K-12 PROFESSIONAL LEARNING COMMUNITIES (PLCS) IN A RURAL SCHOOL DISTRICT ON THE HIGH PLAINS OF TEXAS: MECHANISM FOR TEACHER SUPPORT OF INNOVATIVE FORMATIVE ASSESSMENT AND INSTRUCTION WITH TECHNOLOGY (iFAIT)

A Record of Study

by

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ABSTRACT

The purpose of this study was to explore the evolution of collaborative practices of PLCs as they emerge when using technology based formative assessment via iFAIT or innovative Formative Assessment with Instruction and Technology developed by the researcher using audience response systems and the online data compiler, Eduphoria!. This study used sequential explanatory mixed methods to address the problems that schools face when implementing technology based formative assessments to improve instruction and student achievement.

A survey administered in September 2012 and again in December 2012 provided a measure of teacher use of formative assessments, technology use in formative assessments, and perceptions of teachers using the PLC as a mechanism of support for technology based formative assessment. Training was facilitated by the researcher as PLCs worked together to develop, administer, and interpret formative assessments. Teacher interviews were conducted, and the study ended with the administration of the December 2012 survey and open-response questions for further qualitative analysis.

Quantitative data analysis was completed using ANOVAs to determine if there were significant differences of teacher groups (subject taught, grade level taught, and years of teaching experience) use of iFAIT. This data analysis also included measures of frequency and paired sample t tests between the September and December 2012 responses. Qualitative data was analyzed using hand coding, word clouds, and

WordSmith Tools. The triangulation of qualitative data in the quantitative data provided a narrative to document what collaborative factors affected the use of iFAIT.

For school improvement and implementation of iFAIT, the study revealed that (1) with the right technology infrastructure, on-going professional development must be offered by administrators or sought after by teachers; (2) teachers must have strong beliefs in formative assessment and the technology that supports it; (3) open lines of communication must be supported through the PLC and administration; (4) teachers must see purpose in using revealing student data to drive instruction; and (5) PLCs must have common beliefs and believe that student achievement is connected to school improvement. PLCs should discuss data, share successes, and plan instruction through extended involvement in face-to-face and online venues as communities of practice.

DEDICATION

God has blessed me with loving, encouraging families and friends throughout my life. It is only fitting that this record of study is dedicated to my parents, Bobbie and Howard Brass. Without their love of me and for me, I would have never had the dedication and work ethic to devote to this study. As my father hitchhiked to College Station in the early 1940s to attend Texas A&M College, he never knew that I too would follow his lead, although my mode of attending would be over the Internet that he introduced to me in the early 1990s.

Some say that a venture this late in life was not a sound thing to do; however, what I have done is provide information that could assist schools such as the one that my dad taught and those that my mother supported. I spent thirty-five years in Texas public schools and feel that this is a proper conclusion and a new beginning. To those that question my purpose, I propose one question, what have you done with your life that will have the potential to affect our future, our protégée through the things you have studied, learned, and written? A life of service should not be cut short, it should continue.

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Finally, thanks to my husband, Randy Talkmitt for his support and encouragement, for allowing our home to be a bit untidy and disorganized for much of this study, and understanding those deadlines that I had to meet to get this record of study complete. I would also like to thank my children and grandchildren for their love and support during this time.

I acknowledge that all these things are made possible and freely given by my Lord and Savior, Jesus Christ. Without His sustained love and support, this record of study would never have been possible.

NOMENCLATURE

ARS	Audience Response System
CMISD	Crockett Memorial Independent School District
CoP	Community of Practice
CPS	Classroom Performance System (eInstruction clickers, Mobi, and other class presentation tools)
CSCOPE	Comprehensive online curriculum management system developed and owned by the Texas Education Service Center Curriculum Collaborative (TESCCC), a consortium composed of the 20 Education Service Centers in Texas
DDDM	Data-driven decision making
iFAIT	Innovative Formative Assessment with Instruction and Technology (technology based formative assessment)
IWBT	Interactive White Board Technology
NCLB	No Child Left Behind of 2001 (20 U.S.C. § 6319)
PLC	Professional Learning Community
SRS	Student Response System
STAAR	State of Texas Assessment of Academic Readiness
TAKS	Texas Assessment of Knowledge and Skills
TEKS	Teas Essential Knowledge and Skills

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION

How do teachers know if content mastery is within their students' grasp if they do not assess their students frequently and collect information on their current understanding? As teachers work through the processes of teaching and learning, they must weed through the curriculum, determine what students know, learn how to deal with students' current understandings, and deliver instruction that will gravitate, and stabilize their students' learning. Teachers must be willing to work and collaborate to meet student needs, but this must be done effectively and with minimal disruption of the day-to-day procedures and policies that underlie the business of teaching. Teachers can make the difference in children and learning, but they need to have the technology and pedagogy to support student learning verified through the curriculum and standards that are to be taught and learned. In order for teachers to assist students in their learning, they must come together to assess their students and have the tools needed to make the teaching, learning, and assessment fruitful (Moss & Brookhart, 2009). This study is an original model developed by the researcher and employs a unique approach to technology learning, student achievement, and professional development via professional learning communities (PLCs) in the work place and communities of practice (CoPs) that emerge as the participants develop their identity and purpose.

Many teachers face mandated assessments with fear, a fear of the result be it failure, lack of teacher control of the curriculum, or the fear of the unknown. From early

writings, teachers have been held accountable for their students' learning. This is illustrated during the early 1400s when the leaders of Treviso, Italy made their schoolmaster's salary dependent on student performance (Falk, 2012). This practice continued in many schools throughout the world. Standardized tests emerged after World War I in the United States, and though once a subtle, unthreatening test, they have been dramatically affecting the educational system in every decade that has followed. The No Child Left Behind Act (NCLB) of 2001 (20 U.S.C. § 6319) was a cumulating event that has initiated an increased reliance on student performance and has deeply affected children, their parents, and their teachers. Testing has become a controversial issue in educational, political, cultural, business, media, and financial circles around the United States, but the education of our children ultimately falls on their teachers. It would seem that our education system is spiraling out of control and doomed to face the scrutiny of those in control through standardized testing—politicians, administrators, and others needing some sort of verification that students are becoming successful learners. A powerful force can defeat these fears when the learning community, teachers, and students engage in formative assessment (Moss & Brookhart, 2009).

Formative assessment is the guide for instruction providing a source for the development of the instructional path (Feldman & Capobianco, 2008; Fuller, 2011). Formative assessment *is* the starting point providing the impetus needed to jump start learning. Teachers should learn how to teach *with* the test, not *to* the test (Portin, Feldman, & Knapp, 2006; Swan & Mazur, 2011). Assessment should not be a collection of individual items, but should contain a myriad of tasks that demonstrate content

mastery (National Academy of Sciences, 2001). Assessment can become a complex web if not properly organized and orchestrated. In many respects, assessment is the product of learning (Feldman & Capobianco, 2008; Fuller, 2011). For the student, formative assessment must prove valuable and assist in the obtainment of knowledge, yet provide a picture into the student's mind that illuminates and assists in teachers' student understandings (National Academy of Sciences, 2001). When using formative assessments, teachers must be responsive to students; instruction enhanced with technology has the potential to create a vessel of knowledge and understanding via Innovative Formative Assessment and Instruction with Technology (iFAIT).

Background to the Study

Tools make life and practice easier, and teaching tools are no different. Technology tools are available to ease the burden of teaching, learning, and assessment. Prensky (October 2001) insists that our teaching clientele has changed, and early educational designs can no longer support our education system. We are living in an era where technology and media have a significant impact on our youth. Many adults are not able to keep up with the technology and the media that our young students successfully access on a daily basis. Digital natives and digital immigrants make up our teaching cadres where most of the oldest members or digital immigrants are not familiar with the current digital technologies and the youngest members or digital natives have grown up with digital technology (Prensky, 2001). This disconnect often leaves teachers lacking in technology or the teaching experience needed to educate our children. Youth and

experience are brought together in professional learning communities or PLCs to benefit student learning and achievement.

Technology can become a powerful tool when examining student data to drive instruction. Swan and Mazur (2011) found that there are three influencing factors as student data is analyzed including curriculum designs made by teachers to enhance student learning and achievement, data interpretation heuristics, and the schools' curricular policy. In Swan and Mazur's study, CaseMate, an open source technology tool to support formative assessment enabled preservice teachers to produce assessments, assimilate assessments by objectives, and allowed teachers to get data results compiled and "make sense" of the data that was presented. In their conclusion, Swan and Mazur noted that data could be overwhelming and that much is to be known in order to implement data driven instruction. Current technology available to schools makes data more accessible by providing standard based question development, data acquisition using hand held technology tools, and digital formats that provide visual blueprints of student understandings. These tools instantaneously provide opportunities for learning when teacher feedback is used as a follow up to assessment. Data driven instruction is within reach with technology, using data compilers and student response systems for the specific purpose of formative assessment and student achievement through iFAIT.

iFAIT or Innovative Formative Assessment with Instruction and Technology developed as the researcher began graduate studies at Texas A&M University and piloted the basic principles in an internship. This record of study identifies a method of instruction and formative assessment that does not *teach to the test*, but is a logical

method to combine students' prior knowledge and instructional deficiencies found as content standards using technology to expedite the learning and student feedback process. In 2006, when this researcher was given a class of students who did not master the Texas Exit Science Texas Assessment of Knowledge and Skills (TAKS) test required for graduation, the need to develop a plan of action focused on specific problematic student expectations in the science standards was central to their understanding. In the earliest beginnings of iFAIT, student responses to prior state assessments and their content standards were hand entered in MS Excel by this researcher. The data was sorted, and class and individual graphs were produced that visually showed areas within the content standards that needed remediation. Whole group instruction followed with common content standard deficiencies, and in the later stages of the remediation process, individual student data was entered, and graphs developed to assist the student in their individualized instruction and remediation. As science scores climbed and the percent of students passing increased, the thought of a system of formative assessment generated quickly with technology that other teachers could use became a priority of this researcher. This approach is applicable to any teacher or school wanting to learn collaboratively and use technology in their formative assessment strategies.

Eduphoria!, an online database program was introduced in 2009 and provided state assessment results of students by content standards that could be broken down individually by class or student. Exported MS Excel content from Eduphoria! replaced the hand entry of student data and saved time that could be used for instructional planning. In 2010, the researcher learned that tests could be developed, administered,

and interpreted for students via Eduphoria!, which allowed the documentation of continual content standard success for students. Feedback could be planned and organized for instruction that would best meet student needs to master course specific content. Within weeks of learning the added benefits of Eduphoria!, administration introduced the ARS powered by eInstruction to teachers. The district bought into the system February 2011 giving each core teacher the technology tools to instruct and concurrently assess students with the student response system. As the researcher planned for retirement in early 2012, the plan for the use of technology in formative assessments using Eduphoria! and ARSs began to materialize as CMISD became interested in iFAIT as an innovative way to use technology to drive instruction. In July and August of 2012, discussions between the Superintendent and Assistant Superintendent of CMISD resulted in an agreement for the researcher to assist teachers with iFAIT and provide the groundbreaking task of promoting the use of iFAIT to teachers. Campus principals bought into the plan as well providing the leadership needed to merge iFAIT with PLCs using Eduphoria! and the ARS to promote greater student achievement in their curriculum that is tested in state and federal assessments.

Regardless of personal beliefs, educators in an organization are there for one common goal, to provide avenues of support for student achievement (Branch, 2011; OECD, 2010; Okoye, 2011; Parker, Gallagher, & Griffin, 2011; Portin, Feldman, & Knapp, 2006). This goal can be achieved with PLCs. Historically, schools have focused on teacher quality, self-efficacy, and collaborative inquiry to sustain and build organization capacity; however, PLCs or the professional learning community of

educators is becoming a crucial element in school improvement. These PLCs are teachers and administrators that "seek and share learning, and act on their learning" (Hord, 1997, p. 10). PLCs are associated with workplace educational organizations arranged by subject or grade level by the educational hierarch of educators; however, often teachers in PLCs turn to communities of practice (CoPs) to develop their own identities and roles to meet the educational organization's goals. These communities of practice or CoPs, do not operate on agendas or set meetings, they "share their experiences and knowledge in free-flowing creative ways that foster new approaches to problems" (Wenger & Snyder, 2000) and may meet face-to-face or online. PLC's and CoP's goals are to embrace the spirit of collaboration and enhance their effectiveness as professionals for the benefit of students.

Current job embedded models for the overwhelming task of assuring student achievement involve PLCs to promote collaboration, authentic learning among educators, and professional development. These models must be developed to initiate change in the collaborative power of public school educators when using technology-based formative assessment (Fuller, 2011). To promote student achievement and enrich learning experiences, several schools in Texas are using Audience Response Systems or ARSs and Eduphoria, an online data analysis application that stores past student data and formative assessment development, administration, and analysis. Educators' use of these technology tools depends on the collective experiences and success of those whose insight can promote others' success. The lessons learned from this study could help

public schools in other locales searching for ways to assist teachers, particularly those that use technology with formative assessment.

PLCs can facilitate teacher learning as they collaborate (OCED, 2005; Parker, et al., 2011; Portin, Feldman, & Knapp, 2006; Stiggins, 2009). This collaborative approach in professional development joins teachers together for the development of a common goal or practice and is becoming a vital component of professional development, particularly in technology-based venues (Looi, Lim, & Chen, 2008). The collaborative nature of these groups provides a storehouse of information that is shared and learning becomes a joint venture. Technology is an enabling factor of PLCs as social networking and Web 2.0 technologies have made the collaboration more powerful and asynchronous, an important feature for busy educators (Looi et al., 2008).

There is no time like the present to provide the necessary tools that will make a seamless transition from student knowledge to teacher desktop; however, educators must be empowered to use those tools, the mind tools that will provide insight into what students know, and how to supplement their cognitive needs (Beatty & Gerace, 2009). Teachers have a daunting task as they appraise their students' prior knowledge and instruct them in content necessary to satisfy the state curriculum. Once instruction has progressed and reached a pinnacle where both teacher and student have completed the process, teachers begin to appraise, reappraise, and then look to the criteria outlined in the state assessment. There has been much debate about teaching to the test (Swan & Mazur, 2011; Young & Kim, 2010) and satisfying state mandates rather than students' needs, but assessment is the key to understanding what students know. Curriculum based

assessments necessitate that instruction be geared towards that end, and formative assessments should be developed to assure that students have the knowledge base to be successful.

Statement of the Problem

Test scores in Crockett Memorial Independent School District (CMISD), a pseudonym for a rural school district on the high plains of Texas have steadily improved through the concentrated efforts of teachers and administrators in their analysis of past student performance on state assessments and the way that curriculum is delivered, but now the rules have changed. The state of Texas is in the process of phasing in a new assessment battery called the State Assessment of Academic Readiness, testing students in grades 3-12 where the rigor and complexity of the Texas Essential Knowledge and Skills or TEKS has been increased (Texas Education Agency, July 2012). In preparation for this change, CMISD initiated a monumental pedagogical shift in the way its staff use technology for formative assessment with the addition of Audience Response Systems (ARSs) and the expanded use of the online education database software system, Eduphoria! . The ARS, often called a Classroom Performance System (CPS) or Student Response System (SRS), acts as an Interactive White Board (IWB) and its student response system gives teachers the ability to implement technology as mind tools, which encourages learning as children scaffold through information and questioning, constructing their own learning (Jonassen & Carr, 2000; National Research Council, 1999; Shim & Li, 2006). Eduphoria! gives teachers and administrators the ability to develop, administer, generate, and store academic data on their students and use

formative data to monitor student progress. Teachers were excited about the potential that these technologies held as they were introduced to all core subject areas within the district, but the use of the tools has been sporadic and is not used as much as had been hoped. Research has indicated that technology tools such as this are only as good as the user or facilitator of the tool and the professional development that the teacher receives (Al-Quirim, 2010; Armstrong, Barnes, Curran, Mills, Sutherland, & Thompson, 2005; Beatty & Gerace, 2009; Glover & Miller, 2009; Hall & Higgins, 2005; Mercer, Hennessy, & Warwick, 2010). Since the problem is that not enough teachers are using these helpful, new technologies, this study seeks to understand the collaboration that exists in effective PLCs when implementing technology based formative assessments.

In May 2011, the CMISD administration asked its staff to complete surveys that were patterned after the work of the Parsad, Lewis, Farris, and Greene (2001) in the National Center for Education Statistics' Teacher Preparation and Professional Development: 2000. This survey revealed that the most urgent priority for teacher professional development was to learn more about the technologies that were now available to them in the ARSs and the formative assessments that can be created and used to analyze student performance data for local and state assessments via Eduphoria! . The content and increased emphasis on readiness standards and their multi-faceted supporting standards that are built into the new state- mandated tests make the development, administration, and analysis of formative assessments more crucial than ever. Pellegrino and Quellmalz (2010) state that technology is changing how curriculum is being taught by providing a trail of information that will enable students to

demonstrate mastery of their knowledge and skills. Technology makes the seemingly impossible task of sorting and analyzing data possible. A large body of evidence indicates that a significant shift in teaching pedagogy must be in place, or there is no significant impact on student achievement with the use of technology-based assessment (Al-Quirim, 2010; Higgins, Beauchamp, & Miller, 2007; Mohon, 2008; Slay, Sieborger, & Hodgkinson-Williams, 2008). Expert teachers modeling the pedagogy behind the technology are more likely to lead the school to a pedagogic shift in practice when using the technology (Beatty & Gerace, 2009; Feldman & Capabiano, 2008; Fuller, 2011; Glover & Miller, 2009).

This study will attempt to learn how the collaborative power of PLCs can assist teachers to implement data driven instruction via the implementation of technology based formative assessment. Teachers working and collaborating as PLCs with technology can sustain and further the practice of data-driven instruction and develop a trail that encompasses students' prior knowledge, students' current understandings, and delivers the feedback needed to get students back on track with what they need to know, what they have to know to be successful, and how to get there.

Research Questions

With this base in place, the study can proceed and begin to answer the following overarching question: In what ways do personal and professional factors affect elementary and secondary teachers within PLCs as collaboration evolves with the implementation of technology-based formative assessments via iFAIT?

Sub questions of the study are:

1) How do teachers within PLCs learn to use technology with formative assessments?

2) To what degree does the oral and written documentation sustain teachers' successful iFAIT implementation?

3) How does the use of collaborative activities (oral and written) support the *professional development* of teachers as they implement iFAIT?

Purpose

The purpose of this study is to explore the evolution of collaborative practices as they emerge when using technology based formative assessment via iFAIT PLCs and the collaborative resources that they produce when using ARSs and the online data compiler, Eduphoria!. This process will provide a venue for teachers to develop their technological and pedagogical skills to acquire student data, interpret, and develop instruction as their students gain valuable feedback and remediation within seconds (Moss & Crowley, 2011). This possible solution will provide a means to help teachers resolve the problems they encounter when using technology-based formative assessments.

Significance

As educators struggle with standardized assessments and their ramifications, there appears to be two significant features of this study. The first feature is the use of PLCs that focus on teacher use of formative assessment and technology grounded in research that demonstrates how professional development via PLCs can add to their

professional development. The second feature of this research design, at the ground level of implementation in the school district, can go beyond the test district to other educators facing similar dilemmas. The outcome of this study can become a defining moment in the increasing emphasis on student assessment of learning.

Few studies bring PLCs, technology, and formative assessment together as a professional development effort for the betterment of student learning and achievement to respond to the demands of mandated testing. The concurrent worlds of technology and formative assessment have been brought together in several studies involving Interactive White Board or IWB, which demonstrated the need for technology and pedagogy for successful implementation (Glover & Miller, 2009; Hall & Higgins, 2005; Mercer, et al., 2010). The work of Beatty and Gerace (2009) and Feldman and Capobianco (2008) sought to investigate ways that secondary math and science teachers were using ARSs, but key to those studies was the need to develop questioning techniques. Branch (2011) and Burns (2010) used PLCs to help teachers become more productive with formative assessments. In a study closely tied to professional development with teachers using ARSs, Fuller (2011) gave her experiences providing teachers with professional development and individual observation follow-ups when using technology for formative assessments. A resounding theme in all of these studies was the need for combined technology and pedagogy, teacher understanding of what formative assessment consisted of and how to use it effectively, how to measure student data via technology, and the need for collaboration among all concerned parties by oral or written documentation via PLCs and online social networking forums. This study joins all of

these elements together to provide a better understanding of how PLCs use technology to drive formative assessments and instruction.

Teachers were not taking advantage of the most beneficial resources at CMISD, people and technology. CMISD has many educators skilled in their craft whether it is pedagogy or technology. The technology purchased for teachers and their students were setting in closets and online tools that have a vast array of information including student data, standards based questions, and interpretive tools were used minimally to evaluate student learning and the successfulness of teacher instruction. In order for tools to benefit the work of an artisan, the craftsman must work with others, as either an apprentice or a mentor, practice the use of that tool frequently, and be willing to be both teacher and learner to generate a successful product. Joining the educators together in PLCs will help provide an enhanced vision of formative assessment, data, and student achievement that has the potential to go beyond the confines of the school walls to educators outside the district.

Definition of Terms

To further the reader's understanding, the terms and acronyms are defined below:

1. Audience Response System (ARS): Audience Response Systems consist of digital instruments and software or applications that digitally record student responses to formative assessments as instruction is conducted. These systems may consist of student clickers that relay student responses to a computer or wireless device to answer questions or participate in learning scenarios. Furthermore, the devices will tabulate, sort, and provide cumulative student data

to both teacher and students giving teachers the ability to provide feedback to students and remediate instruction.

2. Classroom Performance System (CPS): The acronym, CPS is another name used to identify the ARS.
3. Communities of Practice (CoP): In social media circles, CoPs are groups of people with common interests and a drive to learn together that meet together regularly and are not separated by place or time. These communities of practice meet face-to-face or virtually online.
4. Data-driven decision making (DDDM): In a term introduced by Moss in 2007, DDDM is the process of collecting and assessing student data either through formative assessments or by mandated government testing to facilitate instructional decision-making in what is taught and remediated in connection with assessments and curriculum (Swan & Mazur, 2011).
5. Eduphoria!: This web application can create, generate questions, gather student responses, assess, and compile formative or summative assessments. In addition, the application can produce visual representations of the data it compiles and document individual, class, teacher, campus, or district student data, both current and historically. The application is updated to allow schools to document everything from curriculum to staff professional development.
6. Formative Assessment: Formative assessment is the guide for instruction providing a source for the development of the instructional path (Feldman & Capobianco, 2008; Fuller, 2011). Bennett (2011) found that formative

assessment has multiple meanings particularly one by Bloom referenced as the means of providing feedback to students in the process of teaching and learning. Bennett urges his readers to see formative assessment as a process, not a product as the full meaning has not evolved. Many schools are currently using common formative assessments or CFAs, developed and interpreted by PLCs to monitor their students' learning (DuFour, 2004).

7. Innovative Formative Assessment and Instruction with Technology (iFAIT): The iFAIT acronym is the creation of the author of this paper to define the interactions between formative assessment and instruction with the technology tools including IWBs, ARSs, and software, web applications, and other tools to gather, assess, and document student learning.
8. iFAIT PLCs: PLC groups are specifically using their PLC to improve their use of technology and formative assessment through iFAIT.
9. Interactive White Board (IWB): Interactive White Boards are electronic boards or projected images (similar to the overhead projector) that enable the use an input device, mouse, or digital pen to interact with the computer to provide instruction that can be saved for later use and reflection.
10. Professional Learning Community (PLC): In the education community, PLCs are groups of teachers, administrators, and others interested in the education system that collaborate for the development of a common goal or practice that will ultimately benefit students within their professional life (Looi, et. al, 2008). The

school in this study has specific PLCs throughout the district, but is not utilizing their PLC to enhance the use of technology in formative assessment practice.

11. State of Texas Assessments of Academic Readiness (STAAR): Beginning in the spring of 2012, STAAR replaced the TAKS for student assessments in Texas. These assessments are assessing student learning at grades 3-8 and through twelve course specific end of course exams at grades 9-12 (Texas Education Agency, July 2012).
12. Student Response System (SRS): The acronym, SRS is another name used to identify the ARS.
13. Summative Assessment: Summative assessment is a picture of student achievement or a measure of performance of schools and student subgroups within a content area that is the cumulating event when formative assessment measures are nearing completion.
14. Technology based formative assessments: The use of technology to develop, administer, and compile student data for formative assessments includes computers, student response devices, and other digital equipment, software, or web based applications that digitally record student responses and assessment data.
15. Texas Assessment of Knowledge and Skills (TAKS): The Texas Education Agency defines TAKS as "assessments that are designed to measure the extent to which a student has learned and apply the defined knowledge and skills at each tested grade level" (Texas Education Agency, 2011). These state assessments are

being fully phased out during the 2012-2013 school year and being replaced by STAAR.

16. Texas Essential Knowledge and Skills (TEKS): The Texas Education Agency defines the TEKs as the state of Texas standards for what students should know and be able to do for all courses offered in the state (Texas Education Agency, June 2012).
17. Web 2.0 technologies: The *social web* or *Web 2.0*, was named by O'Reilly in 2004, consists of the technologies of blogs, wikis, and social networks including Facebook, Google+, Pinterest, and numerous lesser known online forums that enable the social dimension of the web through sharing and online conversations (Wheeler & Wheeler, 2009).
18. Wiki: Wikis are collaborative works or online documentation that weave topics together to create learning materials or topics of interest that can be edited by users as they gain more information. This Web 2.0 application is uses the development of content in the interests of the participants via collaboration. Unlike a blog or discussion board, which are individual reflections, the wiki promotes collaboration among its members that develop a tool for learning in a creative web based document available for others to use. The Hawaiian phrase 'Wiki wiki', which means 'to hurry' give insight as to how easy Wikis are to set up and use as a collaborative base for online writing that provides shared spaces where users can access content, create and edit content through text, images, and hyperlinks (Wheeler & Wheeler, 2009).

