment
		Student Engagement
		Student Thinking
3	Integration of Math & Science In the F2F Classroom	Research Based Strategies
		STEM
		Understanding of Integration
4	Technology Use in the Face-to-Face Classroom	Digital Stories
		Robotics
		Technology Grants
		Technology Application in F2F

Table L2

List of Secondary Themes 5 -6

Number	Theme	Subtheme
5	Transfer of Content Knowledge to F2F Classroom	Assessment Critter Assignment Curriculum Manipulatives Math Content Misconceptions Oreo Activity Problem Based Learning Proportional Reasoning Santa Claus Problem Science Content Standards Student Knowledge TEKS Transfer to F2F Use of the 5E Model
6	Transfer of Pedagogy to Face to Face Classroom	Brain Based Learning Constructivism Development of Pedagogy Differentiation Feedback Journals-Use of Learning Styles Learning Theories Modeling Multiple Intelligences PAP/GT Students Reasoning Skills Relevancy in Curriculum Stations Student Centered Learning Transfer to F2F