CHAPTER II

LITERATURE REVIEW

In the past three decades, researchers have noted the importance of PLCs in the professional development activities of teachers in both formative assessment and technology. This runs concurrently with the increased demand of standardized testing, student achievement, and teacher accountability. Assessment for learning, rather than assessment of learning, can become a complex web if not properly organized and orchestrated. The public and private sectors of our nation have spent too much time on the *assessment of student learning* rather than *assessment for learning* (Stiggins, 2002). Assessment for learning can be achieved through productive instructional decision making using high quality assessments and by making each student's educational journey productive (Stiggins, 2009). Within the research literature, there are four key elements in the conceptual framework of this study—PLCs, technology, assessment, and professional development.

The focus for this study is to analyze the collaborative evolution of PLCs as they develop formative assessments, resolve technology issues, and develop collaborative resources when implementing technology based formative assessment via iFAIT. To produce an environment that fosters the development of technology based formative assessment, an investigation within the literature reveals what exists and provides a lattice to build possible solutions to help answer to the questions within this study. From the literature review, a lattice or crisscross framework illustrated in Figure 2.1 Model –

Support Structure of iFAIT Within the Literature by Researcher on page 21, produced by the researcher, illustrates how the four elements in the literature – PLCs, technology, formative assessment, and professional development—are interrelated when teachers use technology based formative assessments. This original model provides a clear message to educational organizations and leaders that wish to implement iFAIT and need a background to its origins. iFAIT focuses on four areas—PLCs, technology, assessment, and professional development. The interrelations are palpable as PLCs support technology based formative assessment, technology supports PLCs in their implementation of technology based formative assessment, web-based support is available for the implementation of technology based formative assessment, and the professional development of teachers supports the implementation of technology based formative assessments. iFAIT, a concept developed by this researcher, can become a model and a practice for teachers to use formative assessments with technology for student achievement.

As PLCs focus on student achievement, ideas are voiced, and strategies for assessments are developed. Professional development becomes something more as teachers learn together. Technology becomes a tool, a tool for collaboration via wikis, or other Web 2.0 applications, documenting the needs, successes, and resolutions as these ideas evolve a sense of worth and trust develops within the educators. Technology and professional development should not be restricted to face-to-face (F2F) meetings, but can continue using web-based tools. Teachers can then turn to their classes, use the ARS to document what their students know, what they do not know, provide immediate

feedback, and bring that information back to the PLC for discussion. This type of continuing professional development can provide the support that teachers need to develop formative assessments that will strengthen student understanding and promote mastery of concepts. The literature on PLCs, technology, professional development, and formative assessment are bountiful and can provide information to improve and enhance student achievement through technology based formative assessment.

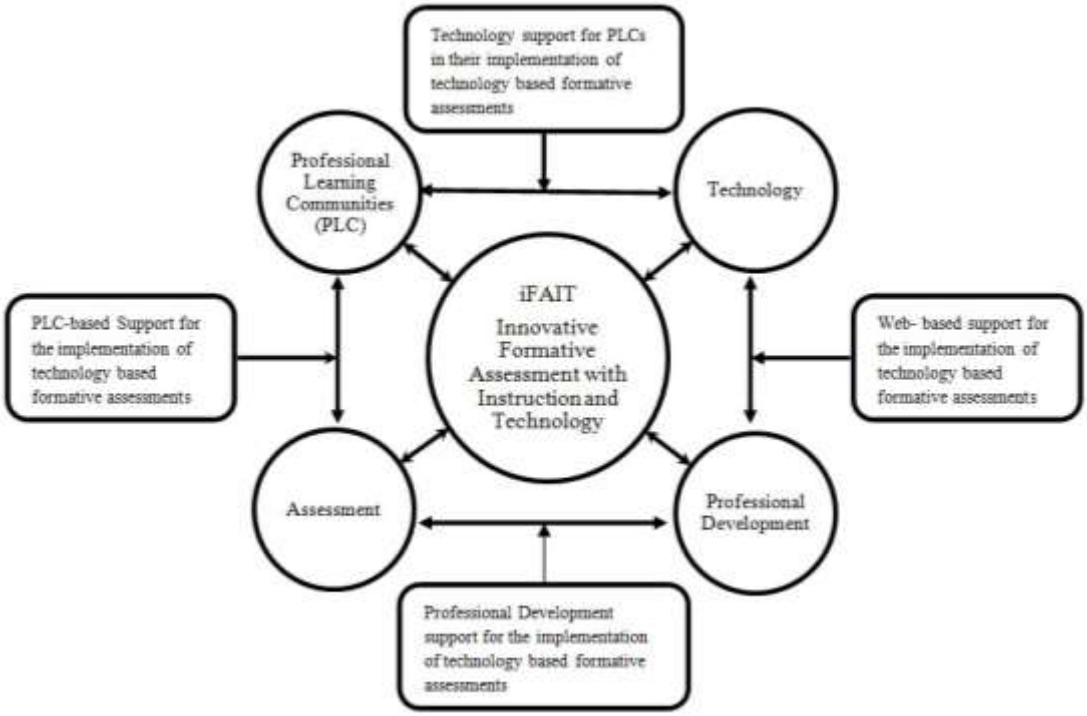


Figure 2.1 Model - Support Structure of iFAIT Within the Literature by Researcher

Historical Aspects of Teachers in PLCs Assessments of Learning

Assessment of learning is as intimidating for teachers as it is for students. Assessment success or failure can hold students and teachers accountable. When

teachers do not respond to student achievement demands and find the necessary corrective measures, collaboration among the teaching staff breaks down. Collaboration must exist in an educational organization or coordination of the most basic of school tasks break down. The mission of the school is to educate and in order for this mission to become a reality, collaboration is essential to the organization's role in the community.

When monetary teacher incentives were introduced to Texas teachers in the 1980s, many teachers began to see each other as competitors rather than colleagues. The Texas Career Ladder was in place from 1984-1992 and provided pay raises from $1500 - $6000 based on local assessment of the teacher's performance, professional development, and years of service (Strayhorn, 2004). In a paper presented at an American Educational Research Association meeting in 1986, Ligon and Ellis noted that there were multiple biases when distributing this type of monetary incentive. Ligon and Ellis (1986) demonstrated how Austin ISD used statistical analysis, particularly z-scores in the distributions of career ladder funds. Austin ISD suddenly abandoned Z-scores due to several factors including dissatisfaction and distrust, changed rules and confused communication, lack of key teachers not selected, and different objectives in place at the campuses. Austin ISD adopted full funding and made the funds available for all teachers that had years of experience and advanced academic training.

Despite the tensions created by monetary incentives in the 1980s, researchers noted how teachers could benefit in collegial activities providing constructive teaching for the experienced teachers as well as the novice. Little (1987) realized that teachers should no longer be an island performing their specific tasks in an independent fashion;

they must become more collegial with each other growing as masters of the trade. Teachers as colleagues talk about teaching, share plans and preparation, observe each other, and train together and train one another (Little, 1987). The stability of collegial relations is extremely fragile, and Little (1987) reported that *serious collaboration* in teaching and learning is rare, but collaboration is needed for educational change.

When connecting teachers with student scores and their achievement, tensions rise and the real issues may be masked. Current research shows that student achievement should not be used to evaluate individual teacher effectiveness or provide monetary incentives, rather measures should be developed that show what teachers collectively do and what happens as a result (Darling-Hammond, Amrein-Beardsley, Haertel, & Rothstein, 2012). The more tools the teachers have in their repertoire, the more prepared they are to face such evaluation. When the teacher turns from *assessment of learning* to *assessment for learning*, they can face what challenges lay ahead. Once assessment for learning is the focus, teachers can work towards that end and begin to join as colleagues rather than combatants. The path to success can become clearer, and the time needed to use formative assessment is more available when using the power of collaboration and technology.

PLCs Designed for Assessment for Learning

In their analysis of the literature on PLCs and student achievement from ten American studies and one English study on the effect of PLCs on pedagogy and student achievement, Vescio, Ross, and Adams (2008) note that PLCs have its origins from within the business community. In order to supply a bountiful research literature to the

review of research on PLCs in teaching practice and student learning, Vescio, et al. (2008) had to use a wide variety of search terms as they relate to PLCs. This included communities of practice and communities of practice in the areas of teachers, schools, and student achievement. Using Newman's 1996 book on authentic achievement, Vescio, et al. (2008) provide five basic characteristics of PLCs in the education system. Their characteristics of PLCs include shared values and norms, clear and constant focus on student learning, reflective dialogue, *deprivatizing* or public practice, and collaborative focus. One of the studies reviewed involved the practices of a *critical friends* group or PLC compared to teachers not participating in a group to promote student achievement; however, the researchers of the study failed to provide data about practices that were there prior to the study (Vescio, et al., 2008). Vescio, et al. (2008) note that in order for the literature to be complete, quantitative studies must document teacher perceptions of change and qualitative studies should document how teachers analyze student work.

PLCs - Social Context

Individuals with diverse backgrounds, but common goals in learning can support and better each other through feedback from one to the other via the social context of learning. The adage that two heads are better than one typifies the PLC concept. Pellegrino and Quellmalz (2010) stress that many studies suggest, "knowledge is embedded within systems of representation, discourse, and physical activity" (p. 89). This would suggest that through collaboration, and when looking at knowledge from different angles and different minds, educators could better educate. In a recent article,

Pellegrino (2012) examines this knowledge acquisition process and acknowledges that assessments do not provide a direct pipeline into student minds, so educators must find ways to assess with multiple mental representations and processes that make student knowledge more visible. In order for learning to occur, a community of professionals can provide a better way to assess since assessment is a complex process. Learning is not in an individual venture and educators must come together as a community. Through the social context, individuals can develop an identity in the community that they learn with together.

Social context involves social contact, be it real through PLC meetings or virtual through an online wiki or other digital collaborative. Although it may seem that online materials are isolated components, the collaborative web expands social contact and the ability to converse and interact with others. Pellegrino and Quellmalz assert that the social context of learning in *responsive social settings* such as a wiki, allows learners share their competence as they are encouraged and perfect their work through the work of others. Feedback from peers is always welcomed for without feedback one feels isolation and disorientation. Deep knowledge and understanding evolves as PLCs practice, give feedback, and affirm each other's learning.

PLCs - Mechanism for Change

In Branch's 2011 dissertation, the coaching experiences of administrators were followed as they lead productive technology PLCs. Branch noted that schools with strong PLCs are better prepared to offer authentic pedagogy and were better prepared to promote student achievement. PLCs have continuous learning opportunities and learn

together for the common goal of student learning. The performance of PLCs was exhibited by open sharing and investigative methodology, embracing risk taking that linked to their organization. Branch stressed that shared leadership should permeate every aspect of a PLC and that successful PLCs view turmoil and tension within the group as an opportunity for creative solutions that strengthen rather than destroy the group for teacher growth. She surmised that PLCs are knowledgeable of their learning environments as they interact with students and the tools used to reach them. In Branch's research, two themes emerged from her qualitative data including the strength of teacher networking and the beneficial use of technology as a form of communication. PLCs are catalysts of change and can facilitate, communicate, collaborate, and innovate.

PLC Digital Resources

PLCs have the ability to create change within a school and can be a powerful force when providing professional development. Pedró (OECD, 2010) notes that digital technology innovations have not evolved as has been hoped, but PLCs can share resources and experiences to lead innovation, the innovation of technology and pedagogy. These experiences can utilize Web 2.0 tools to document their activities, and in this study, a wiki, much like Lai and Ng (2011) note in their research with preservice teachers, can provide a medium of collaborative work in instructional technology (IT), collaboration, and organization skills. PLCs can facilitate, communicate, collaborate, and document their works and findings as they work with their students (Glassman & Kang, 2011; Hutchison & Colwell, 2012; Kim, Miller, Herbert, Pederson, & Loving, 2011; Ruberg, Cummings, Piecka, Ruckman, & Seward 2011).

Digital resources can become valuable to teachers, as their PLC roles require networking with other teachers. As teachers develop these networks, communities of practice (CoPs) evolve from the workplace PLCs where teachers use digital resources to develop their own identity and roles. New school leaders emerge as teachers network with others using digital resources. From electronic bulletin boards and email lists to the Web 2.0 technologies involving social media, blogs, and wikis, technology has allowed the formation of communities that share common interests, creatively develop solutions to common problems, and enable digital habitats as individuals find roles and provide a source of knowledge through their technology stewardship (Wenger, White, & Smith, 2010).

Technology Designed for Assessment for Learning

Technology has changed education as Looi, et al. (2008) and Okoye (2011) note in their studies on PLCs in the professional work place or communities of practice that form from social networks (face-to-face and online) and their implementation of technology and professional development. Okoye found that there are significant correlations to the use of PLCs, computer efficacy, and classroom technology implementation, although some educators believe that intrinsic factors influence technology implementation. Looi, et al. notes that Web 2.0 technologies (wikis, blogs, and other social media) support continual professional development in combination with PLCs and are valuable tools of collaboration of a PLC, but some educators find online environments to be challenging. Little is known how these challenges are overcome, but

when PLCs use technology in their collaborations, the sustainability of the PLC is more lasting and successful.

Technology and Cognition

Cognition is a multifaceted term that may have multiple meanings. Cognition is the process of thought, the chief element of learning that allows the learner to process information, develop understanding, and communicate knowledge and skills. The direction of instruction should be addressed in an engaging manner, where the teacher and their selection of materials are a decisive factor. A variety of strategies allows the teacher to scaffold through materials to prepare students for learning and electronic materials are readily available. Thier and Daviss (2001) assert that engaging digital materials approach learning much differently than traditional textbooks and challenges developers to produce materials that are considered guided inquiry where students develop their own meaning. For this reason, strong connections must be built between educators in order for their students to be successful.

As teachers dive into instruction with their students, they have several learning perspectives that they must consider including prior learning and the implementation of metacognitive skills in the social context that surrounds their students. It is exceedingly difficult to construct metacognitive learning materials when the learner has little prior knowledge. The development of reasoning stems from the development of knowledge and skills that are applicable to real-world situations (Thier & Daviss, 2001). Technology must provide the learner with the ability to construct their own knowledge

through their experiences. These experiences can be provided with technology based formative assessment.

According to Bransford, Brown, and Cocking (National Research Council, 1999), metacognition is "the ability to monitor one's current level of understanding and decide when it is not adequate… [and] recognize the limits of one's current knowledge, then take steps to remedy the situation" (p. 47). Condie and Livingston (2007) note that the development of metacognitive skills include "(1) the ability of students to take responsibility for their own learning, (2) regulate or check their learning, (3) analyze and develop a critical consciousness, and (4) reflect on all the information available to them from today's wide variety of sources" (p. 339). From this information, there is a significant need and opportunity to help students learn to develop metacognitive skills through new technologies. This will allow them to learn how to learn, and adopt a constructivist perspective to teaching and learning, where students' needs are met in an increasing world of technology and information (Condie & Livingston, 2007; Thier & Daviss, 2001).

Clement (1982) identifies one of the most common challenges that teachers face is that once a student has reached the secondary level in their studies; they may have constructed some learning that has misconceptions. Those are often extremely difficult to unseat if the process of reconstruction of learning is not effectively erudited. From this, the task is to create learning that utilizes the most fundamental principles of the concept (Clement, 1982, p. 70). Clement (1982) reminds us that a student's mind cannot be considered as a *blank slat*e as we must come to the realization that student's beliefs

have a profound role in learning. Online teaching sources must allow students to test their beliefs if they are to change. In order for misconceptions to become evident for educators, a mechanism should be in place to assist in the identification and remediation of the misconstruction of knowledge. Technology can be used as a tool to discover what students' beliefs are in the learning process and assist in the displacement of misconceptions for conceptual change.

Technology must allow the evolution of conceptual change through guided inquiry and not through lectures or masses of printed material. This is the danger of *teaching by telling* (National Research Council, 1999). Guided inquiry gives the student power to experience analysis, decision-making, and other personal empowerment as they work through cognitive processes (Thier & Daviss, 2001). Although it seems impossible to know what students are thinking, technologies can make students thinking more transparent and allow teachers to see and hear what their student beliefs contain. If conceptual change is needed, technology must supply it through a variety of learning environments especially those that contain well-organized knowledge of concepts and inquiry procedures (National Research Council, 1999, p. 155). Technology based formative assessments help meet that demand.

Technology for Learning

Interactive White Boards, IWB, and their associated components—student response systems or clickers, mobile slates, and document readers—have been lauded in educational circles as tools for student engagement and knowledge building and provide a rich learning environment in an otherwise lecture based pedagogical system. This

technology, collectively known as Audience Response Systems or ARS, enables teachers to implement technology as mind tools that encourage learning as children scaffold through information constructing their own learning (Jonassen & Carr, 2000; Shim & Li, 2006). Research has indicated that the tool is only as good as the user or facilitator and the professional development that the teacher receives (Al-Quirim, 2010; Armstrong, et. al, 2005; Glover & Miller, 2009; Hall & Higgins, 2005; Mercer, et al. 2010). This study will provide a lens into a purposeful alternative to standard professional development via PLCs and will promote the active use of the ARS as a tool of instruction and assessment via web-based venues, as well as face-to-face meetings geared to individual teacher's needs.

ARSs promote engagement, assessment, and achievement in a classroom where the student becomes a critical voice in a lecture based system provided by a nurturing teacher. Students engage in their own learning as teachers present material through presentation software and connect peripheral devices via an IWB, and gather information on student learning via clickers or other response devices. This system offers immediate formative assessment from students allowing teacher intervention when the need for further explanation facilitates student understanding. Through the system, teachers can provide immediate feedback that is necessary to facilitate understanding through on screen explanations or by using online materials to sustain corrective learning. In their review of the literature on interactive white boards and associated technologies, Higgins, et al. (2007) found that the teacher is a critical element in the success of ARSs.

Current Research in Technology Based Formative Assessments

Most research literature from classrooms in the United States that use technology based formative assessments or components of the tools and processes for formative assessment involve college classrooms and few studies relate to K-12 classrooms. The work of Glover and Miller (2009), Hall and Higgins (2005), and Mercer, et al. (2010) of the United Kingdom note the advantages of IWB, a component of an ARS and associated technologies in formative assessments. Beatty and Gerace (2009) and Feldman and Capobianco (2008) used ARSs and question driven formative assessments in their university studies to investigate approaches for specific content in the secondary math and sciences. Current research also demonstrates how researchers provide the professional development for formative assessment development in collaboration with one another (Branch, 2011; Burns, 2010). Few studies embrace the collaborative capabilities of PLCs to promote the use and application of technology based formative assessments. This record of study can add to the educational literature by the research and information obtained through continual professional development via PLCs, delivered to teachers using iFAIT to drive instruction.

Assessments Designed for Assessment for Learning

Assessment is a vital component of the school agenda that will probably continue for several more generations. Whether the assessment is formative or summative, each tests students learning of curriculum standards, but how these assessments become instruments of testing for learning becomes a much greater task for teachers and students. Pellegrino (2012) defines assessments as a tool designed to observe students'

behavior and produce data that can be used to draw reasonable inferences about what students know. Educators within K-12 are attune to the demands of mandated testing and continually under the scrutiny of individuals and other entities that are flooding the schools' calendar with *testing* days rather than *teaching* days. Moss and Crowley (2011) wrote that a "*needs assessment* approach [should] form part of the Test-Teach-Test model combining assessment for learning with the assessment of learning" (p. 39). The product of learning has become a focus in standardized assessments rather than the process of learning.

Summative Assessment

Summative assessment is a picture of student achievement or a measure of performance of schools and student subgroups within a content area that is the cumulating event when formative assessment measures are nearing completion. Bennett (2011) found that the difference between summative and formative assessment was first noted in Scriven's 1967 works when he referred to summative assessment as the evaluation of the value of an educational program. Summative assessment is then the methodology used to judge what the learner knows at the end of an educational program or study, and it is difficult to separate formative assessment from summative assessment. Summative assessments change the school culture by motivating both student and teacher to work harder to produce educational change (National Academy of Sciences, 2001).

Through the last two decades, the distinction between summative and formative assessments have been blurred promoting summative assessment as assessment of

learning and formative assessment as assessment for learning. It is particularly noteworthy that the two types of assessments remain connected as each serves a vital role in the learning process. Summative assessment provides a valuable learning experience when the design of the test is a representation of what is desired in learning, when the learning is strengthened by the information on the test, and when some formative information is present in the summative assessment connecting current learning with future learning (Bennett, 2011).

Formative Assessments

Formative assessment has been lauded as a means to increase student achievement if teachers implement a sustainable system for students to check their understanding as they progress through learning materials. This process is promoted by evidence of the what, why, and how in data that are presented to the educator in formative assessments. The teacher must develop appropriate formative assessments to analyze student understandings in order for the empirical nature of summative assessments to become concrete. Effective formative assessments are partnered with immediate feedback, feedback within minutes provided by technology, rather than feedback given days later in numerical values and abbreviated commentary.

In a 2010 study on teachers' implementation of formative assessment strategies, Burns used teachers and their students to examine the implementation of formative assessment in three school districts. Burns found that student self-assessment and opportunities for students to monitor their own progress were not a common practice in the schools. When teachers noted that they modified their instructional strategies on the

spot when they saw that students were struggling, the students noted that this only happened occasionally. Burns questioned teachers on the use of formative assessment strategies and found that many teachers did not understand the nature and use of formative assessments. Both teachers and students believed that grades indicated understanding regardless of the breadth and depth of the material the teacher covered. Burns' study revealed that although formative evaluation was acknowledged in the late 1960s, many teachers did not understand what formative assessment entailed. In her recommendations for future studies, Burns suggested that any research dealing with formative assessments must be accompanied with different formative assessment strategies, particularly those that allow students to assess their own learning.

Assessments should transform learning by involving students in the assessment process. The development and administration of formative assessments can often become burdensome, but technology can make assessment and formative feedback an easy task with ARS systems (Moss & Crowley, 2011). Group assessment opportunities allow students to become actively involved in the content. Mohon (2008) noted that peer assessments provide collaboration when using the IWB enabling students to develop their own learning materials as the teacher as facilitator, changes the instructional path as necessary during formative assessments.

Feldman and Capobianco (2008) and Beatty and Gerace (2009) researched the various aspects of technology-enhanced formative assessment with high school physics teachers in Massachusetts using ARSs. Both argued for the separate, yet equal importance of the technology and the pedagogy. Beatty and Gerace provided an

explanation of the process of TEFA or technology enhanced formative assessment and presented a multidimensional reasoning as to how the ARS produced an active and engaging learning environment with question driven instruction. Feldman and Capobianco's study focused on the use of action research and the need to understand how formative assessment becomes part of a teacher's practice. Feldman and Capobianco fashioned his study based on the technologies (hardware, software, and item construction), the understanding of formative assessment, and collaboration with other interested teachers. Feldman and Capobianco's study revealed that in order for formative assessment to be effective teachers must know what formative assessment is and be able to collaborate with each other. The theme throughout each study was the importance of teachers knowing what formative assessment was and how collaboration can extend student and teacher productivity.

Professional Development Designed for Assessments for Learning

Professional development has become more than meeting in a room with a presenter or motivational speaker especially in the area of assessment. Professional development must become more sensitive to the time that teachers have to grow in their profession. Teachers are expected to be in their classrooms and continually responsive to the needs of their students. Carter (2009) advocates the professional development of adult teachers using a constructivist learning approach. Carter uses the 2005 work of Marlowe and Page to identify the basic principles of constructivist learning "(1) constructing of knowledge, not receiving it; (2) understanding and applying, not recall; (3) thinking and analyzing, not accumulating and memorizing; and (4) being active, not passive" (Carter,

2009, p. 20). Carter also emphasizes that teachers need to learn in PLCs in the same workplace, but need to broaden their learning through CoPs that have the diversity of locale or discipline. Carter's professional development encourages the practice of developing teacher voices to solve problems and empower their ability to collaborate and learn from each other in local and distant locations in CoPs.

The Boston Ready Professional Development Resources uses a PLC model for their professional development; however, much of the professional development is based on CoPs that extend beyond the workplace PLC. In their Communities of Practice Indicators Worksheet (Boston Ready, 2009) combines the CoP research work of eleven researchers to produce a worksheet or checklist that gives schools a hierarchy of CoP indicators involving membership, process/activities, and outputs/outcomes. According to their checklist, CoP's memberships should have joint enterprise, diverse membership, and a participatory framework identified by competences, purpose, and interests. These CoP memberships must also have stakeholder representation, no set organizational or geographical boundaries, and actively involved in goal setting, strategic strategies, joint sharing of community roles, and internally motivated. CoP's process and activities include a mutual sense of community, share, and exchange knowledge, have time for reflection, extend beyond time and place, and continuity. The outputs/outcomes of CoPs have action orientation, construct new knowledge, and disseminate knowledge to others in the field.

In order for formative assessment to be effective, teachers must have a clearer understanding about what formative assessment entails as it is embedded in pedagogical

knowledge (Bennett, 2011). When coupled with measurement and technology, the need for professional development is substantial when working through these interconnected components. Bennett (2011) sees this as a joint process that takes significant time for teachers to incorporate into their formative assessment materials. Teachers need time to incorporate these materials in their practice where they can "engage in iterative cycles of use, reflection, adaptation, and eventual creation – all firmly rooted in meaningful cognitive-domain models… [to] better integrate the process and methodology of formative assessment with deep domain understanding" (p. 19).

In a situation similar to the one found at CMISD, a Georgia school district where Fuller (2011) served as a technology specialist, purchased an ARS and mobile IWB for every secondary teacher in the district to implement technology based formative assessments. Using a selection of two middle schools in the district, Fuller provided professional development, performed classroom observations of the teachers using the technology, and gave the teachers an enabling voice through evaluations of teacher perceptions of the professional development that Fuller delivered. Fuller's study used Guskey's five levels of professional development that addressed teaching, scholarship, and leadership to meet the needs of teachers.

This study primarily rated Fuller's teaching approach to learning the technology and pedagogy of technology based formative assessment; however, Fuller noted that future research should implement a team approach and instructional coaching model to serve teachers in their integration of technology and formative assessments. Furthermore, Fuller noted that time to work with the technology was not available to

meet teachers' basic needs. In particular, teachers felt the time to match student needs with the necessary feedback from data presented in a single setting was a weakness in the process. The study with CMISD using iFAIT will support a data compiler, Eduphoria!, which can effectively demonstrate the learning objectives collectively and how progress is being made over time. This will match student needs and present data in a single setting.

Data-driven decision-making may seem new, but many of the concepts surrounding it are not. Formative assessment has been used to guide instruction in determining where to go next in instruction. Technology has narrowed the chasm between what students know, what they do not know, and how to get there making the data easier to follow and feedback to students faster. Swan and Mazur (2011) used a technology application called CaseMate on a web-based site that allowed the development of formative assessment and student achievement that could be aligned identifying student strengths and weakness in a color-coded matrix. These researchers found that there were three key barriers that had to be overcome for successful implementation of formative assessment including curriculum structure and policy, data access, and data interpretation, which varies widely. Professional development must become an essential component of data analysis joining PLC collaboration, technology, and formative assessment of iFAIT. Teachers helping teachers in their PLC can expedite the process of professional development.

In order for formative assessment to obtain a meaningful definition, one that allows a set of practices to be in place to further learning and student achievement, the

educational context of the process must be analyzed. This analysis is rooted in the action of its use, effective research, conceptualized within specific domains, inferences that can be made from what students know, and knowledge needed to implement formative assessment (Bennett, 2011). Using PLCs as advocates of technology and formative assessment completes the picture. Quality teaching should be was focused on student engagement, assessment with immediate feedback from the teacher in order for students to achieve, and a means by which teachers can evaluate the feedback that they receive and give. Technology via the ARS, standardized assessment instruments, and the online data compiler, Eduphoria! in place at the district level can make the transition easier. PLCs can constructively help each other with formative assessments, the technology, and student data interpretation.

CHAPTER III

METHODOLOGY AND METHODS

Methodology

This study used a mixed methods research approach as it focuses on "real-life contextual understandings, multi-level perspectives, and cultural influences" (Creswell, Klassen, Clark, & Smith, 2011, p. 6). The study sought to answer the following question: In what ways do personal and professional factors affect elementary and secondary teachers within PLCs as collaboration evolves with the implementation of technology-based formative assessments via iFAIT? The *sequential explanatory mixed method participant select variant model* best supported this study and consisted of two distinct phases: quantitative followed by qualitative, which is the most direct of all the mixed methods designs (Creswell & Plano Clark, 2007). The strengths of the design included its ease to implement with one researcher, the data is taken in two phases that make it easily understood and written, the research could split into multiphase investigations, and quantitative researchers accept the design (Creswell & Plano Clark, 2010, p. 84).

PLCs are communities of practice in the workplace that learn, share, and grow in strength of shared practices (Looi, et al., 2008). This study involved need to share problems, the problems that teachers experience when using technology in formative assessments. Evidence of this shared knowledge is perceived and unperceived, practice-based and theoretically based and can be measured quantitatively and qualitatively. The evidence needed to make realistic conclusions is multifaceted. The need for mixed

method research is twofold where evidence is required to improve the accuracy of the data and needed to produce a better picture of what is going on using complementary instruments in qualitative research format as well as in quantitative research format.

Opfer and Pedder (2011) note that the research literature on teacher learning and professional development expect change orientation through four different avenues when:

- the professional development can be applied in teaching and learning;
- the professional development is within actual field and classroom experiences;
- teachers are given time for reflection after the practice gained from the professional development; and
- teachers are given a secure environment that offers refuge from challenging or novel circumstances.

Since these characteristics of teacher professional development are more complex than simple purposes, questions, or issues, there was the need for research that defined teachers' worldviews or beliefs (Creswell, 2007). To address the issues, a research protocol was developed to measure teacher beliefs and the changes that occur in those beliefs that spur organizational change, particularly in the areas of assessment and student achievement. Biases are present when only one method of data collection or analysis is used, so stronger research results are present in mixed methods where both perceptions and influences envelope the purpose of research as was the case in this study (Rocco, Bliss, Gallagher, & Perez-Prado, 2003). In fact, Ross, Morrison, and Lowther

(2010) state that with the complexities that often accompany technology in K-12 settings, there is much more going on than empirical data and quantitative data usually needed for federal funders is not easily turned into meaningful results for educators. Ross, et al. (2010) believes that mixed methods research holds significant potential, especially to guide the integration of technology in K-12 schools.

Mixed Methods

The *sequential explanatory mixed method participant select variant model* as the name *sequential* implies, collects the quantitative data first and analyzes the information followed by the qualitative data collection in this mixed method model. The explanatory mixed method approach uses the qualitative data to help explain (*explanatory*) the quantitative results. The rationale for running the quantitative data first for this model is for finding participants in the qualitative phase (*participant select)* by closely examining the quantitative data. In this research design, quantitative data drives the direction of the study providing information for participant selection and the questions asked in the interview phase or qualitative data collection.

In this design, a *sequential explanatory mixed method participant select variant design*, this researcher collected and analyzed the quantitative (numeric) data. From this data, the researcher selected the most appropriate participants for the qualitative portion of the research (Creswell & Plano Clark, 2007). Once the qualitative (text) data was collected, the analysis of the second sequence of the research helped explain, or elaborate on, the quantitative results obtained in the first phase. The rationale for this approach was that the quantitative data and their subsequent analysis provided a greater

understanding of the research problem. The qualitative data and their analysis refined and explained those statistical results by exploring participants' views in more depth (Rossman & Wilson, 1985; Creswell, 2007).

Description of Data Collection

By the end of September 2012, a voluntary request of certified teachers to complete the survey, Formative Assessment Use Scale and Technology with Related Educator Perceptions, and Demographic Information (Appendix B) in Survey Monkey. As shown in Table 3.1 Visual Model for Sequential Explanatory Mixed-Methods Participant Select Variant Design Procedures, page 48, the quantitative data collection began with the survey found in Appendix B, which examined formative assessment use scale with related teacher perceptions and demographic information. This allowed the researcher to get a consensus of the perceptions and experiences teachers in CMISD held with formative assessment and technology. The purpose of this instrument was to provide information about CMISD's teacher baseline formative assessment practices, technology use, and the perceptions they held in regards to technology based formative assessment or iFAIT. This request was made via campus meetings, information flyers, and email to uncover teacher use of formative assessments and to use technology to expedite the development, administration, analysis of formative assessments. No identifiers were associated with the instrument other than subject area, grades taught, years teaching, and years associated with CMISD.

As shown in Table 3.1 Visual Model for Sequential Explanatory Mixed-Methods Participant Select Variant Design Procedures, page 48, once this survey was analyzed

using descriptive statistics, frequencies, and an ANOVA for factors and variations in teacher responses that were derived, the researcher found a cross-section of four select teachers for the qualitative phase. The analysis of this survey was completed using IBM's SPSS.

As soon as the quantitative data was analyzed and select participants chosen from that data, formal interviews (Appendix C) commenced and finalized by the first week of November 2012. The purpose for selecting four teachers for interviewing was to gather information to dig deeper into the issues uncovered by the quantitative data. These interviews focused on questions relating to formative assessments and technology and collaboration within their respective PLC to solve problems and issues that were exposed during the process. Informed consent and confidentiality were explained to these select participants and signed prior to the interviews. The interview questions were provided to the participants a week prior to the interview. These interviews were audio recorded and documented in a word processing program. The interviews relied on text data to code and find common and themes. This research used constant comparative methods to join interviews and later the December 2012 open-ended responses added to the three-part survey, which allowed the coding, and frequency analysis to enhance the analytical integrity of the data.

At the end of the study in December 2012 and demonstrated by Table 3.1 Visual Model for Sequential Explanatory Mixed-Methods Participant Select Variant Design Procedures, page 47, teachers that completed the survey Appendix B Formative Assessment Use Scale and Technology with Related Educator Perceptions, and

Demographic Information, in September 2012 completed an identical survey as found in Appendix D . This instrument was written in the past tense in Survey Monkey. This concluding survey allowed the data from the instrument completed in September 2012 to be compared for obtaining information from teachers to see if there are statistically significant changes in teacher responses.

As shown in Table 3.1 Visual Model for Sequential Explanatory Mixed-Methods Participant Select Variant Design Procedures Research Part 2, page 48, eleven additional open-responses in the December 2012 data enhanced the qualitative data. At the end of the study in December 2012, open-ended survey items were added to the final survey to solicit responses from a wider group of teachers. The purpose of the open-ended responses was to gather information to dig deeper into the issues and resolutions uncovered by the concluding quantitative data by including survey items related to formative assessments and technology and collaboration within the PLCs that was used to solve problems and issues that were exposed during the study. The researcher asked that only those that had completed the entire survey in September complete the survey in December. This procedure allowed the researcher to compare the September 2012 survey with the later for quantitative comparisons that included analysis with descriptive statistics, frequencies, ANOVA, and paired sample t-tests between the September 2012 survey and the December 2012 survey.

Table 3.1 Visual Model for Sequential Explanatory Mixed-Methods Participant Select Variant Design Procedures. Creswell, J. W. & Plano Clark, V. (2007) *Designing and Conducting Mixed Methods Research*. Thousand Oaks, CA: Sage. Ivankova, V., Creswell, J., & Stick, S. (2006). Using mixed-methods sequential explanatory design: From theory to practice, *Field Methods, 18*(3), 3-20, doi: 10.1177/1525822X05282260

Research Part 1		
Research and Data Phase	**Data Collection and Type of Data Analysis Procedures**	**Type of Data and Data Interpretation Products**
Quantitative Data Collection	(Appendix B) Formative Assessment Use Scale and Technology with Related Educator Perceptions, and Demographic Information	• Numeric data Beginning
Quantitative Data Analysis	• Data Screening • Factor Analysis • Frequencies • ANOVA	• Descriptive statistics • Factor loadings • Descriptive statistics • ANOVA Beginning
Connecting Quantitative and Qualitative Phases	• Purposely selecting a cross-section of 4 teachers from 13 PLC groups based on responses, campus, and maximum variance • Begin interview questions (revise if necessary)	• Cases (N=55) • Interview protocol (n=4)
Qualitative Data	(Appendix C) Interviews of select 4 teachers from Representative Cross-Sections	• Text data (Interview recording) Beginning
Qualitative Data Analysis	• Content Analysis • Coding and thematic analysis • Qualitative software • Word Clouds • Microsoft Word find searches	• Codes and themes • Similar and different themes and categories • Cross-thematic matrix Continual

Table 3.1 Continued

Research Part 2		
Research and Data Phase	**Data Collection and Type of Data Analysis Procedures**	**Type of Data and Data Interpretation Products**
Quantitative Data Collection	(Appendix D) Formative Assessment Use Scale and Technology with Related Educator Perceptions, and Demographic Information	• Numeric data to compare with the beginning Quantitative Data Collection (Appendix B and D) End
Quantitative Data Analysis	• Data Screening • Factor Analysis • Frequencies • ANOVA	• Descriptive statistics • Factor loadings • Descriptive statistics • ANOVA End
Qualitative Data Collection	(Appendix D) Open Ended Responses	• Text data from open-ended responses End
Qualitative Data Analysis	• Coding and thematic analysis • Qualitative Software WordSmith • Word Clouds • Microsoft Word find searches	• Codes and themes • Similar and different themes and categories
Integration of the Quantitative and Qualitative Results	• Interpretation and explanation of the quantitative and qualitative results	• Discussion • Implications • Future Research

Methods

Setting

Test scores in CMISD have steadily improved through the concentrated efforts of teachers and administrators in their analysis of past student performance on state assessments and the way that curriculum is delivered. Rules have changed with the advent of the State Assessment of Academic Readiness, testing students in grades 3-12 where the rigor and complexity of the Texas Essential Knowledge and Skills or TEKS has been increased (Texas Education Agency, July 2012). In preparation for this change, CMISD initiated a monumental pedagogical shift in the way their staff use technology for formative assessment with the addition of Audience Response Systems (ARSs) and the expanded use of the online education database software system, Eduphoria! giving teachers the ability to use technology in their instruction and formative assessment. Teachers were excited about the potential that these technologies held as they were introduced to all core subject areas within the district, but the use of the tools has been sporadic and was not used as much as had been hoped. The problem was that not enough teachers were using these helpful, new technologies, this study sought to understand the effectiveness of PLCs as they collaborated to develop, administer, and analyze student data with technology based formative assessment or iFAIT.

In May 2011, the CMISD administration asked their staff to complete a survey that was patterned after the work of Parsad, et al. (2001) in the National Center for Education Statistics' Teacher Preparation and Professional Development: 2000. This survey revealed that the most urgent priority for teacher professional development was

to learn more about the technologies that were now available to them in the ARSs and the formative assessments that can be created and used to analyze student performance data for local and state assessments via Eduphoria!. Technology makes the seemingly impossible task of sorting and analyzing data possible. Teachers can no longer use the excuse that the technology is old and archaic as new computers were purchased during the summer of 2012. Windows 7 Professional was driving the computers on improved network architecture. The technology will continue to be updated through the next few years to provide teachers with tools that will function.

During the school year 2012-2013, new administration came into CMISD — Superintendent, Assistant Superintendent, Crocket Elementary School principal and Crocket Middle School principal. The vision of this new administration was to bring greater meaning and value to its organized PLCs. For the past three years, PLCs had become commonplace in the district; however, most of the PLCs were in name only and not a strong force. The new administration in CMISD came together quickly forming a PLC of their own. When the teachers returned to their respective campuses, the campus principals organized their teachers into PLCs- Crocket Elementary School in grade levels grades 1-5 and Crocket Middle School and Crocket High School in ELA, mathematics, science, and social studies. The campus principals spent the first few weeks of school modeling what a PLC encompasses—collaboration, cooperation, respect, responsiveness, and ownership. From the PLCs that have been established, more attention could be given to the development of common formative assessments (CFAs) to monitor student progress in each level of instruction where feedback from teachers

could come quickly and more efficiently. As teachers worked together weekly within their PLC, the expectation of administration was that through collaboration, teachers would use the data they received from these formative assessments to drive their instruction. Teachers would work together to develop strategies for remediation and instruction to facilitate learning in their classrooms for greater student achievement.

Upon arrival for the 2012-2013 school year, all teachers in CMISD were given opportunities for professional development on technology based formative assessments and data interpretation using data from the 2011-2012 STAAR and TAKS results. This service continues throughout the year in teachers' respected PLCs. This study attempted to learn what mechanisms exist as teachers in PLCs collaborate to implement data driven instruction via the implementation of technology based formative assessment. Teachers working and collaborating as PLCs with technology can sustain and further the practice of data-driven instruction and develop a trail that encompasses student prior knowledge, students' current understandings, and delivers the feedback needed to get students back on track with what they need to know, what they have to know to be successful, and how to get there.

Participants

Crocket Memorial ISD currently has approximately 110 classroom teachers in grades 1-12. Of these teachers, about 35% of them teach at Crocket Elementary School (1st – 5th grade), 25% teach at Crockett Middle School (6th – 8th grade), and around 40% teach at Crockett High School. Approximately 60% of these teachers are core (English Language Arts (ELA), mathematics, science, and social studies) teachers. CMISD has a

teaching force of 25% male and 75% female. Master's degrees are held by 25% of the teachers, and the remaining teachers have their bachelor's degree. The ethnicity of the staff in CMISD was 1% African American, 9% Hispanic, 87% white, 1% Asian, and 2% other ethnicity. Teachers on each campus of CMISD have organized PLCs for curriculum development, student needs assessments, and to promote cohesiveness among the faculty. These PLCs are organized by grade level in the elementary school and subject area in the secondary schools. The teaching staff at CMISD has a high percentage of experienced faculty members as 60% of them have been teaching for over 10 years, and 40% of the teachers have less than 10 years of experience. Over 30% of the teaching staff has taught for over 20 years. This means that a large percentage of the teacher population are digital immigrants (Prensky, 2001) or have learned most technology skills after being in university teaching programs. The younger populous of the teaching staff are avid users of technology, which makes this a fertile territory of experienced teachers in pedagogy and youthful experience in technology.

At the end of the 2011-2012 school year, the certified teaching staff of CMISD took the "Classroom Assessment Literacy Inventory" (ALI) developed by Dr. Cynthia Campbell and Dr. Craig Mertler to determine their knowledge of assessment (Mertler, 2009). Based on the results of the inventory, professional development was designed to strengthen any areas of weakness shown on the ALI, specifically those areas that are necessary for formative assessments. The researcher analyzed student assessment data from the 2011-2012 State of Texas Assessment of Academic Readiness (STAAR) or Texas Assessment of Knowledge and Skills (TAKS) received from the Texas Education

Agency (TEA) during the summer 2012. The information gleaned from the STAAR student data was blended into the professional development. The information from teacher assessment knowledge and CMISD student data provided core information in the manifestation of the role that formative assessments play in student achievement at CMISD, particularly in areas of students' academic weaknesses. The central office administration of CMISD assisted campus administration in the organization of PLCs specifically organized to promote continuity, collegiality, and enhancement of the teaching community at large in CMISD. The provision of professional development to meet technology and formative assessment needs have been developed by the administration. Those provisions included the assistance of this researcher that provided support for CMISD certified and supporting staff during the school year 2012-2013.

All certified teaching staff within CMISD was given the opportunity to complete the 3-part survey in Appendix B, Formative Assessment Use Scale with Related Educator Perceptions, and Demographic Information from a modified survey that Burns (2010), Fuller (2011), and Gates (2008) used in their studies. Most teachers within CMISD were well acquainted with formative assessment practices. With the information secured from the survey, general information of teacher perceptions and experiences with formative assessment and technology in CMISD determined the course of action for the district as well as for the fall 2012 study, which was conducted from early September to the first week of December. In CMISD, there were thirteen active PLCs with four to six members in each PLC that were used to collect the quantitative data of the study. Within these PLCs, a cross sample of at least four teachers was used for in-

depth questioning relating to significant information that was revealed from the beginning survey. These teachers came from a representative sampling including subject area, experienced teachers, novice teachers, etc. using their PLC to develop, create, administer, and interpret student assessments with technology during the qualitative portion of the study. Participant selection was based on purposive sampling designed to (1) generate a sample to match research questions; (2) address specific purposes; (3) utilize a small sampling for in depth qualitative measures; (4) use informal sampling frame larger than sample; and (5) provide narrative data (Teddlie & Yu, 2007, p. 24) producing a *sequential explanatory mixed method participant select variant design*.

Fifty-five teachers were extracted from 88 responses to the survey in the core curriculum classes of ELA, mathematics, science, and social studies. This also included generalists from the elementary schools and special education teachers. The thirty-three teachers dropped from the study either did not complete the survey or were from non-core classes. The demographic information was further broken down by student grade level, years teaching, and years teaching at CMISD as seen in Table 3.2 Demographic Information of Study Participants.

Table 3.2 Demographic Information of Study Participants

		Years Teaching				Years Teaching at CMISD			
Number	Subject/Grade	0-5	6-10	11-20	>20	0-5	6-10	11-20	>20
10	**ELA**								
2	3rd-5th	1	0	0	1	1	0	0	1
4	6th- 8th	1	1	2	0	1	2	1	0
4	9th-12th	0	0	2	2	3	0	1	0

Table 3.2 Continued

		Years Teaching				Years Teaching at CMISD			
Number	Subject/Grade	0-5	6-10	11-20	>20	0-5	6-10	11-20	>20
12	**Math**								
1	1st-2nd	0	0	1	0	0	0	1	0
4	3rd-5th	0	0	1	2	0	1	2	1
1	6th- 8th	0	1	0	0	0	1	0	0
6	9th-12th	2	1	2	2	3	3	0	0
7	**Science**								
2	3rd-5th	1	0	1	0	2	0	0	0
2	6th- 8th	1	0	1	0	1	0	1	0
3	9th-12th	0	1	2	0	3	0	0	0
9	**Social Studies**								
1	3rd-5th	1	0	0	0	1	0	0	0
3	6th- 8th	2	1	0	0	2	1	0	0
5	9th-12th	2	1	2	0	4	1	0	0
10	**Generalist**								
5	1st-2nd	0	0	2	3	1	1	2	1
1	3rd-5th	0	0	1	0	0	0	1	0
1	6th- 8th	0	0	1	0	0	0	1	0
3	9th-12th	1	1	1	0	1	1	1	0
7	**Special Ed**								
1	1st-2nd	0	0	1	0	1	0	0	0
1	3rd-5th	1	0	0	0	1	0	0	0
2	6th- 8th	0	2	1	0	2	0	0	0
2	9th-12th	0	1	1	0	1	1	1	0
55	**←Totals→**	**13**	**10**	**22**	**10**	**28**	**12**	**12**	**3**

Study Design

In response to the main research question, *In what ways do personal and professional factors affect elementary and secondary teachers within PLCs as collaboration evolves with the implementation of technology-based formative assessments via iFAIT?* and to the explanatory mixed methods research design that was

used to explain the collaboration, instruments were developed and used over a sixteen-week period from September through December 2012. Table 3.1 Visual Model for Sequential Explanatory Mixed Methods Participant Select Variant Design Procedures on page 48 and 49 outlined the design phase and methods that were used in this research. Table 3.3 Summary of Instruments, Purpose, and Participant Involvement below provides specific information on the instruments, the research methods each represents, the purpose for their administration, the participants that will complete the instruments, and the time frame for the participants to complete the instruments.

Table 3.3 Summary of Instruments, Purpose, and Participant Involvement

Instrument	Purpose	Participants	Data Dates	Time Spent by the participant
Quantitative Methods				
Appendix B iFAIT Participants' Survey Sept. 2012	To define the attributes of study participants to their teacher experiences and perceptions of iFAIT	55 teachers in the PLC Groups	Mid-Sept. 2012	15-30 minutes
Qualitative Methods				
Appendix C iFAIT Participants' Interview Questions	To define PLC members' common goals and practices with current technology	Four teachers from a cross-section of members in PLC groups	Mid-Oct. 2012-Nov. 2012	1 hour
Quantitative Methods				
Appendix D iFAIT Participants' Survey Dec. 2012	To identify the use, type of use, contributions, and frequency of use of formative assessment by the PLCs.	PLC Groups (N=55)	Dec. 7-14, 2012	15-30 minutes
Qual Methods				Qualitative
Appendix D iFAIT Participants' Open Ended items in Dec. 2012 Survey				30 minutes

For the first phase, the quantitative phase, a survey was developed (Appendix B) to explore the formative assessment practices, the technology use, and the perceptions teachers held of the technology that was available to them. The survey was administered to a volunteer pool of teachers 88 teachers in CMISD. After the data from the quantitative instruments was analyzed, select participants (4 teachers from a representative cross section) were chosen to explain the collaborative processes of a PLC and its collaborative resources in the qualitative research setting.

During the qualitative phase, interviews began with the select four teacher participants. Throughout the study, this researcher attended PLC meetings and provided technology assistance to the entire CMISD teaching staff. However, notes were not taken as planned as the researcher was immersed in technology assistance and the needs of teachers. The interviews became extremely important as the thematic data that they contained uncovered questions that evolved throughout the study.

At the end of the study, all PLC groups in CMISD from the volunteer pool completed the quantitative survey, Formative Assessment Use Scale and Technology with Related Educator Perceptions, and Demographic Information (Appendix D) that was quantitatively analyzed and compared to the corresponding survey in Appendix B at the beginning of the study. Open-ended questions were added to the December 2012 survey to supplement the qualitative data from the interview. Once the quantitative data from the concluding survey was analyzed (Appendix D), data analysis was completed for the quantitative methods of the study.

All of these instruments and their individual analysis were brought together and analyzed during the concluding data analysis period in December 2012.

In summary, the instruments, used to collect the data include the following:

- Quantitative – Survey (Likert-format scale) (Appendix B and D)
- Qualitative - Interviews (Appendix C)
- Qualitative – Open Ended Responses in the Dec. survey (Appendix D)

Quantitative Methods

Description

Quantitative methods were first used in this study. This research strategy will provide purposeful sampling where the focus in information seeking and will enable analytic paths for data analysis (Sandelowski, 2000). The quantitative methods of the study were directed by a survey that gathered information on formative assessments, technology, and the use of PLCs fused together from the dissertation surveys of Burns (2010), Fuller (2011), and Gates (2008). The survey provided the information for quantitative methods used within this study and was necessary to provide a statistical roadmap for the means to develop a training rationale that best met the needs of teachers when using iFAIT.

When gathering information such as this, statisticians (Howell, 2011) suggest using means, standard deviation, variance, and standard errors of the mean for descriptive statistical measures. Readers can get a picture of what is going on in calculations that involve averages or means of responses and the relationships that exist between the categorical variables. From these measures, one can dive a bit more into the

data, find other information, and explore unusual cases provided by inferential statistics. This is done using cross tabs or chi-square measures, comparing the means of two sets of data taken at the same time via t-tests or go beyond the t-test by using one-way analysis of variance or ANOVAs confirmed with Tukey Post Hoc measures to discover variance of a single factor (Howell, 2011).

Instrument: Survey

The September 2012 data collection consisted of a three-part survey administered to 1st – 12th grade teachers in CMISD:

- Survey Part 1 (S1) Teacher Perceptions of the Kinds and Frequency of Formative Assessment Strategies Used in Instruction;
- Survey Part 2 (S2) Kinds and Frequency of Technology Based Formative Assessments Used in Instruction; and
- Survey Part 3 (S3) Teacher Perceptions of iFAIT and the Use of PLCs.

Quantitative Data for Teacher Interviews

The quantitative data for this study involved both descriptive and inferential statistical methodologies. To uncover information relating to teacher demographics of content taught, grade levels taught, and years of teaching as it relates to the use of iFAIT, cross-tabs and ANOVAs confirmed with Tukey Post Hoc measures were first calculated. This data provided the information needed to interview the teachers that were unique in their use of iFAIT or stood out as users of technology when most of their specific group did not. The quantitative data at this stage was critical in the development of a method to learn more about these unique cases of teachers using iFAIT through qualitative means.

Quantitative Data Analysis: Descriptive and Inferential Statistics

Descriptive and inferential statistics played a role in the documentation of teacher perceptions of use and frequency of use of iFAIT over the sixteen weeks of the study. During this time, Teachers learned to work together in their PLCs to provide formative assessment data with technology for administrative and PLC review. September 2012 and December 2012 Survey used the following descriptive statistics to document teacher responses:

- means,
- standard deviations,
- frequencies,
- variances, and
- changes in the means and frequencies.

Standard deviation calculations included in every measure provided importance to the study as it told how the data distributes around the mean. A standard deviation of one means that 68.2% of the responses fall within one standard deviation and the smaller the standard deviation, the more confident the measure. The documentation of the descriptive statistics led to the use of inferential statistics with the September and December 2012 data. This determined the significance of the paired responses by using paired-samples t tests and helped determine if the changes were significant. Inferential statistics measures used were:

- the means of two identical variables over a time from paired-samples t tests;
- the sample size;

- the standard deviation; and
- standard error of the mean to calculate differences.

The smaller the significance, the more variance there was in the paired samples.

Qualitative Methods

Description

The embedding of qualitative data in the quantitative data provided a narrative to document what was actually going on during the time of the study. Qualitative methods followed the quantitative methods for further explanation and validation. This process enables the researcher to find specific characteristics or parameters within the quantitative data that will provide variables that come together to provide answers needed in the study when qualitative methods are employed (Sandelowski, 2000). The interview questions set the tone for the direction of the study in training as well as in research. The determination of the characteristics of teachers in the quantitative research led to choice of interviewees in the qualitative portion of the study. The instruments used for qualitative data analysis included interviews from volunteer teachers who were characteristic of teachers who were implementing iFAIT and eleven open-ended completion statements formulated from the quantitative information submitted at the beginning of the study. Although the researcher developed an iFAIT wiki, currently there is little support of the wiki and other social media assistance for reasons discussed later. I had hoped to be a bystander in PLC meetings providing support and facilitation as necessary; however, my role in the PLC meetings became one that did not give me the

opportunity to take notes and observe. Most of my time in PLC meetings was spent providing support and facilitation of teacher use of iFAIT.

Instruments: Teacher Interviews and Open-Ended Responses

From the quantitative data, teachers were selected for interviews that had significant differences in the way they used technology with formative assessments. From 65 certified core teachers of ELA, math, science, and social studies, teachers were targeted for the interview process from a wide range of fields. They were science teachers, math teachers, ELA teachers, and generalists from both the elementary and secondary campuses. These teachers also varied in their use of technology in the classroom and the number of years that they had taught. Four teachers agreed to be interviewed including one secondary science teacher, two ELA teachers from the secondary and elementary level, and a secondary math teacher. All of the teachers that agreed for interview were technology proficient and had varied teaching experiences novices to educators with more than 20 years of experience in the classroom.

Interview Process

Interview questions were developed from the quantitative information that was received and through a review of the literature. These questions related to teacher formative assessment practices and iFAIT. Interviews were delayed, as teachers were more concerned about learning to use the tools of iFAIT. Before interviews could be done, implementation of teacher training began about mid-September. ARS tools (clickers, mobis, and document cameras) distributed to the entire core teachers in CMISD became a priority with the assistance of CMISD technology and maintenance

departments. Over fifty percent of the tools had lain dormant in the school distribution warehouse for nearly two years. Many teachers had not assumed the responsibility of completing required modules to secure the tools and the decision to move those tools gave teachers the opportunity to learn and use clickers and mobis through the technology assistance of myself and other successful teacher users. Soon teachers in special education and the elective areas were requesting the tools. Teachers begging for training left little room for interviews, so interview questions (Appendix C) were given to teachers during the week of November 5, 2012.

Qualitative Data Analysis: Interview Transcription and Coding

The coding process went through multiple avenues to generate the themes of the interviews. Ryan and Bernard (2003) note that researchers know they have found a theme when they can use an expression and know what it is an example of in the research findings. The type of questions and their clarification in an interview helps the process. The interview data shed light on some things left unanswered in the quantitative data and provided evidence needed to dissect the problems as they presented themselves in the data.

As interviews conclude and transcription leads to further analysis, word clouds can assist researchers. Word clouds alone do not enable the interpretation of themes; however, word clouds such of those generated in Wordle, can give preliminary analysis of key words that emerge by increasing the font size due to the frequency of the word used in a passage (McNaught & Lam, 2010). Word clouds can also validate interpretations of themes. McNaught and Lam used previous qualitative interview data

analysis and demonstrated how Wordle can generate major themes, often identical to themes uncovered by researchers through other methods (McNaught & Lam, 2010). Not only had the word clouds picked up on the big ideas of the research findings, they had also demonstrated the underlying reasons for the likes and dislikes relating to those themes. When using word clouds, the researcher needs to be aware of word cloud pitfalls. In a study pioneered by Ramsden and Bate (2008), word clouds were defined, inspected for considerations involved in their use, and examined in the way word cloud software or applications generate these word clouds. Ramsden and Bate recommended that for data analysis with word clouds, the data should exist in a meaningful state. These formats include:

- electronic format;
- correct spelling and punctuation (hyphens linking words, etc.);
- application and context of the words understood;
- consideration of the way word cloud generators notice single words
- (*interested* used rather than *not interested*); and
- word cloud recognition software's failure to notice words with similar meanings.

Although word cloud documentation needs further research attention in the future, the process was extremely helpful in this study.

The final data analysis of the interviews used the software program, WordSmith Tools, and the built-in search function and word counts of Microsoft Word 2010. WordSmith Tools, developed by Mike Smith is based on lexical analysis, a conversion

of a sequence of characters into an understandable sequence of comments. The codebook generated in WordSmith Tools is found for interviews as well as open-ended responses is clarified in Chapter 4. The listing of words and word clusters in these tables demonstrates their importance within the interviews and open-ended responses discussed later. As another check, the interviews and open-ended responses were run through the *find* function of Microsoft Word 2010 to give the number of times that the word or word cluster appears in the document for the context of the word use.

Triangulation of the Data

The quantitative data, which was analyzed previously, formed explanatory variables to be combined with the qualitative categorical data. The qualitative data that follow the quantitative data provided alternative explanations as needed for the information that was revealed in the quantitative data. Underlying processes were revealed when combining the two types of research that provided an understanding that one type of research cannot. The communication of "results" for the integration of qualitative research into quantitative was sounder and provided a firm foundation for the explanatory structure of the process and its products. From the combined data, this methodology integration provided insight to the research process, more evidence to understand the process, and converged the two for more plausible solutions to educational problems.

A mixed methods approach containing several quantitative and qualitative procedures directed this research. From the quantitative data in the September 2012 survey that used SPSS to analyze frequencies, cross tabs, and ANOVAs confirmed with

Tukey Post Hoc measures from the responses, teacher characteristics desired for interviewees were determined. Specific demographic information from teachers' subject area, grade level taught, and years of teaching were pivotal to discover if any particular group was more or less successful using formative based assessments and the use of technology. Interview questions developed from the initial quantitative data arose from the data. The survey in the December 2012 administration used SPSS to analyze frequencies, cross tabs, and ANOVAs confirmed with Tukey Post Hoc measures from the responses to note any changes among the groups since the September 2012 survey. In addition, the September 2012 and December 2012 survey used paired sample t-tests to determine if there were significant changes in the study from the September 2012 and December 2012 data.

Interviews conducted in early November and open-ended survey items added to the December 2012 survey administration gave substance to the qualitative side of the study. Looking at the qualitative side of the research to complete the mixed method study, three basic themes emerged using hand coding, production of word clouds with Wordle found at http://www.wordle.net/, the computer program WordSmith Tools, and *find* word searches in MS Word 2010. These themes included the use of time, the use of support, and the use of data within PLCs to drive iFAIT.

A typology development integration strategy was used to join the quantitative to qualitative data sets. The quantitative data provided a conceptual framework for the categorical information that the qualitative data provided (Caracelli & Greene, 1993). The embedding of qualitative data in the quantitative data provided a narrative to

document greater insight during the time of the study to discover what collaborative factors influence the use of iFAIT. Caracelli & Greene (1993) suggests that this type of data integration lends itself to iteration, a process that further defines each data type.

Limitations

Challenges exist in all research and the explanatory mixed methods is no different. Creswell and Plano-Clark (2007) expose some of the challenges that hinder this type of research including the time for implementation, the researcher's role in the study, and the introduction of bias into the findings and data integration. First, more time was needed to implement this type of research. Secondly, the researcher assumed two roles in the study—researcher and technology integration specialist providing training for teachers to use iFAIT. Lastly, the researcher needed to decide what areas of iFAIT needing further testing and verification after the initial quantitative portion of the study were completed.

The focus for this study was to analyze the collaborative evolution of PLCs as they developed formative assessments, resolved technology issues, and developed collaborative resources when implementing technology based formative assessment via iFAIT. Since this researcher resigned from a full time teaching position and was contracted to work with iFAIT at CMISD, there was time to concentrate on this study and see that teachers were successful with iFAIT. The researcher had an active role in the district's implementation of the online data system, Eduphoria! and technology integration and the research commenced without jeopardizing the study.

The first concern or limitation of the study was its time since the data will only apply to teachers during the first sixteen weeks of school. A longitudinal study would have provided better evidence of the success of the study. Another item that was not addressed in this study due to time constraints was whether the students of the teachers in the PLCs are more successful or performed better on the state assessments. The time for teachers to participate in this study should not have been a problem; in fact, teachers had the potential to save time with the knowledge and practice they developed with iFAIT. Teachers should have been concerned about the success of their students, iFAIT supported student learning, and achievement and the researcher helped, encouraged, and focused on the process and product, not the people, understanding that all people have frustrations and need to vent.

The second consideration was given to the researcher's assumption of two roles in the study. As a technology integration specialist that could supply the training that was needed for teachers, often teachers would fall back on the support they knew they could get rather than working together to solve technology problems as they developed in the use of iFIAT. In the beginning of the study, teachers were extremely dependent on the training that could be supplied by the researcher; however, after a month of attention to individual training and support, teachers began to help each other. The researcher was only available two days a week to assist the participants, so they had to find and develop other avenues of support, the support of their PLCs or teacher peers.

The third consideration was the introduction of bias into the findings and data integration; however, the use of the quantitative methods at the beginning of the study

was a crucial component when considering the qualitative methods. The researcher was aware of the past technology issues of CMISD. When teachers blamed the technology for iFAIT for their difficulties, it was difficult to believe the teachers were not able to use the technology. The fact that the technology in CMISD had improved remarkably over the last year allowed the researcher to focus on the users of the technology (the teachers) rather than excuses that the technology was not working. A technology audit completed in October 2011 helped determine what type of infrastructure was needed to update aging equipment and network protocols. Teachers have seen better service when working with streaming and quicker network response time due to increased bandwidth for the Internet. The technology personnel have increased in numbers and response time for maintenance and emergencies has been shortened. Special network permissions for teachers have given teachers the ability to integrate more technology into their classrooms quickly and without concern for network blocking. The only real technology issue that was found while doing this research was that the wiki developed for this study initially was blocked when teachers tried to access it. Teachers became frustrated with the blocked resources and perceived security, and legal issues became a concern. Efforts to implement the wiki were unsuccessful. Other technology issues including upgrading from Windows XP to Windows 7 and replacing aging computers has finished and will continue to be on track for the future.

Qualifications of the Protocol Researcher

Personal information should be disclosed when considering the bias that can exist in research and the measures that will be followed to alleviate any bias. I have been in

public education for 35 years, 23 of those years was with a school much like CMISD. I have become well acquainted with research techniques and am sensitive to the needs of teachers and their students. I am convinced that teachers can save time in their development, administration, and analysis of student data with the use of technology. I also have a deep understanding of teacher collaboration, which has become a valuable aspect in PLCs and with social media. I concentrated this research on the teacher, their needs, and the sensitive nature of student data analysis.

I became interested in computer technology in the late 1980s and began to implement technology into my classroom in 1989. As science and technology grew in the 1990s and into the 2000s, I was able to attend numerous institutes and workshops in science and technology, held positions on state technology boards, and received national awards in technology and education. After 25 years in education, I began to see the need for further research as I grew older. I became involved in the Information Technology in Science (ITS) program at Texas A&M University in 2003-2004, received my MEd in Educational Technology in 2008, and am currently in my fourth year of study as an EdD student.

I became interested in the analysis of student data about six years ago after going to Margaret Kilgo workshops and beginning a higher education degree with the ability to increase my understanding as a scholar. I was not interested in the order of curriculum that Kilgo advocated. I was more interested in the relationships that existed between student data and the absence of the knowledge needed to be successful on standardized tests. I began to look at the student's data individually and began to hand enter the data

in MS Excel that I received from students' standardized tests and benchmark exams. This process would take up to 48 hours to compile and produce graphs from data, but the data would reveal the areas my students needed for the incorporation of new concepts, review, and remediation. When Eduphoria! was introduced a few years ago, I knew that this would save much time in the data analysis. As I worked with Eduphoria! over the last 2 years and began to use ARSs and other technology and computer applications, via Eduphoria!, my time was reduced further in the development of TEKS based assessments, student historic data, and TEKS based benchmark assessments.

Stepping out of the teacher mold after thirty-five years in the classroom was quite an experience, but one I welcomed, as I believed that I had something that I could share that would benefit teachers and their students. Not only was I beginning a different path in education, I also began gathering data in the process. As I meet with the new administration of CMISD in early August, I knew that these administrators were geared for change, a change that included the use of technology in the way formative assessment data was collected and analyzed.

Within two weeks of assuming my responsibilities, eInstruction tools (clickers, mobis, and document cameras) were distributed to all of the core teachers in CMISD with the assistance of CMISD technology and maintenance departments. Over fifty percent of the tools had lain dormant in the school distribution warehouse for nearly two years. Many teachers had not assumed the responsibility of completing required modules to secure the tools. The decision to move those tools gave teachers the opportunity to learn and use clickers and mobis through the technology assistance of myself and other

successful teacher users. Soon teachers in special education and the elective areas were requesting the tools.

As the demands of network and equipment began to affect the use of the eInstruction tools and other district computer programs and Internet applications, administration began to replace and discard all the old technologies – computers, wireless routers, etc. Computers using Windows XP and a variety of Windows operating systems were replaced with new computers creating a district networking infrastructure with Windows 7. Teachers began to note increases in response time when using the network and interest began to peak in the technologies the district had in place.

I began offering technology assistance for teachers and administrators the first week of September 2012 and am continuing in that capacity at CMISD. Initially, my goals were to increase teacher use of the eInstruction tools (clickers and Mobis), as well as more implementation of Eduphoria!, which gives teachers and administrators the ability to develop, administer, generate, and store academic data on their students and use formative data to monitor student progress. I attended several PLC meetings often supplying the professional development that teachers needed to implement Eduphoria! in formative assessment development, administration, and data analysis. The consensus of teachers was that they would do what administration asked them to do-use Eduphoria for common formative assessments throughout the six weeks reporting period and use district developed summative assessments in Eduphoria! until teachers learned to develop the assessments themselves. I have served as a teacher liaison reporting to the central office administration.

As the study progressed, more attention has been on using Eduphoria!; however, the eInstruction tools (ARSs) provide an excellent addition for Eduphoria!. The teachers in the district that were experienced with the ARS used these tools for common formative assessments, completed throughout the six weeks reporting period. At the end of every six weeks reporting period, district assessments were given in Eduphoria!. Teachers and district administrators could gauge the progress of students in the core areas of ELA (reading and writing), mathematics, science, and social studies by tracking the success on the Texas Essential Knowledge and Skills (TEKS) of each respective subject. These summative assessments used the answer sheet and scanner function in Eduphoria! to yield the results in order to mimic the actual state mandated tests. As a technology integration specialist and researcher, I was able to see the progress of teachers in their implementation of technology based formative assessment through the lens of both.

CHAPTER IV

FINDINGS

Introduction

This chapter presents the research findings of the collaboration that evolved when teachers used technology based formative assessment or iFAIT in a K-12 rural school. In addition, as teachers implemented iFAIT, the role of oral and written documentation addressed how these collaborative activities support the professional development of teachers. The research was conducted through a mixed methods approach with several quantitative and qualitative procedures.

As teachers work through the processes of teaching and learning, they must work through the curriculum, determine what students know, learn how to deal with students' current understandings, and deliver instruction that will gravitate, and stabilize their students' learning. Teachers must be willing to work and collaborate to meet student needs, but done effectively with minimal disruption of the day-to-day procedures and policies that underlie the business of teaching. In order for teachers to assist students in their learning, they must come together to assess their students and have tools that make the teaching, learning, and assessment fruitful (Moss & Brookhart, 2009).

Teachers were excited about the potential that technology held as a tool for formative assessment when it was introduced, but the use of the technological tools had been sporadic. Research has indicated that formative assessment technologies are only as good as the user or facilitator of the tool and the professional development that the

teacher receives (Al-Quirim, 2010; Armstrong, Barnes, Curran, Mills, Sutherland, & Thompson, 2005; Beatty & Gerace, 2009; Glover & Miller, 2009; Hall & Higgins, 2005; Mercer, Hennessy, & Warwick, 2010). Since the problem at CMISD was that not enough teachers were using these helpful, new technologies, this study sought to understand the collaboration that exists in effective PLCs when implementing iFAIT.

Research Methodology

This study used a mixed methods research approach as it focused on "real-life contextual understandings, multi-level perspectives, and cultural influences" (Creswell, Klassen, Clark, & Smith, 2011, p. 6). The *sequential explanatory mixed method participant select variant model,* as the name *sequential* implies, collects the quantitative data first and analyzes the information followed by the qualitative data collection in this mixed method model, which is the most direct of all the mixed methods designs (Creswell & Plano Clark, 2007). The explanatory mixed method approach uses the qualitative data to help explain (*explanatory*) the quantitative results. The rationale for running the quantitative data first for this model is for finding participants in the qualitative phase (*participant select)* by closely examining the quantitative data. In this research design, quantitative data drives the direction of the study providing information for participant selection and the questions asked in the interview phase or qualitative data collection. The strengths of this research design include its ease to implement with one researcher, the data taken in two phases that make it easily understood and written, the research can split into multiphase investigations, and quantitative researchers easily accept the design (Creswell & Plano Clark, 2010, p. 84).

Research Questions

With this research design in place, the study proceeded and began to answer the following overarching question: In what ways do personal and professional factors affect elementary and secondary teachers within PLCs as collaboration evolves with the implementation of technology-based formative assessments via iFAIT?

The sub questions addressed include:

1. How do teachers within PLCs learn to use technology with formative assessments?
2. To what degree does the oral and written documentation sustain teachers within PLC's successful iFAIT implementation?
3. How does the use of collaborative activities support the "professional development" of teachers within PLCs as they implement iFAIT?

Presentation of the Data

By the end of September 2012, volunteer certified teachers completed the September survey, Formative Assessment Use Scale and Technology with Related Educator Perceptions, and Demographic Information (Appendix B). The purpose of this instrument was to provide information about CMISD's teacher baseline formative assessment practices, technology use, and the perceptions they held in regards to technology based formative assessment or iFAIT. No identifiers were associated with the instrument other than subject area, grades taught, years teaching, and years associated with CMISD.

At the end of the study in December 2012, teachers that completed the survey Formative Assessment Use Scale and Technology with Related Educator Perceptions, and Demographic Information (Appendix B) in September 2012 completed an identical survey (Appendix D). This concluding survey allowed the data from the instrument completed in September 2012 to be compared for obtaining information from teachers to see if there are statistically significant changes in teacher responses.

In the qualitative phase of the study, four teachers were interviewed to dig deeper into the issues uncovered by the quantitative data. These interviews focused on questions relating to formative assessments and technology and collaboration within their respective PLC to solve problems and issues that were exposed during the process. At the end of the study in December 2012, open-ended survey items were added to the final survey to solicit responses from a wider group of teachers. The purpose of the open-ended responses was to gather information to dig deeper into the issues and resolutions uncovered by the survey items related to formative assessments and technology and collaboration within the PLCs that was used to solve problems and issues exposed during the study.

Table 4.1 Summary of the Data Results and Presentation summarizes the data results as they are presented within Chapter 4.

Table 4.1 Summary of the Data Results and Presentation

Method	Survey Origin	Analysis
Quantitative	Teacher Interview Selection from S2 and S3 Data	4 results using ANOVA with Tukey Post Hoc confirmation (Result 1-4)
Quantitative	Survey Part 1 (S1) CMISD 1st- 12th Grade Teacher Perceptions of the Kinds and Frequency of Formative Assessment Strategies Used	6 survey items compared by Sept. 2012 and Dec. 2012 survey administration
Quantitative	Survey Part 2 (S2) CMISD 1st- 12th Grade Kinds and Frequencies of iFAIT Strategies Used (S2a – S2g)	7 survey items compared by Sept. 2012 and Dec. 2012 survey administration
Quantitative	S2 Kinds and Frequencies of iFAIT Strategies Used (S2a – S2g)	4 significant results from paired sample t tests (Result 5-8)
Quantitative	Survey Part 2 (S2) CMISD 1st- 12th Grade Kinds and Frequencies of iFAIT Strategies Use of Written Materials for Teacher Learning (S2h-S2l)	5 survey items compared by Sept. 2012 and Dec. 2012 survey administration
Quantitative	Survey Part 2 (S2) CMISD 1st- 12th Grade Kinds and Frequencies of iFAIT Strategies Use of Written Materials for Teacher Learning (S2h-S2l)	2 significant results from paired sample t tests (Result 9-10)
Quantitative	Survey Part 3 (S3) CMISD 1st- 12th Grade Teacher Perceptions of Technology and the Use of PLCs (S31-S311)	11 survey items compared by Sept. 2012 and Dec. 2012 survey administration
Quantitative	Survey Part 3 (S3) CMISD 1st- 12th Grade Teacher Perceptions of Technology and the Use of PLCs (S31-S311)	2 significant results from paired sample t tests (Result 11 and 12)
Qualitative	Interview Teacher Selection and Question Development	4 teachers for interviews
Qualitative	Interview and Open Ended Response Themes	3 themes, each having 2 subthemes
Qualitative	Use of Time	
Qualitative	Use of Time: Time for Training and Learning	
Qualitative	Use of Time: Time for Group/PLC Collaboration	
Qualitative	Use of Support	

Table 4.1 Continued

Method	Survey Origin	Analysis
Qualitative	Use of Support: Training Support	3 themes, each having 2 subthemes
Qualitative	Use of Support: Question Development Support	
Qualitative	Use of Data	
Qualitative	Use of Data: Teaching Tool	
Qualitative	Use of Data: Instruction and Assessment	
Data Triangulation	Summary of the findings	12 general findings from the quantitative and qualitative data

Quantitative Findings

Quantitative Data: Teacher Interviewee Selection

Once the September 2012 survey was analyzed (Appendix B) by descriptive methods, then examination with cross tabs and ANOVA could be completed to uncover any differences between teacher groups by subject area, grade level taught, and their years of teaching. Ertmer, Gopalakrishnan, and Ross (2001) found that the best technology practices varied by grade level and curricular expectations and resources. Data extracted from the three-part survey helped determine teacher interviewees.

There were no significant differences between 1st-12th grade teachers in CMISD when crosstabs and ANOVAs confirmed with Tukey Post Hoc measures were calculated by content area, grade level taught, and years of teaching groups in Survey Part 1 (S1), Appendix B, which sought to find the kinds and frequencies of formative assessment practices of teachers. CMISD teachers gave positive feedback as they ranked their formative assessment strategies in the 3-4 mean range indicating that they usually or almost always used in the six areas defined in the six formative assessment strategies

categorized in S1. There were no significant differences in the December 2012 survey when ANOVAs confirmed with Tukey Post Hoc measures were calculated by content area, grade level taught, and years of teaching groups in S1.

Survey Part 2 (S2) found in Appendix B adapted from Branch (2011) and Gates (2008) was concerned with teacher use of technology in their formative assessment practices identified in twelve areas. In general, teachers within the content area, grade level taught, and years of teaching were in agreement with their rankings. The use of ANOVA statistical measures confirmed by Tukey Post Hoc measures revealed that there were significant differences found in two areas of S2 between 1st- 12th grade teachers in content or subject areas in Table 4.2 CMISD 1st -12th Grade Teacher Use of Computer Test Programs for Formative Assessments ANOVA and 4.3 CMISD 1st -12th Grade Teacher Use of Assessments Found on the Internet (Including CSCOPE) ANOVA.

Table 4.2 CMISD 1st -12th Grade Teacher Use of Computer Test Programs for Formative Assessments ANOVA

Question Type	Subject	N	M	SD
S2-a Result 1 Use of technology indirectly in formative assessment by using test programs such as ExamView or other databases to generate questions	ELA	9	**1.89**	.78
	Math	12	**2.75**	.75
	Science	7	**3.29**	1.11
	Social Studies	9	**2.11**	1.05
	Generalist	10	**2.00**	.94
	Special Education	6	**1.67**	.52
	Total	53	**2.30**	.99
Significance Difference p Between Science and ELA Teachers p = **.033** Significant Differences p Between Science and Special Education Teachers p = **.022**				

A ranking of 1 is "Almost Never" and 4 is "Almost Always" on a scale of 1-4.
Note: Any significance p that is < .05 is an important significant difference.

Table 4.2 CMISD 1st -12th Grade Teacher Use of Computer Test Programs for Formative Assessments ANOVA provides information for a one-way ANOVA that was conducted to compare the use of computer programs or Internet applications to develop formative assessments with teachers teaching different subject areas. There was a significant use of computer programs or Internet applications, $F(2.88, .78) = 3.67$ p = .007. Post hoc comparisons using the Tukey HSD test indicated that science teachers (M=3.29, SD=1.11) were more likely to use computer programs or Internet applications to develop formative assessments than ELA (M=1.89, SD=.78) at a p = .033 and special education (M=1.67, SD=.52) at a p = .022. As indicated by the high standard deviation in science (SD=1.11), there was a larger variance in their use of computer programs for formative assessment. It was for this reason that interview questions probed deeper into the use of computer programs.

Table 4.3 CMISD 1st -12th Grade Teacher Use of Assessments Found on the Internet (Including CSCOPE) ANOVA

Question Type	Subject	N	M	SD
S2-c Result 2 Use of technology indirectly in formative assessment by using tests or other assessments from the Internet (including CSCOPE)	ELA	10	**2.30**	.82
	Math	12	**3.58**	.67
	Science	7	**3.57**	.53
	Social Studies	9	**2.89**	.93
	Generalist	9	**2.67**	1.22
	Special Education	7	**2.43**	.79
	Total	54	**2.93**	.97
Significance Difference p Between Science and ELA Teachers p = **.045** Significant Difference p Between Math and ELA Teachers p = **.013**				

A ranking of 1 is "Almost Never" and 4 is "Almost Always" on a scale of 1-4.
Note: Any significance p that is < .05 is an important significant difference.

Table 4.3 CMISD 1st -12th Grade Teacher Use of Assessments Found on the Internet (Including CSCOPE) ANOVA provides information for a one-way ANOVA that was conducted to compare the use of tests or other assessments from the Internet including the district curriculum, CSCOPE. There was a significant use of tests or other assessments (including CSCOPE), $F(2.87, .74) = 3{,}90$, $p = .005$. Post hoc comparisons using the Tukey HSD test indicated that science (M=3.57, SD =.53) and math (M=3.58, SD=.67) teachers were more likely to use assessments from the Internet than ELA (M=2.30, SD=.82) at a significance of .045 with science and .013 with math. Noting the standard deviations within the data and from working with these two subject areas (science and math), there was an indication that science and math teachers' PLCs understood how to use technology to enhance their instruction with formative assessments with CSCOPE. They worked together to determine how to use iFAIT, and used technology in their assessment practices, especially (as indicated in interviews) the district curriculum, CSCOPE.

S3 (Appendix B) adapted a rating system from the dissertation of Fuller (2011) seeking information on the teachers' perception of organizational support in twelve areas. The wording of the survey items included the element of PLCs, administration, and other district leaders—the superintendent, assistant superintendent, and teacher leaders in the district. This survey gathered information on teachers of each campus and reported how teachers viewed organizational support within PLCs. Elementary PLCs formed by grade level, and secondary PLCs formed by subject area had varied views in two areas of S3. Their analysis is displayed in Table 4.4 CMISD 1st -12th Grade Teacher

Perception of Campus Administration Support with iFAIT PLC ANOVA and 4.5 CMISD 1st -12th Grade Teacher Perception of Other District Leaders (Superintendent, Assistant Superintendent, and Teacher Leaders) Support of the iFAIT PLC ANOVA and explained after the table.

Table 4.4 CMISD 1st -12th Grade Teacher Perception of Campus Administration Support with iFAIT PLC ANOVA

Question Type	Grade	N	M	SD
S3-6 Result 3 Administrators view the iFAIT PLC as an important component of formative assessment	1-2	7	**3.57**	.53
	3-5	11	**3.73**	.47
	6-8	12	**3.33**	.49
	9-12	23	**3.13**	.34
	Total	53	**3.36**	.48
Significance Difference p Between Teachers that Taught 3rd-5th grade and 9-12th Grade Teachers p = **.002**				

A ranking of 1 is "Strongly Disagree" and 4 is "Strongly Agree" on a scale of 1-4.
Note: Any significance p that is < .05 is an important significant difference.

Table 4.4 CMISD 1st -12th Grade Teacher Perception of Campus Administration Support with iFAIT PLC ANOVA provides the information for a one-way ANOVA that was conducted to compare the perceptions that teachers held concerning their administrators view of the iFAIT PLC as an important component of formative assessment between the grades levels that teachers taught in CMISD. While the majority of teachers in CMISD agreed that their campus administration viewed the iFAIT PLC as an important support factor in their use of iFAIT (M=3.36, SD= .48). There was a significant number of teachers in CMISD that more strongly agreed that their campus

administrators viewed the iFAIT PLC as an important support factor $F(1.00, .19) = 5.37$, $p = .003$. The ANOVAs were confirmed with post hoc comparisons using the Tukey HSD test indicated that teachers in 3rd-5th grade (M=3.73, SD=.47) held this view more strongly than the 9th-12th grade (M=3.13, SD=.34) at a significance of .002. There were many things happening at the 3rd-5th grade level that may have contributed to their more strongly held view, including a new administration and the fact that the elementary school was faced AYP needed corrections. The elementary school had received numerous awards in their high rankings over the last decade and for them to receive lower ratings in reading and math in the 2011-2012 school year, led to an atmosphere that favored the introduction of iFAIT.

Table 4.5 CMISD 1st -12th Grade Teacher Perception of Other District Leaders (Superintendent, Assistant Superintendent, and Teacher Leaders) Support of the iFAIT PLC ANOVA

Question Type	Grade	N	M	SD
S3-7 Result 4	1-2	6	**3.50**	.55
	3-5	9	**3.67**	.50
Other school district leaders view the iFAIT PLC as an important component of formative assessment	6-8	12	**3.33**	.65
	9-12	21	**3.10**	.30
	Total	48	**3.31**	.51
Significance Difference Between Groups p = **.025**				

A ranking of 1 is "Strongly Disagree" and 4 is "Strongly Agree" on a scale of 1-4.
Note: Any significance p that is < .05 is an important significant difference.

Table 4.5 CMISD 1st -12th Grade Teacher Perception of Other District Leaders (Superintendent, Assistant Superintendent, and Teacher Leaders) Support of the iFAIT

PLC ANOVA provides the information for a one-way ANOVA that was conducted to compare the perceptions that teachers held concerning district leaders (superintendent, assistant superintendent, and teacher leaders) view of the iFAIT PLC as an important component of formative assessment between the grades levels that teachers taught in CMISD. The data from S3-7 as shown in Table 4.5 CMISD 1st -12th Grade Teacher Perception of Other District Leaders (Superintendent, Assistant Superintendent, and Teacher Leaders) Support of the iFAIT PLC ANOVA shows results similar to those from S3-6 in Table 4.3 CMISD 1st -12th Grade Teacher Use of Assessments Found on the Internet (Including CSCOPE) ANOVA. There was a significant number of teachers in CMISD that more strongly agreed that district leaders viewed the iFAIT PLC as an important support factor $F(.78, .23) = 3.44$, $p = .025$. While the majority of teachers in CMISD agreed district leaders (superintendent, assistant superintendent, and teacher leaders) viewed the iFAIT PLC as an important support factor in their use of iFAIT (M=3.31, SD= .51), the post hoc comparisons using the Tukey HSD test indicated that teachers in 3rd-5th grade (M=3.67, SD=.50) more strongly held the view than the 9th-12th grade (M=3.10, SD=.51) at a significance of .021. There were many things that 3rd-5th grade level teachers faced in the accountability rankings, which would lead teachers to believe that iFAIT was a viable solution to their low accountability rankings.

Using the quantitative analysis provided from the data in the September 2012 survey and teacher willingness to participate in the qualitative study, 4 study participants were purposively selected for interview. The quantitative data used to determine the characteristics of the teachers interviewed were critical to the training of teachers and the

research of the study. This information uncovered teacher characteristics relating to teacher demographics of content taught, grade levels taught, and years of teaching. Teacher groups separated by their frequency of iFAIT use added to the qualitative measures of this study, which would help answer the research questions as discussed in the qualitative section of this study. In the December 2012 data, there were no significant differences when crosstabs and ANOVAs confirmed with Tukey Post Hoc measures were delineated by content area, grade level taught, and years of teaching groups in Survey Part 1, 2, or 3.

Quantitative Results from Survey Part 1

S1 data provided data in teachers' perception of the kinds and frequency of formative assessment strategies they used in September 2012 (Appendix B) and December 2012 (Appendix D) Survey. Table 4.6 Survey Part 1 (S1) CMISD 1st -12th Grade Teacher Perceptions of the Kinds and Frequency of Formative Assessment Strategies Used in Instruction Sept. and Dec. 2012 displays S2 content and results.

Table 4.6 Survey Part 1 (S1) CMISD 1st -12th Grade Teacher Perceptions of the Kinds and Frequency of Formative Assessment Strategies Used in Instruction Sept. and Dec. 2012

Formative Assessment Strategies	**Sept. 2012** M	**SD**	**Dec. 2012** M	**SD**	**Δ**
S1-a Use of planned formative assessments (questioning probes, pretests, open-ended questions) to provide information that guides next steps for instruction	3.3	.84	3.1	.83	**-0.2**
S1-b The written or oral feedback given students about their work explicitly addresses how they did or did not meet the TEKS and/or national content standards	3	.93	3.1	.91	**+0.1**

Table 4.6 Continued

Formative Assessment Strategies	**Sept. 2012** M	**SD**	**Dec. 2012** M	**SD**	**Δ**
S1-c Units of study have included opportunities for students to engage in and get feedback on the kinds of problems that will be on their tests or exams	3.6	.54	3.70	.60	**+0.1**
S1-d Instructional strategies have been modified when a student does not do well on a quiz or assessment	3.5	.66	3.3	.82	**-0.2**
S1-e Modification of instructional strategies are done on the spot/while teaching when a student or group of students does not seem to understand	3.5	.72	3.6	.62	**+0.1**
S1-f Scheduled class time for students to revise their work and provide ongoing feedback has been given during that process of instruction	3.4	.75	3.3	.74	**-0.1**

A ranking of 1 is "Almost Never" and 4 is "Almost Always" on a scale of 1-4.

The greatest changes in the data from S1 information are seen in S1-a, which indicated a drop in the use of planned formative assessments (Δ=-.2). With the use of more iFAIT strategies, there can be immediate information where feedback could occur instantaneously from the data seen with the ARS and there would be less need for planned formative assessment preparation and grading. Although minimal changes were found in S1-b and S1-c (Δ=+.1), there was a move for greater use of feedback in the two question types, which would be a good indicator that teachers are looking more closely at the type of feedback they are giving students, especially through the use of technology. S1-d (Δ=-.1) could be interpreted in two different ways: (1) instructional strategies have dropped because most corrective feedback was being given with the assessment via technology's use of immediate feedback or (2) teachers do not need to

spend time after the assessment for remediation. S1-e (Δ=+.1) indicates that more modifications were being made on the spot while teaching with iFAIT. S1-f (Δ=-.1) indicates that either there was no need for scheduled class time to revise work because the time spent with iFAIT had optimized instruction or that the feedback was not necessary. The standard deviations in all the data within Table 4.6 Survey Part 1 (S1) CMISD 1st -12th Grade Teacher Perceptions of the Kinds and Frequency of Formative Assessment Strategies Used in Instruction Sept. and Dec. 2012 were minimal (SD= < 1.0).

The graphic (Figure 4.1 Graphic Survey 1(S1) CMISD 1st -12th Grade Teacher Perceptions of the Kinds and Frequency of Formative Assessment Strategies Used in Instruction) on page 90 provides a visual of the data above noting small incremental differences of little significance as indicated when S1 data was analyzed in paired sample t-tests to determine if there were significant changes in the study from the September 2012 and December 2012 data. There were no significant differences in S1 in formative assessment strategies that they used in their classrooms between September 2012 and December 2012 as the data contained negligible changes (N=55) and changes were within the range of -0.2 – + 0.1 on a four point scale. However, it is crucial to note that the CMISD teachers had well-established ideas as indicated in S1 data (Table 4.5 CMISD 1st -12th Grade Teacher Perception of Other District Leaders (Superintendent, Assistant Superintendent, and Teacher Leaders) Support of the iFAIT PLC ANOVA) and many practices that Bennett and Gitomer (2009) report as:

…an assessment system that goes beyond fulfilling a simple accountability function by:

- documenting what students have achieved (‘assessment of learning’),
- helping to identify how to plan instruction (‘assessment for learning’), and
- engaging students and teachers in worthwhile educational experiences in and of themselves (‘assessment as learning’). (Bennett & Gitomer, 2009, p. 43)

Teachers’ rankings were in the 3 – 4 mean range indicating that they usually or almost always used in the six areas defined in the six formative assessment strategies on the use of formative assessment as discussed in Chapter 3 Methodology.

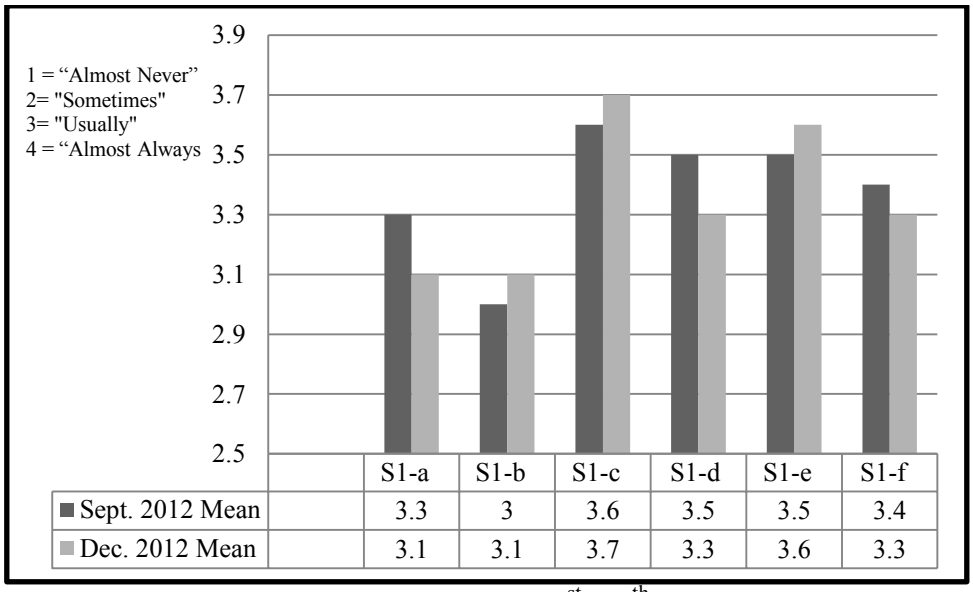


Figure 4.1 Graphic Survey 1(S1) CMISD 1st -12th Grade Teacher Perceptions of the Kinds and Frequency of Formative Assessment Strategies Used in Instruction

Quantitative Results from Survey Part 2

To gauge how teachers learn to use technology based formative assessments via iFAIT, comparisons between the survey data collected in September 2012 and December 2012 in S2 provided evidence to the study as shown in Table 4.7 Survey Part 2 (S2) CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Strategies Used with Technology Sept. and Dec. 2012. This further identifies S2a - S2g as the kind and frequencies of iFAIT strategies and how teachers learn the methods of formative assessment—by themselves or through the help of novice teachers that have used technology for the greater part of their life. These survey items also note if more experienced educators were helping the novice educators in their formative assessment practices or pedagogy. Table 4.8 Survey Part 2 (S2) CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Strategies Used Sept. and Dec. 2012 T-Test Paired Samples (2 Tailed) identifies S2h-S2l as the kinds and frequencies of iFAIT use of oral and written documentation. Any significant changes in the S2 data were measured with paired sample t-tests (Table 4.8 Survey Part 2 (S2) CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Strategies Used Sept. and Dec. 2012 T-Test Paired Samples (2 Tailed) and 4.9 CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Use of Written Materials September and December 2012) to determine if there were significant changes in the study from the September 2012 and December 2012 data.

Table 4.7 Survey Part 2 (S2) CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Strategies Used with Technology Sept. and Dec. 2012

Kinds and Frequencies of iFAIT Strategies	**Sept. 2012** M	**SD**	**Dec. 2012** M	**SD**	**Δ**
S2-a Use of technology indirectly in formative assessment by using test programs such as ExamView or other databases to generate questions	2.3	.99	2.7	1.09	**+0.4**
S2-b Use of technology indirectly in formative assessment by using premade tests or make rubrics from the Internet	2.4	.82	2.8	.86	**+0.4**
S2-c Use of technology indirectly in formative assessment by using tests or other assessments from the Internet (including CSCOPE)	2.9	.97	3.3	.85	**+0.4**
S2-d Use of technology directly in formative assessment by using CPS or clickers (eInstruction)	1.6	.94	2.1	1.15	**+0.5**
S2-e Use of technology directly in formative assessments which are graded via the Internet (Eduphoria!), etc.	2.2	1.15	3.3	.96	**+1.1**
S2-f Use of more technology in formative assessments using strategies that more computer literate novice teachers within the PLC used and assisted	1.9	1.06	2.6	.90	**+0.7**
S2-g Use of more pedagogy in my formative assessments using strategies that more pedagogical oriented experienced teachers within the PLC used and assisted	1.9	.89	2.5	.89	**+0.6**

A ranking of 1 is "Almost Never" and 4 is "Almost Always" on a scale of 1-4.

As indicated in Table 4.7 Survey Part 2 (S2) CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Strategies Used with Technology Sept. and Dec. 2012, there were gains in several areas relating to the kinds and frequencies of iFAIT. Those positive changes came from the following:

- Use of technology in test programs (ExamView, etc.) (Δ=+0.4);
- Use of technology in premade test or rubrics (Δ=+0.4);

- Use of technology using tests from the Internet (CSCOPE) (Δ=+0.4);
- Use of technology using CPS or clickers (Δ=+0.5);
- Use of technology using Eduphoria! (Δ=+1.1);
- Use of iFAIT supported with computer literate novice teachers (Δ=+.7); and
- Use of iFAIT supported with pedagogical oriented experience teachers (Δ=+.6).

The following graphic (Figure 4.2 Graphic Survey Part 2 (S2) CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Strategies Used Sept. and Dec. 2012) provides a visual for the data in Table 4.6 Survey Part 1 (S1) CMISD 1st -12th Grade Teacher Perceptions of the Kinds and Frequency of Formative Assessment Strategies Used in Instruction September and December 2012.

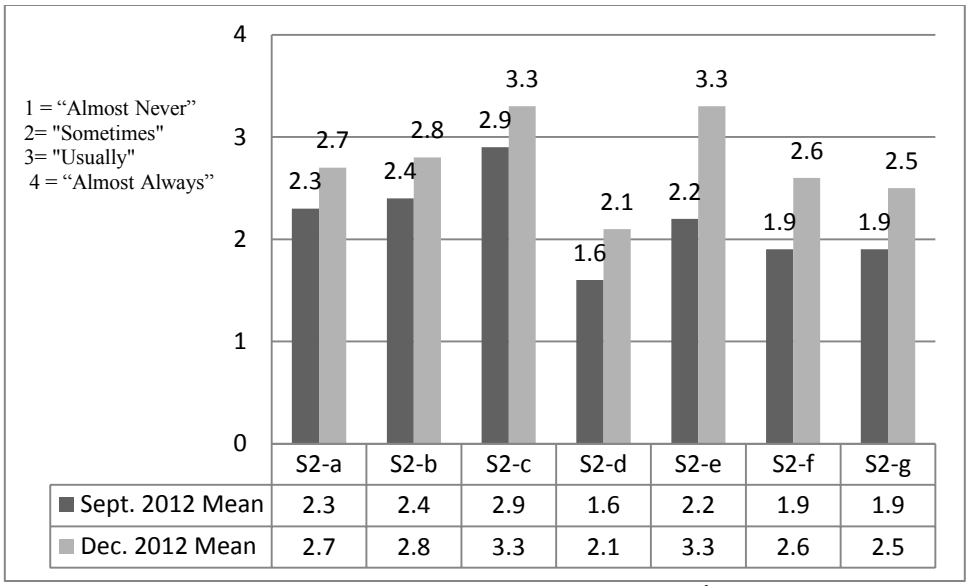


Figure 4.2 Graphic Survey Part 2 (S2) CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Strategies Used Sept. and Dec. 2012

There were significant changes found in the following S2 survey items (S2d – S2g) as indicated in Table 4.8 CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Strategies Used September and December 2012 further defined as the kinds and frequencies of iFAIT strategies.

Table 4.8 Survey Part 2 (S2) CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Strategies Used Sept. and Dec. 2012 T-Test Paired Samples (2 Tailed)

Kinds and Frequencies of iFAIT Strategies	Survey Administrations				
	Sept. 2012 M (SD)	**Dec. 2012 M (SD)**	**t**	**df**	**p**
S2-d Result 5 Use of technology directly in formative assessment by using CPS or clickers (eInstruction)	1.6 (.94)	2.1 (1.15)	-2.19	46	**.033**
S2-e Result 6 Use of technology directly in formative assessments which are graded via the Internet (Eduphoria!), etc.	2.2 (1.15)	3.3 (.96)	-4.66	49	**.000**
S2-f Result 7 Use of more technology in formative assessments using strategies that more computer literate novice teachers within the PLC used and assisted	1.9 (1.06)	2.6 (.90)	-3.66	47	**.001**
S2-g Result 8 Use of more pedagogy in my formative assessments using strategies that more pedagogical oriented experienced teachers within the PLC used and assisted	1.9 (.89)	2.5 (.89)	-3.19	47	**.003**

A ranking of 1 is "Almost Never" and 4 is "Almost Always" on a scale of 1-4.
Note: Any significance p that is < .05 is an important significant difference.

Paired sample t tests, an inferential statistics method, were used with the September and December 2012 data to determine if the changes were significant from Table 4.8 Survey Part 2 (S2) CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Strategies Used Sept. and Dec. 2012 T-Test Paired Samples (2 Tailed), noted below highlights the quantitative data:

1. S2-d Sept. 2012 (M=1.6, SD=.94) and Dec. 2012 (M=2.1, SD=1.15) indicated a significant (p =.033) increase in the use of the ARS clickers. There was a significant effect for the use of clickers t(46) = -2.19, p = .033 between the September and December 2012 survey. This data also indicated there was still work to be done as there were high standard deviations (Sept. 2012 SD=.94 and Dec 2012 SD=1.15) indicating that there were teachers needing assistance or were unsure about their abilities. I found this to be true when assisting teachers and through the qualitative data.
2. S2-e Sept. 2012 (M=2.2, SD=1.15) and Dec. 2012 (M=3.3, SD=.96) indicated a significant (p =.000) increase in the use of technology in formative assessments when graded via the Internet or Eduphoria!. There was a significant effect for the use of Eduphoria! to grade via the Internet t(49) = -4.66, p = .000 between the September and December 2012 survey. This data also indicated that there was still learning to be done as there was a high standard deviation (Sept. 2012 SD=1.15 and Dec 2012 SD=.96). Verification came from teachers when looking at qualitative data as they issued requests to learn more about Eduphoria! and the different ways it could be used.

3. S2-f Sept. 2012 (M=1.9, SD=1.06) and Dec. 2012 (M=2.6, SD=.90) indicated that there has been significant changes (p=.001) in the way teachers value each other in their PLCs as computer literate novice teachers can offer their technology expertise to their colleagues. There was a significant effect for more computer literate novice teachers assisting their colleagues $t(47) = -3.66$, $p = .001$ between the September and December 2012 survey. Once again, the high standard deviation (Sept. 2012 SD=1.06 and Dec. 2012SD=.90) showed that more work needed to be done to encourage the continued use of these novice teachers and their knowledge of technology.
4. S2-g Sept. 2012 (M=1.9, SD=.89) and Dec. 2012 (M=2.5, SD=.89) indicated that there has been significant changes (p =.003) in the way teachers look to each other in their PLCs as pedagogically sound experienced teachers can offer their pedagogical expertise in formative assessment practices to assist others in their PLC. There was a significant effect for the use more pedagogically experienced teachers assisting the novice teacher $t(47) = -3.19$, $p = .003$ between the September and December 2012 survey. The high standard deviation (Sept. 2012 SD=.89 and Dec. 2012 SD=.89) showed that more work needs to be done to encourage the continued use of these experienced teachers and their knowledge of formative assessment strategies.

One can only imagine the empowerment that teachers feel when they possess both technology and formative assessment skills.

Table 4.9 Survey Part 2 (S2) CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Use of Written Materials Sept. and Dec. 2012 examines the way teachers used oral and written documentation to sustain iFAIT.

Table 4.9 Survey Part 2 (S2) CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Use of Written Materials Sept. and Dec. 2012

Kinds and Frequencies of iFAIT Use of Written Materials	Sept. 2012 M	SD	Dec. 2012 M	SD	Δ
S2-h Use of the iFAIT wiki to assist in the use and learning of technology based formative assessments	1.8	.98	1.6	.88	**-.2**
S2-i Use of more web based tutorials and instructional materials with the support of the PLC	1.9	1.00	2.5	.94	**+.6**
S2-j Interest in using an iFAIT PLC to assist in technology and pedagogical expertise	2.9	1.00	2.7	.90	**-.2**
S2-k Use of the scanner to "read" tests that students have taken where answers and scores are uploaded to Eduphoria for further analysis	2.1	1.14	3.0	1.11	**+.9**
S2-l Use of MS Excel or other ways to visualize student data, note their knowledge and adjust instruction accordingly	2.4	1.19	2.4	1.17	**0**

A ranking of 1 is "Almost Never" and 4 is "Almost Always" on a scale of 1-4.

As indicated in Table 4.9 CMISD 1st- 12th Grade Teacher Kinds and Frequencies of iFAIT Strategies Used September and December 2012 T-Test Paired Samples (2-

Tailed), there were changes relating to the kinds and frequencies of iFAIT. Negative changes came from the following:

- use of the iFAIT wiki (Δ= -.2) and
- interest in the iFAIT PLC (Δ=-.2).

Positive changes came from the following:

- use of web-based tutorials (Δ=+.6) and
- use of scanner to "read" and upload test results to Eduphoria! (Δ=+.9).

There were no changes in teacher use of MS Excel to visualize student data.

Figure 4.3 Graphic Survey Part 2 (S2) CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Use of Written Materials Sept. and Dec. 2012) provides a visual for the data in Table 4.9 Survey Part 2 (S2) CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Use of Written Materials Sept. and Dec. 2012).

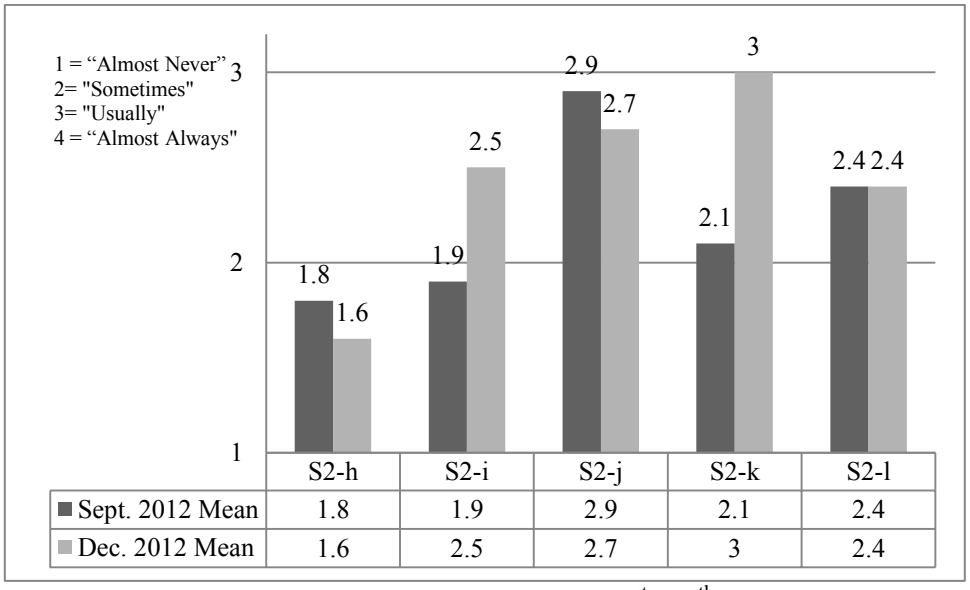


Figure 4.3 Graphic Survey Part 2 (S2) CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Use of Written Materials Sept. and Dec. 2012

There were significant changes in S2-i and S2-k of S2 as indicated in Table 4.10 Survey Part 2 (S2) CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Use of Written Materials Sept. and Dec. 2012 T-Test Paired Samples (2 Tailed).

Table 4.10 Survey Part 2 (S2) CMISD 1st -12th Grade Teacher Kinds and Frequencies of iFAIT Use of Written Materials Sept. and Dec. 2012 T-Test Paired Samples (2 Tailed)

Kinds and Frequencies of iFAIT Use of Written Materials	Survey Administrations				
	Sept. 2012	Dec. 2012	t	df	p
S2-i Result 9 Use of more web based tutorials and instructional materials with the support of the PLC	1.90 (1.00)	2.50 (.94)	-3.23	50	**.002**
S2-k Result 10 Use of the scanner to "read" tests that students have taken where answers and scores are uploaded to Eduphoria for further analysis	2.10 (1.14)	3.0 (1.11)	-4.15	45	**.000**

A ranking of 1 is "Almost Never" and 4 is "Almost Always" on a scale of 1-4.
Note: Any significance p that is < .05 is an important significant difference.

Paired sample t tests, an inferential statistics method, were used with the September and December 2012 data to determine if the changes were significant from Table 4.10 CMISD 1st – 12th Grade Teacher Kinds and Frequencies of iFAIT Use of Written Materials September and December 2012 T-Test Paired Samples (2 Tailed), noted below highlights the quantitative data:

1. S2-i Sept. 2012 (M=1.90, SD=1.00) and Dec. 2012 (M=2.50, SD=.94) provided information on the use of web based and instructional materials with the support of the PLC specially an increase in the use of the written materials t(50) = -3.23,

p =.002 although the qualitative data still notes the number of teachers wanting face-to-face time.

2. S2-k Sept. 2012 (M=2.10, SD=1.14) and Dec. 2012 (M=3.0, SD=1.11) provided information on the use of the scanner and the data that it provides in Eduphoria! which was significantly used more t(45) = -4.15, p =.000. Teachers began to use the scanner more frequently to input student assessment answers from their scan sheets to Eduphoria! to supply the data visualization that they were able to get when using Eduphoria!.

Quantitative Results from Survey Part 3

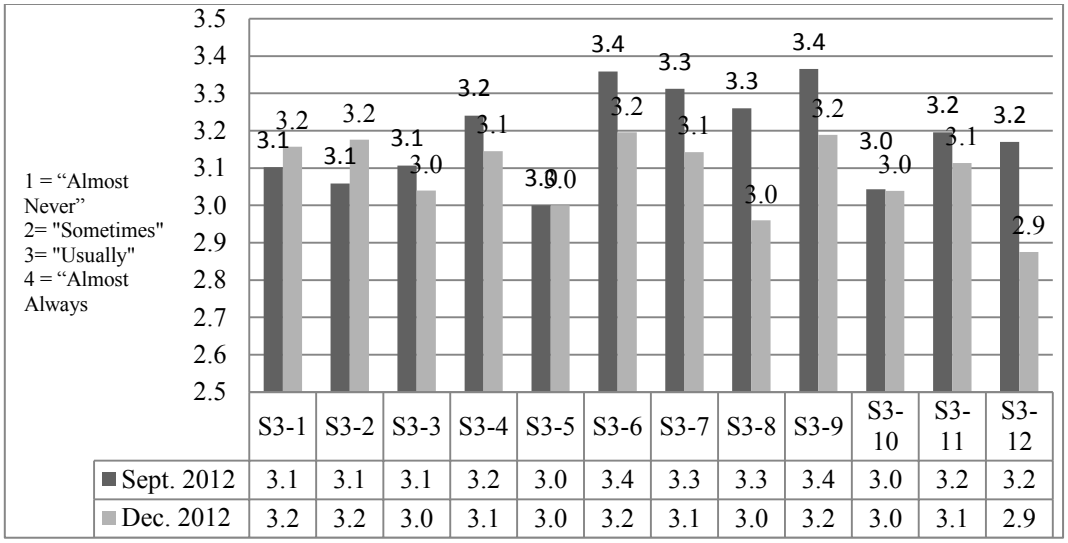
Professional development of teachers within PLCs was instrumental to the success of technology based formative assessment through iFAIT. The survey data collected in Table 4.11 CMISD 1st -12th Grade Teacher Perceptions of Technology and the Use of PLCs September and December 2012from S3 data provides information on how teachers view their PLCs and organizational support as they implemented iFAIT. There were subtle changes in teacher perceptions from (MΔ = -.1 to +.4, approximate SD=.5) as seen in Table 4.11 Survey Part 3 (S3) CMISD 1st -12th Grade Teacher Perceptions of Technology and the Use of PLCs Sept. and Dec. 2012.

Table 4.11 Survey Part 3 (S3) CMISD 1st -12th Grade Teacher Perceptions of Technology and the Use of PLCs Sept. and Dec. 2012

Question Type	Sept. 2012 M	SD	Dec. 2012 M	SD	Δ
S3-1 Identified strategies for using the technologies for iFAIT	3.1	.66	3.2	.46	**+.1**
S3-2 Ability to use the technologies for formative assessment	3.1	.60	3.2	.52	**+.1**
S3-3 When technology for formative assessment was used, students were engaged in learning	3.1	.43	3.0	.59	**-.1**
S3-4 Using technology had a positive effect teaching	3.2	.51	3.1	.56	**-.1**
S3-5 Teachers in the school view the use of the iFAIT PLC as a positive experience	3.0	.47	3.0	.53	**0**
S3-6 Administrators view the iFAIT PLC as an important component of formative assessment	3.4	.48	3.2	.49	**-.2**
S3-7 Other school district leaders view the iFAIT PLC as an important component of formative assessment	3.3	.51	3.1	.47	**-.2**
S3-8 The iFAIT PLC helped with teacher's professional learning goals	3.3	.56	3.0	.50	**-.3**
S3-9 Using technology in formative assessment content is connected to school improvement and student achievement	3.4	.49	3.2	.59	**-.2**
S3-10 PLCs helped me when assistance was needed with the technologies	3.0	.47	3.0	.58	**0**
S3-11 Feelings of support during implementation of iFAIT	3.2	.62	3.1	.57	**-.1**
S3-12 Teacher successes were recognized and shared during the PLC sessions	3.2	.64	2.9	.60	**-.3**

A ranking of 1 is "Strongly Disagree" and 4 is "Strongly Agree" on a scale of 1-4.

The following graphic (Figure 4.4 Graphic Survey Part 3 (S3) CMISD 1st -12th Grade Teacher Perceptions of iFAIT and the Use of PLCs Sept. and Dec. 2012) provides a visual for the data in Table 4.11 Survey Part 3 (S3) CMISD 1st -12th Grade Teacher Perceptions of Technology and the Use of PLCs Sept. and Dec. 2012 .



	S3-1	S3-2	S3-3	S3-4	S3-5	S3-6	S3-7	S3-8	S3-9	S3-10	S3-11	S3-12
Sept. 2012	3.1	3.1	3.1	3.2	3.0	3.4	3.3	3.3	3.4	3.0	3.2	3.2
Dec. 2012	3.2	3.2	3.0	3.1	3.0	3.2	3.1	3.0	3.2	3.0	3.1	2.9

Figure 4.4 Graphic Survey Part 3 (S3) CMISD 1st -12th Grade Teacher Perceptions of iFAIT and the Use of PLCs Sept. and Dec. 2012

There were some significant changes in S3-8 and S3-12 as illustrated in Table 4.12 Survey Part 3 (S3) CMISD 1st -12th Grade Teacher Perceptions of Technology and the Use of PLCs Sept. and Dec. 2012 T-Test Paired Samples (2 Tailed).

Table 4.12 Survey Part 3 (S3) CMISD 1st -12th Grade Teacher Perceptions of Technology and the Use of PLCs Sept. and Dec. 2012 T-Test Paired Samples (2 Tailed)

Teacher Perceptions of Technology and the Use of PLCs	Survey Administrations				
	Sept. 2012	**Dec. 2012**	**t**	**df**	**p**
S3-8 Result 11 The iFAIT PLC helped with teacher's professional learning goals	3.3 (.56)	3.0 (.50)	2.54	44	**.015**
S3-12 Result 12 Teacher successes were recognized and shared during the PLC sessions	3.2 (.64)	2.9 (.60)	2.75	40	**.009**

A ranking of 1 is "Strongly Disagree" and 4 is "Strongly Agree" on a scale of 1-4.
Note: Any significance p that is < .05 is an important significant difference.

Inferential statistics used with the September and December 2012 data determined if the changes were significant in the study using paired sample t-tests from the September 2012 and December 2012 data Part 3. From Table 4.11, the data provides the following information:

1. Teacher perception of the use of the iFAIT PLC as helping them reach professional learning goals was lower in the December 2012 (M= 3.0, SD=.50508) as opposed to the September 2012 data (M=3.3, SD=.56460) and led to significant changes t(44) = 2.54, p=.015. Although there were significant changes, the response was still in the *agree* range (3 is agree and 4 is strongly agree).
2. Teacher perception of the use of the iFAIT PLC as recognizing and sharing successes during PLC sessions was lower in the December 2012 (M= 2.9, SD=.60142) as opposed to the September 2012 data (M=3.2, SD=.63654) led to significant changes t(40) = 2.75, p =.009. Although there were significant changes, the response was still in the *agree* range (3 is agree and 4 is strongly agree).

Quantitative Findings Summary

There were 30 survey items from the three-part survey given in September 2012. From this data, four key findings through mean frequencies and ANOVAs confirmed with Tukey Post Hoc measures influenced the selection of teachers for interview from the comparison between groups.

In addition to these finds in the September 2012 survey, means were calculated for each of the thirty survey items laying the base for the addition of December 2012 data for comparison. From the September means, it was also necessary to note the low areas in teacher use of technology for development of interview survey items and the training of teachers.

Quantitative Data Findings: S1 Teacher Use of Formative Assessment Strategies

There were no significant differences in Survey 1 *Teacher Perceptions of the Kinds and Frequency of Formative Assessment Strategies* (S1) that teachers used in their classrooms between September 2012 and December 2012. These kinds and frequencies in the use of formative assessment strategies were highly rated (usually used or almost always used). In the study of Herman, Osmundson, Ayala, Schneider, & Timms (2006) report that when goals are specified with adequate teaching protocols, teachers intuitively know whether or not their students are progressing and can adjust instruction and remediation as in the case of most CMISD 1st -12th grade teachers. Many scholars believe that knowledge of formative assessment strategies is an essential component of iFAIT (Beatty & Gerace, 2009; Bennett & Gitomer, 2009; Branch, 2011; Burns, 2010; Feldman & Capobianco, 2008). Bennett & Gitomer's simple view of assessment -- *assessment for learning* and *assessment as learning* – provides a rationale for their design of a comprehensive system of accountability at Educational Testing Service. Their belief in using technologies for formative assessment notes "…putting current tests on the computer will not lead to substantive change I assessment practice. Instead, the system relies on advances in:

- cognitive science and an understanding of how students learn.
- psychometric approaches that attempt to provide richer characterizations of student achievement, and
- technologies that allow for the presentation of richer assessments tasks, for the collection and automated scoring of more complex student responses." (Bennett & Gitomer, 2009, p. 43).

Quantitative Data Findings: S2 and S3 Teachers Interview Selection

Four results were decisive for teacher interview selection, and they are as follows:

- **S2-a Result 1** suggested that teachers from subject areas that had been using technology based testing programs (ExamView, etc.) should be solicited for interviews, $F(2.88, .78) = 3.67$ $p = .007$.
- **S2-c Result 2** suggested that teachers using online tests or web applications including CMISD's curriculum CSCOPE, a comprehensive online curriculum management system, and Eduphoria! should be interviewed, $F(2.87, .74) = 3{,}90$, $p = .005$.
- **S3-6 Result 3** suggested that teachers believed their administration viewed iFAIT as important for formative assessment, results varied by teacher grade level taught as determined from the September 2012 ANOVA, $F(1.00, .19) = 5.37$, $p = .003$.
- **S3-7 Result 4** revealed that teachers believed that other district leaders (district administration and teachers leaders) viewed iFAIT, as an

important part of formative assessment as determined by the September 2012 data varied by the grade level that teachers taught should be interviewed, $F(.78, .23) = 3.44$, $p = .025$.

From **Result 1**, the quantitative data showed that science and math teachers were more likely to use technology based testing programs or applications than ELA or special education teachers. In addition, the **Result 2** revealed that science and math teachers were also more likely to use online tests supplied by the district curriculum CSCOPE than were ELA or special education teachers. The research of Hickey, Taasoobshirazi, and Cross (2012) embedded formative assessment into their science curricula to assist and enhance learning of the sciences in a two-year study. Their research provided a means to integrate inquiry-oriented activities in standards-based tests for situated learning, suggesting that this motif of learning and assessment might be difficult to achieve in other subject areas. The work of Fester, Hammond, Alexander, & Lyman (2012) suggested that ELA teachers were less likely to use programs or applications to generate assessment questions and conducted research in the ability of different technology applications to assess written documents. Ferster, et al. (2012) report that many subjects are more difficult to grade with technology due to their open response or essay question, as opposed to the more empirical and objective science and mathematics subjects.

Result 3 and 4 of the September 2012 data revealed that 3rd- 5th grade teachers believed that their administration and other district leaders (district administrators and teacher leaders) viewed the iFAIT PLC as an important part of formative assessment. As

suggested previously the elementary campus of CMISD had always been highly rated and did not meet AYP in reading and math last year; therefore, they strongly believed their administrators viewed the iFAIT PLC as important for formative assessment.

The analysis of September 2012 and December 2012 study determined if significant changes had occurred in the training and use of iFAIT. There were no significant differences in part 1 of the survey, seven significant differences in part 2 of the survey, and two significant differences in part 3 of the survey. Changes need further investigation as desired changes occurred within part 2 of the survey, but there were some surprising negative changes in part 3 of the survey that required more research and further investigation from qualitative data.

Quantitative Data Findings: S2 Teacher Use of Technology in iFAIT

How teachers used Eduphoria! results were dramatic in **Result 5,** and there was a significant change in teachers' use of the ARS in **Result 6.**

- **S2-d Result 5** demonstrated how teachers embraced the use of Eduphoria! (Sept. M=2.2, Dec. M=3.3), yet did not gain in their use of the ARS and clickers (Sept. M=1.6, Dec. M=2.1) as found in the **Result 6**.

There were significant gains in teachers' use of the ARS and the clickers from result 5 $t(46) = -2.19$, $p = .033$; however, much more encouragement and training could produce more productivity and positive attitudes among teachers. This training can be provided through web-based tutorials.

- **S2-e Result 6** revealed that significant gains were made in the use of technology to grade formative assessments via Eduphoria! $t(49) = -4.66$, $p = .000$.

Qualitative data will reflect more on **Result 5 and 6** data and provide some possible explanations for these changes. With so much data, manual data sorting is no longer feasible, and technology must be used (Mandinach, 2012). Administration at CMISD required all core teachers to have Common Formative Assessments (CFAs) every two weeks and six weeks summative exams that could be evaluated in Eduphoria! (Hollingworth, 2012).

- **S2-f Result 7** revealed that survey respondents also said that more computer literate novice teachers within the PLC assisted with the technology $t(47) = -3.66$, $p = .001$ providing support.

Although result seven revealed that computer literate novice teachers assisted with the technology, current research is limited or does not give any information about the impact "digital native" teachers (Prensky, 2001) or those teachers now in the profession that grew up with technology are in today's classrooms. (Belland, 2009; Pattee, 2012). In a 2012 dissertation of Pattee, he provides research that seeks to discover why some digital immigrants become successful users of digital technology. In this quest, Pattee speculates that as digital natives become teachers, they will be able to use new teaching strategies with digital technologies and will widen the effective use of technology.

- **S2-g Result 8** revealed that the pedagogical skills of the experienced teacher within the PLC added to teacher gains in formative assessment pedagogical strategies $t(47) = -3.19$, $p = .003$).

Looi, et al.(2008) report in their article discussing PLCs and professional development that when PLCs can meet together and reflect on student learning and formative assessment, pedagogy can be discussed, novice teachers have the chance to listen and learn from experienced teachers. Herman, et al. (2006) remark that there are no cookbook methods to guide teachers in providing learning. When teachers have "strong content knowledge, sophisticated pedagogical knowledge and strategies, effective assessment, and strong routines and norms for student engagement" (p. 33). Experienced teachers have the potential to assist novice teachers.

Quantitative Data Findings: S2 Teacher Use of Written Materials to Learn iFAIT

Result 9 and 10 dealt with the way written tutorials or online applications assisted teachers in their use of technology based formative assessment.

- S2-I **Result 9** indicated that there was more use of web based tutorials $t(50) = -3.23$, $p =.002$
- **Result 10** indicated that teachers were using the scanner for assessments and visualization of data $t(45) = -4.15$, $p =.000$.

As teachers learn the applications and programs of iFAIT, they must determine the best way to learn those technologies. Al-Qirim (2011) found that it was difficult to keep teachers motivated as they learned technology applications and basic training was not enough. One strategy he used was providing continuous tutorials and videos one

topic at a time in addition to the one-on-one time he spent in teacher classrooms.

As teachers worked with Eduphoria! and scanned their students' documents into the online application, they soon realized that they could visualize their data and know what their students knew and what individual student expectations needed greater emphasis and remediation. If the administration had not required them to use Eduphoria! these revelations may have never occurred (Hollingworth, 2012).

Quantitative Data Findings: S3 Teacher Perception of iFAIT and PLCs

Result 11 and 12 dealt with the PLC and attitudes that teachers held in their professional goals (Result 11) and shared successes in their PLC (Result 12).

- **S3-8 Result 11,** significant changes ((M Δ =.24444, SD=.64511, p = .015) were found in teachers' views of the perception that helped with their professional learning goals and the same sentiment was found in Result 12 t(44) = 2.54, p=.015.
- **S3-12 Result 12,** Teachers significantly noted that more PLC support t(40) = 2.75, p =.009 was needed.

One of the most intriguing revelations from December 2012 data was found in the Result 12 in the S3 administration was that teachers did not feel that their successes were recognized and shared in PLC sessions (Sept. M=3.2, Dec. M=2.9), as had been the case in the September 2012 survey. Mandinach (2012) sees this as one of the challenges that teachers face when working with data. She notes that teachers should learn from each other—how to work together as data teams or PLCs to interpret the data and share

successful instructional strategies; however, that takes time, particularly in overcrowded schedules (p.81) as indicated in qualitative interviews and open-ended responses.

Teacher support includes the addition of *shared success.* Successful practices should be the highlights of PLC meetings sharing successful practices, thoughtful reflections, and connections with students and other teachers (Looi et al., 2008; Moss & Brookhart, 2009; OCED, 2005; Parker, et al., 2011; Stiggins, 2009). *Shared success* is an crucial component of iFAIT, particularly as PLCs work together. Teachers should have "*shared ownership* in the success of their students and an understanding *It's not just about me; it's about the whole school*" (Means, Padilla, & Gallagher, 2010, p. 71).

Qualitative Findings

Interview Selection

From the quantitative data, ELA teachers, generalists, and special education teachers were the least experienced with the use of iFAIT from both the elementary (1st – 5th grade) and secondary levels (6th – 12th grade). An elementary ELA teacher who was also a generalist and a secondary ELA teacher volunteered for interview. Both of the ELA teachers were actively using the ARS on a weekly, often daily basis. One of the ELA teachers, Anna (a pseudonym) was using Eduphoria to develop and administer tests with scan sheets and used the eInstruction tools on a daily basis. Both the science teacher, Hattie and math teacher, Shelby (both pseudonyms) were exceedingly proficient using technology tools, including one that was using the ARS system on a daily basis and both using Eduphoria to develop, administer, and interpret data results. From September – October 2012, the math secondary teachers were meeting consistently to

discuss student expectations with more than one teacher assigned a specific math class to gather student data within their PLC. The science secondary subject specific teachers had limited PLC meetings during this time, and the elementary ELA teacher, Janelle (a pseudonym) was meeting one to two times a week with grade and subject specific PLCs. Interview data came from digitally recorded interviews and transcribed by Dragon NaturallySpeaking 12.0 speech recognition software and was edited for errors.

Themes from Interview and Open Ended Response Qualitative Data

Three basic themes emerged using a variety of techniques – hand coding, production of word clouds with Wordle found at http://www.wordle.net/, the computer program WordSmith Tools, and *find* word searches in MS Word 2010. As seen in Figure 4.5 Themes of Use of Time, Support, and Data for iFAIT on page 113, these themes were the use of time, the use of support, and the use of data within PLCs to drive iFAIT. The school education system is brought together – administrators and teachers as school leaders, to provide the collaboration and innovation that leads to greater student achievement. With limited time to teach and learn, administration must provide time for teachers to train and learn the technology tools for formative assessment or iFAIT. Time must also be given to sustain the abilities of PLCs or CoPs to collaborate and connect student data to instructional content. Administration must provide support for the training of technology tools for formative assessment or iFAIT that are relevant to their content and grade level and are comparable to state and federal test content standards. In addition, as teachers grow in their abilities to use the technology, administrators must provide support for teachers to develop their questioning skills, both oral and written, as

they develop and administer formative assessments. Once the administration of these assessments is completed, student data interpretation is paramount, and teachers need to be able to use the technology and methods to obtain the student data they need to improve instructional practices. The use of data is essential as teachers work with the tools of formative assessment to provide adequate and relevant instruction and assessment.

Figure 4.5 Themes of Use of Time, Support, and Data for iFAIT

The codebooks generated in WordSmith Tools are3 found in Table 4.13 Codebook for the frequencies of words more commonly used with associated word clusters in the teacher interviews and Table 4.14 Codebook for the frequencies of words more commonly used with associated word clusters in the December 2012 open-ended

responses. The listing of words and word clusters in these tables demonstrates their importance within the interviews and open-ended responses discussed later. As another check, the interviews and open-ended responses were run through the *find* function of Microsoft Word 2010 to give the number of times that the word or word cluster appears in the document for the context of the word use.

Table 4.13 Codebook for the frequencies of words more commonly used with associated word clusters in the teacher interviews (This information was dissected from WordSmith Tools and checked via Microsoft Word 2010.)

Codebook: Word Counts from Interviews			
Words Used	**Word Frequency**	**Word Clusters in WordSmith Concordances and Collocates**	**Word Cluster Frequencies**
student	65	student learning, student expectations, student data	33
time	52	have time, the time	30
grading	48	grade book, writing grade, data	38
PLC	40	PLC meetings, my PLC	16
learning	34	student learning, learning expectations	17
question	33	test questions	15
training	22	classroom training, clicker training, technology training	13
Writing	20	subjective writing, grade writing, creative writing, STAAR writing	14
assessment	20	formal assessment, six weeks assessment	14
STAAR	19	grading STAAR, writing STAAR, reading STAAR	13
self-discovery (self-taught)	17	self-taught, self-learned	7
support	16	technology support	12
CSCOPE	13	CSCOPE current, CSCOPE tests	6
instruction	12	NA	0
TAKS	10	STAAR or TAKS, TAKS Data	9
TEKS	8	TEKS SEs	2
tool	7	NA	0
collaborate	5	NA	0
group	4	NA	0
step by step	3	NA	0
purpose	2	NA	0
testing	2	NA	0
one-on-one	1	NA	0

Table 4.14 Codebook for the frequencies of words more commonly used with associated word clusters in the December 2012 open-ended responses (This information was dissected from WordSmith Tools and checked via Microsoft Word 2010.)

Codebook: Word Counts From Open-Ended Responses			
Words Used	**Word Frequency**	**Word Clusters in WordSmith Concordances and Collocates**	**Word Cluster Frequencies**
student	47	student data, student engagement student progress	9
time	43	Enough time, have time, time involvement, more time	28
tool	32	great tool, invaluable tool, tracking tool, helpful tool	23
instruction	20	classroom instruction, drive instruction, specialized instruction	13
learning	18	student learning, individual learning	3
training	16	better training, adequate training, more training	8
assessment	12	formative assessment, student assessment	5
grading	9	data grading, easy grading, quick grading	6
question	9	NA	0
step by step	9	NA	0
one-on-one	8	NA	0
face to face	8	NA	0
support	6	NA	0
group	6	NA	0
explore self-discovery (self-taught)	6	NA	0
CSCOPE	4	NA	0
explore	4	NA	0
Writing	3	NA	0
STAAR	2	NA	0
TEKS	2	NA	0
purpose	1	NA	0

Use of Time

The word *time* was second only to the word *students*. Lack of time was a barrier 92% of the school districts face when implementing greater data use as reported in a nationwide research study conducted by Means, et al. (2010). Teachers interviewed were sensitive to time issues that plagued all teachers and allowed them to reflect on the time issue; however, they noted that teachers are willing to get the training they need to be successful. From these interviews, sub themes evolved for the use of time for training and learning and group/PLC collaboration. Many educators believe *data* is the four-letter word in education, to others *time* is the actual enemy (Mandinach, 2012, p. 75). Janelle, the elementary ELA teacher noted, "I don't even have enough time in my room where I can just breathe and organize".

From the open-ended responses, teachers noted that they needed time to use all of the technology information that had and that the process was more time-consuming at the beginning. Teachers noted that time was needed to learn more about CSCOPE, STAAR, TAKS, and to spend time for small group learning, online technology assistance, and one-on-one training. For this researcher, word clouds clarified the open-response statements with more clarity than did the other analytical approaches; therefore the choice of display as shown in the following example (Figure 4.6 Word Cloud for Use of PLCs, Instructional Coach, etc. to Learn iFAIT) and two other figures using Word Clouds within this content. Appendix E holds the remaining word clouds.

Figure 4.6 Word Cloud for Use of PLCs, Instructional Coach, etc. to Learn iFAIT (Please note the increasing font size is an indication of the word or word phrase used more frequently in the open-ended responses.)

Time for Training and Learning

Hattie reported that she could go online at home and find several things she could use for her classes. She knew that to gather the types of technology and information that she needed; home was the place to start exploring. Anna felt that being self-taught was notable, as "That is the best way to learn in my opinion. You have to sit down and play with it. Of course, time is such a premium that sometimes you have to dedicate your summers to learning the technology. There's not always time during the school year with the demands of teaching and instructing."

Shelby knew that time was a significant factor for several teachers as she stated, "I know it's not used 100% across the board (clickers). There are teachers that are scared of technology and they want to use their same ways. This is fine, but they don't know, and there's not enough time in the day to convince them otherwise." When asked if she

knew that she could develop tests in Eduphoria, Janelle stated, **"**Yes, I am aware that I can do that, but I haven't done that yet. I just haven't had the time, but I am educated in CPS. That's the system I will use right now. If I had time…Sure, everyone wants to improve, but I wish I had more time… Other teachers have asked me for help…but time…**"**

Janelle echoed Hattie's sentiment stating, "A lot of my learning of technology is self-taught… as far as the clicker system is concerned…The district required us to go through modules online…so I just learned it." Although many teachers would like time to sit and learn, not all teachers are *self-starters*, but they would like to have additional professional development (Means, et al., 2010)

Hattie, the science teacher, emphatically stated, "Time constraints are bothersome. Eduphoria and I have become good friends because I have to learn that." From these comments, Hattie knew that she had to use her time optimally as district administration required certain things that she was accountable for doing. Furthermore, Hattie noted that the use of time was crucial for learning as "The best PLC group that I have is my lunch group, it's me and two of the English teachers, and we help each other out trying to figure out Eduphoria and here's how you do this, here's how you organize your data". Many districts start training administrators and teachers, but turnkey models used frequently to train staff to train others evolve (Mandinach, 2012).

Productive PLCs build their own communities from those with common interests within the district and expand beyond. Teachers broaden their own networks via communities of practice and develop their own identity. Wenger, White, and Smith

(2010) note that there is an emergent practice between CoPs and technology as technology stewarding becomes an emergent form of leadership in CoPs. From electronic bulletin boards and email lists to the Web 2.0 technologies involving social media, blogs, and wikis, technology has allowed the formation of communities that share common interests, creatively develop solutions to common problems, and enable digital habitats as individuals find roles and provide a source of knowledge through their technology stewardship (Wenger, et al., 2010).

Although learning was frustrating at times, teachers noted in the open-response statements that iFAIT held many rewards. These frustrations are illustrated in Figure 4.7 Word Cloud for Frustrating Aspects of Using iFAIT depicting a word cloud of teacher responses on the most frustrating aspects of using iFAIT. Teachers soon learned that the central gathering of student data in Eduphoria and through the ARS created opportunities for teacher feedback more timely and effective.

Figure 4.7 Word Cloud for Frustrating Aspects of Using iFAIT (Please note the increasing font size is an indication of the word or word phrase used more frequently in the open-ended responses.)

Time for Group/PLC Collaboration

Time was a precious commodity to Shelby, the secondary math teacher as she instinctively was selective with her time… "Yes, I utilize my conference period and I get here before 8:00 in the morning. I don't take anything home. I don't import grades, I don't do lesson plans at home. That's why I have a conference period and that's why I get here early." Means, et al. (2010) assert that it is vital for administrators to provide time for educators to use data and learn how data can guide improvements in their programs and practice.

Janelle knew that time was extremely important as she stated, "I need to make sure my planning is very clear. I have to know what I am doing and use CSCOPE to weigh each TEK and make sure that they are covered… I have several sets of curriculum books in my room that I can pull from ...looking at CSCOPE and feedback that I get from my students using clickers all the while." Mandinach (2012) notes that using data as evidence to *inform practice* is as important to teachers as using symptoms to diagnose diseases are to the practice of medicine.

Shelby noted, "As a math PLC, we sat down at the beginning of the year and determined the categories of the TEK content that we wanted to cover and the percentages that we wanted to get from our students." For Shelby, the PLC was an essential component to the time she needed to instruct and assess students.

Anna noted, "As the expectations for this district increase and they want us to use more Eduphoria, wanting us to use the clickers more, and they want us to use the Mobi digital white board. As those expectations go up, it helps to have other people in

our PLCs and other colleagues who have the expertise to be able to say "Oh I've used this… this is easy…" Once again administrative desires spawned greater use of the technology for formative assessments. Anna noted, "Administration is rethinking how we use technology. I feel like there is going to be more of a push to use it." Hattie noted, "PLCs should not be a time to get-together and go over an agenda that goes over different topics and move on. Teachers should be taught how to use a PLC." DuFour, DuFour, Eaker, and Many (2010) note that PLCs built from collaborative teams form productive PLCs; otherwise PLCs will not work for schools.

Use of Support

In order for iFAIT to benefit teachers and their associated PLCs, there have to be support structures in place for training and question development. In Branch's 2011 dissertation dealing with PLC support of technology, she felt technology support begins with a supportive environment of collaboration and learning within a PLC to increase student learning. Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur (2012) investigated K-12 classroom teachers who were successful technology using educators. These teachers used student-centered methods of instruction using a variety of technology tools. Barriers that found in this study specifically addressed the attitudes and beliefs of teachers and the technology support they receive.

Training Support

Janelle, one of the most consistent users of the ARS system stated, "I think seeing a real teacher in the classroom and hands-on experience yourself—just like any other student would learn… They expect us to teach our student that way, so why

wouldn't adults want to be taught the same way?" Shelby noted "It's easy when someone is walking you through the steps, and you have the steps written in front of you then you come back to your room, alone and try to repeat what you just saw in training. You get bogged down or stuck at one point, and you get frustrated and you just shut it down because you've ran out of time and you have to go home today."

Teacher learning of software or applications is currently an area of importance for learning iFAIT. Hardware may contain the software and Internet applications, but software and applications drive the process. This was touched on as Hattie said, "There's a lot of teachers here that are savvy on technology and we work together and try to figure out the problems. We did that on Eduphoria, a teacher figured out how to do a matching test, and we were all excited about that one. Administration can help push hardware issues, but we don't have anyone that can figure out our software issues."

Anna added, "I think having a younger generation who knows so much about it [technology] like my son is incredibly helpful." In a review of the literature on using assessments for instructional improvement, Young & Kim (2010) found evidence in the literature from the 2002 work of Hightower and others that demonstrate how novice teachers needed to develop assessment practices that support learning with peers who are more experienced or instructional coaches. As novice teachers can be instrumental in using their innate technology expertise, instruction and assessment pedagogy can be built into the novice teacher's repertoire from those they assist, the experienced teachers. Hollingworth (2011) report that many teachers are leaving university education programs that are unprepared to cope with assessment practices.

Question Development Support

Feldman (2008) believes that learning the technology for formative assessment is not the only thing teachers should know. Teachers should also be able to master questioning skills. Shelby came from a well-developed PLC, which had a clear vision as to the real purpose of their PLC—to use data to help their students learn via the feedback they receive in assessments. "We decided to put more weight on tests rather than daily work. All daily work we assign is strictly by the SEs of the TEKS and is fully aligned to the STAAR test. I give immediate intervention to those students from the data I receive from the ARS, but the way CSCOPE is set up I just go ahead and move to the next lesson as one lesson builds on the other. I know that those students either are a little foggy about certain things are going to see those topics again."

Hattie, who had a clear vision of how to work through the inquiry process stated, "Students focus better on graphic representations rather than abstract words. For grades, I use Eduphoria and get data that I can use to talk to students about their understanding. Questions that can be developed and administers via our clickers encourage conversations with students."

Looking at the unique situation of the ELA teachers, Anna stated , "If it is writing, then technology isn't going to help …we just 'flat out have to sit down and grade.' English is different from the other subjects. We have the flexibility to put in our own content and cover the TEKS that we are expected to do… I can't get Eduphoria to mimic what they will see on STAAR, but I am getting pieces here and there, but I'm not getting a big picture until I design some kind of the benchmark." Recent research from

Ferster, Hammond, Alexander, & Lyman (2012) demonstrate some computer programs that have the ability to grade *written* content of students.

Use of Data

One of the greatest advantages of iFAIT is the ease of data organization and the way data gives clarity to student strengths and weaknesses. The subthemes that developed centered on the use of teaching tools and instruction and assessment relationships. Technology and data can supply a resource for teachers that have never been envisioned and as Janelle put it, "it's kind of scary to see where it's all going to go…" Swann and Mazur (2011) address the abundance of data and note how schools can work with the data they have had for years easily and more quickly than ever with today's technology.

Teaching Tool

Al-Qirim (2011) reports that when technology links to teaching pedagogy, the technology can become a valuable teaching tool, an important integration for successful learning. Anna elaborated on her love of certain projects that she has used with her students and how technology involved her students. Her passion for technology and teaching was obvious as she reflected on how to understand new technologies, "I'm a visual learner, and if they give me an online picture or an online click sheets I'm going to understand a lot more … reading through those instructions drives me crazy".

Shelby was willing to get help any way she could to understand how to use technology, particularly when it becomes a part of her instruction. "I think I try taking help from everywhere, anywhere I can find it. If I'm here (and even in our PLCs

meetings) and I hear one of our math teachers talking about how he or she is managing assessments, I want to go to them and have them show me how. If I am playing around with a program or other technology and I've figured out a simple way that is great for students, I want to show that to my PLC."

When asked about the role social media (wikis, blogs, or FaceBook) might play in learning the technology for formative assessment, teachers voiced their concerns.

Shelby stated, "The problem with social networking is that it becomes a gripe session…especially among PLCs or teachers, because…If I posted something really great about my Geometry lesson or that it might be helpful for someone else…I really don't think they are going to go there looking for that kind of information. I really don't think they are they are because they have the exact same CSCOPE, they have the same textbooks that I have, they have the same Google that I have….so they aren't going to go there and look for information. I think they are going to go there for a place to release, and I just don't want something there to become a gripe session."

Janelle, the youngest of the teachers made a remark that was wise beyond her years as she stated, "As far as other social media for teaching purposes only… I don't think anything can replace the human relationships as I think that fosters learning more than anything."

As teachers noted in their open-ended responses, professional development can be handled differently using iFAIT. Teacher learning and training can be in house through social media and collaborative resources; however, many resources are blocked by the filter. These professional development experiences should be ongoing,

mandatory, hands-on, and given during the summer as indicated in Figure 4.8 Word Cloud for Professional Development Needs for iFAIT. On-going professional development can become virtual at any time and any place using social media. Teachers must be shown how they can develop roles in CoPs using social media to support their PLC agendas. Teachers within a school and those in the "world" community can benefit from each other's knowledge. iFAIT can help perpetuate that professional learning scenario.

Figure 4.8 Word Cloud for Professional Development Needs for iFAIT (Please note the increasing font size is an indication of the word or word phrase used more frequently in the open-ended responses.)

Instruction and Assessment

One of the pitfalls of viewing student data is that it can lead to instruction that *teaches to the test* rather than teaching for learning. Also known as item teaching (Popham, 2001), instruction that is directed to teach items on a test provides little

support of what students should know—the knowledge and skills of each subject area that is tested. Administration must approach this scenario carefully encouraging teachers, rather than discouraging them with relevant student expectations and trusting teachers to teach those expectations to the best of their ability, rather than teaching questions on a test. Janelle notes that she focuses on concepts. Even though she has a variety of curriculum materials that she can use, assessment was continual in her classroom with the clickers as she notes, "I have complete and immediate responses that I can review the concept and know whether students did or did not get the concept."

As a teacher of a variety of classes, Shelby can implement and extend her classes as one unit. She states, "For one thing it's not the same mundane thing. For two, I can change little things; I can see the things in my geometry students that can be used in Algebra 2. When I am in an Algebra 1 class, I can come back to my Algebra 2 class…, and I can say I know you did this in Algebra 1."

Technology in PLC meetings can give teachers the information they need for critical instruction decisions. Shelby states, "I think that our principal really takes into consideration what we have to say in our meetings. If it's not working for three out of the five teachers then it's not working and something needs to change. Alternatively, if something that we are doing is great and working then there is no reason to make any changes, because if it is working for us and for our students and our scores are showing it, then there's nothing that needs change. I think it's great our principal sees us in a PLC and hears our thoughts. It is great to hear that we are doing things right or man, that's not working for me. Let's change it. PLC meetings shouldn't be for training. We've seen

how we can pull data, but we have not discussed data in our PLC."

Anna understood that instruction was not just using technology, but there were things to consider that were not measurable with technology. She notes that her successful instruction (often with technology) can lead to different methods of assessment. "Sometimes it's hard because if you take a ten question test, it may not cover more than one or two student objectives. It's not like STAAR tests because not only do students do editing and revising, three written compositions the first day, but the second day they have to test over all of the literary, nonfiction, poetry, and the multiple-choice questions. They also face three short answers so there is a gamut of things they have to cover." If the use of technology can assist in some of the assessment measures of teachers, then it can free up time for the more subjective areas of assessment.

Summary of the Findings

The triangulation of the quantitative and qualitative data helped gain insight into the collaborative factors that influenced the use of technology based formative assessment. This typology approach integrated the data to produce the following general findings:

1. Teachers have strong beliefs in formative assessment strategies.
2. Teachers must have the support of systemic instruction provided by one-on-one training.
3. Technology encouraged conversations with students.
4. Administration must require and provide time for student data analysis.
5. Administration must support budgetary changes for technology.
6. Teachers must make an effort to learn the technology.

7. Support factors must be in place so technology and pedagogical skills can be learned.
8. Teachers and those that support them must have shared belief s for student success, student engagement, and shared support for iFAIT.
9. A wiki is not a viable solution due to available support, blocked content, legal concerns, and lack of time to explore resources.
10. Teachers can use online tutorials.
11. Teachers can use the scanner for data and visualization.
12. Teachers hold common beliefs as to the support that PLCs can provide. PLC meetings should be constructive for the discussion of student data, shared classroom success, creativity among the subject areas within the school district and other area districts, extended year-round involvement, and look to the social web for collaboration and support.

CHAPTER V

DISCUSSIONS, IMPLICATIONS, RECOMMENDATIONS, AND CONCLUSIONS

Research Overview

Using a mixed methods study approach with several quantitative and qualitative procedures, this research analyzed the collaboration that evolves when elementary and secondary teachers within PLCs use technology based formative assessment or iFAIT in a K-12 rural school. A *sequential explanatory mixed method participant select variant model* (Creswell & Plano Clark, 2007) was used to gain insight into way teachers learn to use technology based formative assessment and how these collaborative activities support the professional development of teachers.

The overarching research question was: In what ways do personal and professional factors shape elementary and secondary teachers within PLCs as collaboration evolves with the implementation of technology-based formative assessments via iFAIT? Quantitative data was collected via a three-part survey given to 55 teachers in September 2012, interviews from four volunteer teachers characteristic of successful users of iFAIT, and concluded with the final administration of the December 2012 survey and eleven open-ended survey items given to 55 teachers. The quantitative data analysis process used descriptive statistics and variances between teacher groups in the September 2012 data followed up with the use of paired sample t tests between the September 2012 and December 2012 data. The qualitative data analysis containing

twenty-one pages and included code formatted interview data and eleven open responses for the development of themes from hand coding, with word clouds, word and word cluster analysis with WordSmith Tools, and *find* word searches in MS Word 2010. The triangulation of qualitative data in the quantitative data provided a narrative to document what was actually going on during the time of the study through the development of a typology to discover what collaborative factors influenced the use of iFAIT (Caracelli & Greene, 1993).

Chapter V provides an overview of the research, a discussion of the findings, the implications, recommendations, future research, and a conclusion to the study.

Discussion of the Findings

CMISD has improved its technology infrastructure, which was instrumental for their teachers to implement technology based formative assessments. Without these external factors, teachers were able to face their internal barriers, but when both factors existed, the integration of any technology was a hard sell (Ertmer 1999). Administration must provide support and time for teachers to implement iFAIT and require teachers to use technology based formative assessment for successful implementation. The data that teachers collect should represent the abilities of their students and concepts that they have learned as required from the school district curriculum. This data was for further investigation through their PLCs to provide recommendations for student feedback and remediation. Table 5.1 summarizes the overall findings for the research survey items and how the findings relate to the research questions. After these findings are discussed, the three themes of the qualitative methods will be discussed.

Table 5.1 Review of Key Findings of the Research Survey Items

Overarching Research Question (ROQ)		
ROQ In what ways do personal and professional factors affect elementary and secondary teachers within PLCs as collaboration evolves with the implementation of technology-based formative assessments via iFAIT?		
Findings	**ROQ1** The technology infrastructure was growing and improving, so technology "not working" was no longer a barrier for iFAIT. **ROQ2** Teacher beliefs and perceptions were barriers to the implementation of iFAIT. **ROQ3** Professional development focused on boosting teachers' confidence levels with peer, administrative, and instructional technology support can break technology barriers when using iFAIT. □ **ROQ4** Professional development for iFAIT cannot be a one-time effort, but should be a continued process with positive experiences.	**Quan** **Qual**
Sub-Question 1 (R1)		
R1 How do teachers within PLCs learn to use technology with formative assessments?		
Findings	**R1.1** Teachers should have strong beliefs in formative assessment strategies.	**Quan**
	R1.2 Teachers must have the support of systematic instruction provided by one-on-one training.	**Quan** **Qual**
	R1.3 Since students could focus on the graphic representations of concepts and evaluative information, teachers recognized that the technology encouraged *conversations* with students for immediate feedback and remediation making the addition of iFAIT appealing.	**Qual**
	R 1.4 Administration must require and provide time for teachers to look at student data for immediate intercession and remediation.	
	R1.5 Administration must support budgetary changes for technology and fruitful grant writing for technology procurement and support personnel.	
	R1.6 Teachers must continually make an effort to learn the technology as an important tool of instruction and assessment.	**Quan** **Qual**
	R1.7 Support factors must be in place for teachers via PLCs, administration, and other school district leaders including the district level administration, novice teachers that excel in technology skills, and experienced teachers that excel in pedagogical skills.	
	R1.8 Teachers and those that support them must have shared beliefs for student success, shared vision for student engagement, and shared support for implementation of iFAIT.	

Table 5.1 Continued

Sub-Question 2 (R2)		
R2 To what degree does the oral and written documentation sustain teachers within PLC's successful iFAIT implementation?		
	R2.1 Although prior research promotes the use of a wiki for iFAIT, the wiki was not viable for this study because:	
Findings	**R2.1a** Other forms of assistance were readily available.	**Quan Qual**
	R2.1b Blocked websites, legal concerns, and general concern for the confidentiality of social media was concerns of teachers. **R2.1c** Lack of time to explore the resources available.	**Qual**
	R2.2 Teachers can use online tutorials for iFAIT when:	
	R2.2a PLCs and peers can share experiences and learn together.	**Quan Qual**
	R2.2b Materials are available via email, search engines, and help sections of the technology implementation.	**Qual**
	R2.2c Teachers must have sustained support and communication for successful implementation of iFAIT.	**Quan Qual**
	R2.3 Teachers can use the scanner to read Eduphoria! tests and for visualization processes when:	
	R2.3a Specific purposes and objectives are within the data as required by administration. **R2.3b** Eye-opening data is rendered.	**Qual**
	R2.3c Data is available to drive instruction.	**Quan Qual**
	R2.3d Grading is easy and instantaneous feedback is available.	**Qual**

Table 5.1 Continued

Sub-Question 3 (R3)		
R3 How does the use of collaborative activities support the "professional development" of teachers within PLCs as they implement iFAIT?		
Findings	**R.3.1** Common beliefs should be shared among the members of a PLC when:	
	R3.1a Teachers are able to identify formative assessment strategies and use the technology that can measure it. **R3.1b** If iFAIT is used, students should be engaged in learning. **R3.1c** Technology has a positive effect on teaching and the experience using an iFAIT PLC is a positive experience. **R3.1d** Teachers, administrators, and other district administration and school district leaders view the iFAIT PLC as an important component of formative assessment. **R3.1e** Using iFAIT content is connected to school improvement and student achievement. **R3.1f** PLCs can provide assistance and support with iFAIT.	**Quan**
	R.3.2 PLC meetings should be constructive and should be used for:	
	R3.2a Discussion of the data that the iFAIT reveals. **R3.2b** Sharing successes and discussing ideas. **R3.2c** Gathering the creativity of teachers from all subject areas and in other districts within the area. **R3.2d** Extended year-round involvement. **R3.2e** Extension to the social web.	**Qual**

Summary of Research Findings as Related to the Research Questions

The overarching question for this research was: In what ways do personal and professional factors affect elementary and secondary teachers within PLCs as collaboration evolves with the implementation of technology-based formative assessments via iFAIT?

- **ROQ1** The technology infrastructure was growing and improving, so technology "not working" was no longer a barrier for iFAIT.
- **ROQ2** Teacher beliefs and perceptions were barriers to the implementation of iFAIT.

In a 1999 study conducted by Ertmer, two types of barriers affect technology utilization in the classroom. The first concerned external factors outside the teachers control that included software and hardware issues. The second group of barriers included those that were within the teacher and include teacher beliefs and perceptions about how they feel about learning and the technology they possess, their confidence level with the technology, and other obstacles they personally faced when using technology (Ertmer 1999). Without external factors, teachers were able to face their internal barriers, but when both factors existed, the integration of any technology is a hard sell.

- **ROQ3** The technology infrastructure is continuing to grow at CMISD, so professional development focused on boosting teachers' confidence levels with the technology is crucial as is changes in attitudes towards technology and formative assessments, peer support, administrative support, and instructional technology support.

Teachers who have become accustomed to "quick fixes" to make technology work for them can become disenchanted with technology as was in the case of CMISD. If teachers cannot change their beliefs in how technology works for them, then technology must meet the needs of teachers from where they are. In a study undertaken by Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur (2012), eleven out of twelve teachers were able to integrate technology that was aligned with their beliefs suggesting "second-order, not first-order, barriers are the true gatekeepers [for successful technology integration]" (p. 433). With sound technology –hardware and

software, teachers in CMISD had comprehensive formative assessment procedures and beliefs, so the prospect of having the technology to meet their needs was conducive for success.

- **ROQ4** Professional development for iFAIT cannot be a one-time effort, but should be a continued process with positive experiences.

Kim, Kim, Lee, Spector, & DeMeester's 2013 study on teacher beliefs and technology integration lay out a blueprint for successful technology integration based on teacher knowledge and learning, effective ways of teaching, and teacher beliefs on the integration of technology. Kim, et al. note that one-time efforts to change teachers' beliefs do not happen immediately, but that sustained positive experiences are the catalyst for changes in teacher beliefs. It is important to note that change happens with strong leadership from administration. In this study, implementing iFAIT, teachers dramatically changed the way they used Eduphoria! to collect student data as the quantitative data demonstrated. Within the qualitative data that included interviews and open-ended responses, participants noted that they had to learn to use Eduphoria! as directed by administration. Administration has held firm to the belief that teachers and their students benefit from the use of iFAIT, provided the technology tools they needed for proper implementation, hiring support for the technology in place, and introducing PLCs, beginning a process where teachers can help teachers. Kim, ET al. notes, "…fundamental beliefs about knowledge and knowledge acquisition exist in every teacher and learner, and these are critically important for understanding effective technology integration" (p. 84).

First Sub-Question

The first sub research question seeks to demonstrate: How do teachers within PLCs learn to use technology with formative assessments?

- **R1.1** Teachers in the study held firm in their beliefs of formative assessment strategies:
    1. Formative assessment should provide information to guide the next steps for instruction.
    2. The written or oral feedback should explicitly address how students did or did not meet the TEKS.
    3. Units of study should include opportunities for students to engage in and get feedback on the kinds of problems that will be on their assessments.
    4. Teachers should modify their instructional strategies on the spot while teaching when a student or groups of students do not seem to understand.
    5. Teachers should schedule class time for students to revise their work and provide ongoing feedback to them during that process.

In regards to the kinds and frequencies of iFAIT strategies and the use of technology to grade formative assessments in Eduphoria! and other applications, there were significant changes in the way teachers used technology. Those changes included the use of technology directly in formative assessments by using the ARS or clickers as well as the data application Eduphoria!. Respondents via interviews offered the following rationale for the increases:

- **R1.2** The technology was easier to use because of the addition of support

that provided systematic, one-on-one training.

- **R1.3** Students could focus on the graphic representations of concepts, evaluative information, and the technology that encouraged "conversations" with students for immediate feedback and remediation.
- **R1.4** Administrative demands for visualization of student data for immediate intercession and remediation.
- **R1.5** Administrative support of budgetary changes for technology and fruitful grant writing for technology procurement and support personnel.
- **R1.6** There was a continual effort on the teachers in CMISD to learn the technology as an important tool of instruction and assessment.
- **R1.7** Support structures were available for teachers via their PLC, campus administration, and other school district leaders including district administration, novice teachers that excel in technology skills, and experienced teachers that excel in pedagogical skills.

There were significant changes in the way teachers used the computer knowledge of the novice teacher $t(47) = -3.66$, $p = .001$ to support the experienced teacher. Experienced teachers recognized the technology abilities of the novice teachers within their PLC and throughout their campuses. The *need to know* provided the stimulus for the partnerships.

In regards to the use of more pedagogy in formative assessments using strategies that more pedagogical oriented experienced teachers within the PLC used and assisted

novice teachers, there were significant changes in the way teachers used the pedagogical knowledge of the experienced teacher $t(47) = -3.19$, $p = .003$. Novice teachers recognized the pedagogical abilities of the experienced teachers within their PLC and throughout their campuses. Once again, the *need to know* provided the stimulus for the partnerships.

Respondents via interviews and open-ended responses offered a rationale for the increases found in R1.7 as indicated in R1.8 below.

- **R1.8** Teachers and those that support them must have:
    1. Shared beliefs for student success;
    2. Shared vision for student engagement; and
    3. Shared support for implementation.

Second Sub-Question

The second sub research question seeks to know: To what degree does the oral and written documentation sustain teachers within PLC's successful iFAIT implementation?

- **R2.1** Although there were no significant changes in the use of the iFAIT wiki (Sept. 2012 M=2, SD= .66112 and Dec. 2012 M=1.9, SD=.46358) to assist in the use and learning of iFAIT, respondents via interviews and open-ended responses offered the following experiences:
    - **R2.1a** Other forms of assistance are readily available through email, one-on-one assistance, step by step communication, and PLC support;

- **R2.1b** Due to the experiences that teachers have had with blocked websites, legal issues, and general concern over the confidentiality of social media, users were hesitant to use the resources; and
- **R2.1c** Lack of time to explore the resources available for iFAIT.

- **R2.2** In regards to the use of more web based tutorials and instructional materials with the support of the PLC, there were significant changes in the use of those resources with the aid of the PLC $t(50) = -3.23$, $p = .002$. Respondents via interviews and open-ended responses offered the following rationale:
    - **R2.2a** Availability of friends and peers to share experiences and learn together;
    - **R2.2b** Availability of online materials via email, search engines, and help sections of technology to be implemented; and
    - **R2.2c** Sustained support and communication for successful implementation with students.
- **R2.3** In regards to the use of the scanner to "read" tests that students have taken where answers and scores were uploaded to Eduphoria!, there were significant changes in the use of the scanner to "read" tests in Eduphoria! $t(45) = -4.15$, $p = .000$. Respondents via interviews and open-ended responses offered the following rationale:
- **R2.3a** Specific purpose and objectives are available within the data;
- **R2.3b** Eye-opening data is within the results rendered from the process;

- **R2.3c** Provides data to drive instruction; and
- **R2.3d** Ease of grading and instantaneous feedback.

Third Sub-Question

The third sub research question seeks to explore: How does the use of collaborative activities support the "professional development" of teachers within PLCs as they implement iFAIT?

- **R3.1** Teachers continue to agree that within their respective PLCs that they had common beliefs that are shared among their members. Specifically they had:
    - **R3.1a** Identified strategies for using the technologies for formative assessment and associated tools and the ability to use the technologies for formative assessment
    - **R3.1b** Beliefs that when technology for formative assessment was used, students were engaged in learning.
    - **R3.1c** Beliefs that using technology had a positive effect teaching
    - **R3.1d** Beliefs that teachers in the school view the iFAIT PLC as a positive experience and beliefs that administrators and other school district leaders view the iFAIT PLC as an important component of formative assessment
    - **R3.1e** Beliefs that using technology in formative assessment content is connected to school improvement and student achievement

    - **R3.1f** Beliefs that PLCs helped when assistance was needed with the technologies and feelings of support during implementation of iFAIT

- **R3.2** PLC meetings should be constructive. In regards to the belief that teacher successes were recognized and shared during the PLC sessions, there was a significant change $t(44) = 2.54$, $p=.015$ (though in the agree range) observed from September 2012 to December 2012. Respondents via interviews and open-ended responses offered these rationales:
    - **R3.2a** PLC meetings should not be for training, but be for discussing the data that the technology reveals.
    - **R3.2b** PLC meetings should not be for discussion of topics or agendas, but be for sharing successes and discussing ideas.
    - **R3.2c** PLCs should not be restricted to specific subject areas, but be for the extension of creativity that matches needs with teachers in other subject areas. PLCs should not be restricted to one school district, but be extended to area schools with similar interests.
    - **R3.2d** PLCs should not be restricted to a ten-month calendar, but be extended to a year round involvement.
    - **R2.e** PLCs should not be restricted to oral communication, but be extended to the social web.

Three Themes

From the interview data and through the open-ended responses, three themes emerged including the use of time, use of support, and use of data.

The first theme, supported by both interview data and open-ended survey items, was the use of time- use of time for training and learning and for collaboration among groups of educators or PLCs. Teachers noted that they need time for training and learning, for self-discovery and exploration. This time was needed for collaboration within their PLCs – PLCs that vary in purpose for optimum collaboration are instrumental when implementing iFAIT. Content areas blur, and teaching strategies are similar when learning is authentic (Branch, 2011). These PLCs are not necessarily those assigned by fate, or through the categorization of their subject matter, they can be formed through professional investment or campus hierarchy. The purpose of learning the technology tools is specific to the use of data. Using student data is encouraged by school improvement planning that provides adequate time for professional development, support positions for data interpretation, and tools for gathering data (Means, et al., 2010). Gathering and analyzing data in their respective group or PLCs becomes commonplace with the provision of time for learning and collaboration.

The second theme was the use of support for training and question development. Means, et al. (2010) found that many schools use colleagues and instructional coaches to provide support in schools rather than extensive professional development programs. Support time within the workweek for teachers is an investment for increasing teachers' data use capabilities. Administrative leadership, support, and stimulus are critical for

iFAIT to exist within PLCs (Hollingworth, 2011). This leadership carries over as teachers work with technology to develop questions that are intuitive and replicate the learning objectives of each core subject in formative assessment. Frey, Schmitt, & Allen (2013) state that authentic classroom assessment building blocks are the questions that drive the formative assessments in they sought to define authentic assessment as if relates to the approach to classroom assessment in their study. In their study, the crucial elements of an authentic question "involves the student deeply, both in terms of cognitive complexity and intrinsic interest, and are meant to develop or evaluate skills and abilities that have value beyond the assessment itself" (Frey, et al., 2013, p. 14). Teachers need the professional development to support their implementation of iFAIT with appropriate questions and questioning techniques.

Questioning techniques and strategies are instrumental for student success and technology can help support formative assessment conversations that probe student knowledge and support their learning. Teachers need to improve their ability to integrate formative assessment questioning as part of their practice (Beatty & Gerace, 2009). From the beginning, Beatty's studies documented with other researchers from the last decade was of interest as they had a well-developed system working with 39 secondary Physics teachers in public schools using the ARS in Massachusetts. Their research involved the pedagogy behind the technology of the ARS using Technology-Enhanced Formative Assessment (TEFA) for *question-driven instruction*, *dialogical discourse*, *formative assessment*, and *meta-level communication* (Beatty & Gerace, 2009, p. 159).

The third theme was the use of data—use of data for a teaching tool and learning and assessment. Using data is not limited to numbers, assessments, and clusters of student expectations. It is the combined process of resource development with teaching tools to instruct and assess. iFAIT goes beyond data driven instruction; it is the means by which teachers use formative assessment to instruct and use technology. In the Means, et al. 2010 study, many schools were using data discussions in their administrative meetings and reports, but there were few reports of teachers using data to diagnose the areas of instruction that needed improvement. In order for data to change schools, Means, et al. 2010 report for the U. S. Department Education's Office of Planning, Evaluation and Policy Development on education data at the local level set some clear expectations for schools (p. xix):

- Set clear expectations using data for decisions;
- Integrate a collaborative exploration of data where teachers can plan and reflect;
- Provide an environment that allowing examination of student performance; and
- Support teachers as they link data to alternate instructional strategies.

CMISD administrators had specific guidelines and expectations on the way data was collected and continually monitored their teachers, their students, and the data that was collected throughout the study. The data collection through Eduphoria! was mandatory as were the formal weekly PLC meetings developed to help interpret the data and find viable solutions for areas of low achievement in the students of CMISD. As teachers worked together within an environment of support and safe surroundings, they began the task of reformation in the way they use data. Technology or iFAIT had made it easier to

obtain the data. The steps that followed, but not documented in this research, was the discussion and implementation of alternate instructional strategies developed via the PLC and the data that they analyzed.

Continual Improvement After the Study's Conclusion

In regards to the use of MS Excel or other ways to visualize student data, note student knowledge, and adjust instruction accordingly, there were no significant changes (identical measures in Sept. and Dec. M=2.4, SD=1.18). However, since the end of this study, the process of using MS Excel to document successes and failures to identify the student expectations within each core area, ELA, math, science, and social studies has become more commonplace. Administration is taking the lead compiling course information that will eventually lead to student-by-student academic progress as it pertains to readiness and rigor of instruction.

In conclusion, a school is only as good as the people who run them. School leaders create an environment favorable for positive change. Respect must be a key component of the school climate. CMISD teachers had respect for each other. School leadership that encourages their teachers to interact with each other provides a knowledge system that can lead to success in other grades and disciplines. Collaboration and cooperation was a natural component in teachers' day-to-day service for their students. Novice teachers helping experienced teachers with technology and experienced teachers helping novices was an significant factor in the technology integration of technology based formative assessment. In CMISD, administration acknowledged and resolved substantial barriers in technology provisions. Teachers felt empowered, morale

has improved, and the environment in CMISD makes teachers want to stay.

Implications

Technology is a powerful tool when examining student data to drive instruction; however, the school must provide the technology infrastructure, trained teachers and adequate tools for implementation of iFAIT. From its earliest beginnings when developed by this researcher, iFAIT was used for student achievement. In order for students to be successful, teachers need the time and support to learn and use iFAIT. That support has to come from school leaders, administrators, and teachers. iFAIT is unique in its approach for formative assessment and data driven instruction from the standpoint of delivery and coordination through PLCs or CoPs. Gates (2008) and Burns (2010) research involved teachers use of formative assessment. Branch (2011) focused on administration using PLCs as a mechanism for technology learning and Fuller (2011) trained teachers in the use of ARSs and IWBT. Now through this researcher's original work, educators can use this model as a point of reference and duplication for the use of technology based formative assessment as iFAIT.

iFAIT is a process where teachers work collectively in their PLCs or CoPs to learn how to (1) use technology to enhance their formative assessments; (2) use technology to develop, administer, and visualize student data and the associated student expectations or curriculum standards; (3) use technology and the combined leadership of teachers and administrators to pinpoint student strengths and weaknesses to drive instruction; and (4) plan and coordinate instructional practices that will have an impact on student achievement with technology. As indicated by this research, CMISD has

three vehicles to drive the process: PLCs, for organization; technology to expedite data collection; and iFAIT, the technology tools and logistics to support the process. The desired effects of this research are evident in its inferences.

PLCs

As the research progressed, PLCs grew in their ability to communicate through the sharing of formative assessment strategies and the technology that can drive it, instructional strategies, and analyzing student data. Once PLC members recognized the ease of collection and organization that iFAIT offered, they embraced the data collection process with technology tools and learned from each other. The more computer literate teachers in the PLC, often the novice educators, assisted in the knowledge and use of more technology tools—the ARS and Eduphoria. The more pedagogically capable teachers, often the experienced educators, assisted in the knowledge and use of formative assessment and instructional strategies. As PLCs grow stronger, the PLC should not be restricted to learning the tools of iFAIT. They should embrace the data, learn how to interpret it, and take the information back to the classroom in the form of innovative instructional strategies and practices.

Technology

Technology has to work to get teachers excited about the possibilities that it can offer (Ertmer, et al., 2012) as the data within this study began to show. Administration took the initiative (Hollingworth, 2011) and supplied teachers with current computers and operating systems, networking, and other technologies to drive the preexisting formative assessment tools. Teachers noted that the learning of technology based

formative assessment took more time in the beginning, but after learning, the process accelerated.

Teachers had just begun to analyze the data that they had collected in the study. Teachers have initiated the construction of their own tests in Eduphoria! through the collaborative activities of their PLCs and have begun analyzing the data and formulating the instructional strategies that are needed to remediate their students' low performing areas. Teachers have begun to want more training and assistance. More teacher time was being devoted to the process as teachers grew in the knowledge of technology based formative assessment (Ertmer, 1999).

iFAIT

A demonstrated in this research, *Innovative Formative Assessment with Instruction and Technology* has the potential to change schools and the classrooms it serves. To implement iFAIT to the fullest, administrators at CMISD set their goals high and have maintained the drive of better formative assessment practices for their teachers with or without technology (Hollingworth, 2011). Teachers have begun to embrace iFAIT and all it can offer to teachers and their students.

Teachers and administrators have learned that iFAIT depends on people, not machines. Those that develop iFAIT including software and application developers must be responsive to their users' needs making their products more user friendly, more responsive to school district needs, and producing easy online tutorials and accessible help. Administrators must be supportive of their teachers and be willing to support them offering better curricular practices and solutions, better procedural policies and

heuristics, and better tools for data interpretation (Swann & Mazur, 2011). Teachers should be willing to learn and explore the technologies of formative assessment. Teachers should implement the ARS into their instruction more frequently. When schools change, student achievement changes.

Recommendations

Technology is a powerful tool when examining student data to drive instruction (Swann & Mazur, 2011), but the coordination and assistance that teachers need must come from school leaders (Hollingworth, 2011). School leaders and their leadership practices must provide instructional technology assistance as often as possible to the campuses it serves. Professional development must be ongoing and readily available throughout the school year. PLCs must extend their capacity as data users to data interpreters (Means, et al., 2010). The technology that drives iFAIT must be current and responsive. The Web 2.0 technologies, wikis and other social media methodology tailored to the needs of educators can expand the PLC and educators can develop, explore, or learn in communities of practice from others in the field of education and educational organizations or businesses.

PLCs

When educators use PLCs to organize the process of student achievement, they need school leadership to help facilitate understanding of the PLC's purpose and the process needed to achieve the goals they set collaboratively. Success of iFAIT is dependent on the administrative leaders that will model the purpose and process that PLCs must go through to be successful (Hollingworth, 2011; Means, et al., 2010). From

this research, as well as prior research, iFAIT PLCs share common beliefs for student success, shared vision for student engagement, and shared support for the implementation of iFAIT. PLCs will feel growing pains. Teachers will disagree, but come to realize that in disagreement comes resolution. Communication must be a priority as PLCs grow.

Schools should have specific expectations for their teachers as they work together to implement iFAIT. Schools should be willing to the time and resources that extend the campus PLC to district level PLCs. Small schools must be willing to provide different opportunities for subject and grade specific teachers to expand their PLC beyond the local community to other area or distant schools. PLCs should individualize their data, looking at individual students rather than class performance. When addressing low areas in the curriculum, the PLCs should plan for remediation.

Technology

Teachers must become stewards of their time and take charge of their learning when administration provides additional time to support their training and learning of the technology (Ertmer, et al., 2012). Teachers must understand that although one-on-one training is desired, reality is that they must also use their own time for discovery. Learning the *how tos*, *what ifs*, and *how comes* from the use of technology based formative assessment is empowering. Empowerment makes better teachers and teacher leaders.

Technology can take mountains of data and provide rich information for teachers to use in their personal inventories of their students (Means, et al., 2010; Swann &

Mazur, 2011). The numerical data can be transformed to give categorical information on students. Categorical information transforms student achievement when placed in the hands of teachers that can utilize the data, the information to improve their instruction. Groups of teacher in their respected PLCs can communicate and collaborate to narrow the achievement gap in their students' learning and concept attainment.

iFAIT

Innovative Formative Assessment with Instruction and Technology has the potential to change schools and the classrooms it serves. To implement iFAIT to the fullest, administrators must set their goals high and maintain the drive for better formative assessment practices for their teachers with or without technology. iFAIT does depend on people, not machines. Those that develop iFAIT including software and application developers must be responsive to their users' needs making their products more user friendly, more responsive to school district needs, and producing easy online tutorials and accessible help. Administrators must be supportive of their teachers and be willing to support them offering better curricular practices and solutions, better procedural policies and heuristics, and better tools for data interpretation (Swann & Mazur, 2011). Teachers should be willing to learn and explore the technologies of formative assessment. Teachers should implement the ARS into their instruction more frequently. When schools change, student achievement changes (Hollingworth, 2011; Means, et al., 2010).

The technologies of iFAIT must expand to include programs or applications that provide greater opportunities for the analysis of writing and open response survey items

(Ferster, et al., 2012). Online assessment/data packages like Eduphoria! should give teachers the opportunity to put more assessments into their assessment item banks that are relevant, address the TEKS and the STAAR requirements, and allow educators to develop their own tests easier and more efficiently.

CMISD

Administrators in CMISD must assume leadership roles for the implementation of iFAIT (DuFour, et al., 2010; Hollingworth, 2011). There are some fragmented PLCs within their district in different subject areas and administrators must encourage teachers to use the technologies that are available to them. Administrators in CMISD must convey specific data requirements and the support of training and learning that accompanies successful implementation of iFAIT (Means, et al., 2010). There should be no exceptions or excuses as data is revealed. Justification, without clear evidence and rationale, furnish little purpose as data is analyzed and remediation collaboratively planned.

Many teachers continue to use the technology as an excuse to defer the time and learning of iFAIT (Ertmer, 1999). Others do not want to face the fact that as long as the political and curricular processes of mandated assessments exist, teachers must evaluate and assess their students in the same ways regardless of their beliefs that the tests are unfair, the pace of instruction is too fast, or that there are different ways of assessment (Swann & Mazur, 2011). Excuses or their discussions serve no real purpose except to delay the adoption of solutions that students need to be successful on mandated assessments.

The development of PLCs should extend to regional and/or subject specific organized PLCs. When organized or funded through grants, the region service center can provide rich learning and professional development for teachers. Teachers can use social media more in regional teacher groups than school districts as the legalities and security concerns are less problematic than in their respected individual school districts. Professional development and subject specialists in the region service centers, universities, and other educational organizations should be utilized fully as they are training professionals, have the time to work with teachers, and are well informed on technology and pedagogical skills in formative assessment.

Future Research

Looking back at areas that needed more information from research or deeper understandings of concepts within the research, there were three distinct areas needing more research. Those areas include research on question development in other subject and grade levels as begun in the sciences by Beatty and Gerace (2009); more research on novice teachers as digital natives as they impact the integration of technology and teaching in K-12 schools; and how schools and PLCs work with student data generated by the tools of iFAIT and data interpretation (Means, et al., 2010).

How do teachers develop questions that meet the requirements of question development for formative assessment can be a difficult task with or without technology? How do different subjects develop questions for formative assessment? Beatty and Gerace (2009) researched physics teachers' use of question development in *question-driven instruction, dialogical discourse, formative assessment,* and *meta-level*

communication (p. 146). Popham (2010) dedicates over half of his book, *Everything School Leaders Need to Know About Assessment*, discussing the development of questions specifically noting three things that school leaders must possess for the test construction process – the building of test items, the improvement of test items, and the assembly of tests (p. 102).

How are novice teachers as digital natives influencing how technology is used, and the pedagogy of formative assessment is executed? Novice teachers as digital natives are entering the K-12 classrooms of today offering new and exciting teaching pedagogies, working with students that grew up with technology. Very little research has been done in this area of technology based formative assessment (Patee, 2012).

Once data has been collected, how do teachers within PLCs discuss and act on the student data they receive? How do tools of iFAIT generate visual information for data interpretation? Mandinach (2012) notes that data informs instruction; however, there is a lack of human capacity and training that provides teachers and administrators in data literacy (p. 80). While technology can assist in the development of data literacy, other mechanisms need to be studied on how data is used for student learning.

Conclusions

As the findings dictate, there are things that schools can do to help implement iFAIT. It takes time to build mutual trust and the sharing of successful formative assessment strategies that lead to organizational success. These findings provide the rationale for schools to improve the way they: (1) Provide training and support for their staff using iFAIT within their PLCs; (2) Use oral or written documentation via their

PLCs to implement iFAIT; and (3) Use collaborative activities to support the "professional development" of teachers within PLCs as they implement technology based formative assessments. For school improvement and implementation of these findings, this study has revealed the following:

1. With the right technology infrastructure, on-going professional development must be offered that encourage and support teachers' learning of technology based formative assessment.
2. Teachers must have strong beliefs in formative assessment and functional technology that supports the acquisition of learning and assessment from engaged teachers and students.
3. Open lines of communication must be made available for the deposition of online resources and social networking applications through email, PLC support, and teacher and administrative leadership in the district.
4. When teachers see purpose in using iFAIT and eye-opening data can be used to drive instruction, teachers will use technology tools for formative assessment.
5. PLCs must have common beliefs, believe that student engagement is critical in iFAIT and connected to school improvement and student achievement when PLCs meet to discuss data, successes, creativity in instruction, and extended involvement through PLC meeting both face-to-face and online.

While writing his chapter on the evidence that supports formative assessment, Popham (2010) noted the 1998 research review by Paul Black and Dylan William who

reviewed almost 700 published studies on classroom assessment and their selection of 250 for in depth analysis (p. 138). These researchers found that the most prominent component of classroom assessment that can lead to significant learning gains was formative assessment. In fact, they could find no negative components of formative assessment practices and the authors noted that formative assessment learning gains could be achieved in a variety of ways. This study provides valuable information for schools wanting to implement the time saving process of technology based formative assessment. As technology and teacher's skills in using new technologies increase, the most important mechanism in student assessment and achievement is teachers' ability to collaborate and learn with PLCs or CoPs.

iFAIT holds promise in today's schools as students are assessed more often and in more subject areas. In our age of accountability, political, curricular, and policy drives the push of state and federal assessment (Swann & Mazur, 2011). Educators must be prepared to face these assessments. Time is of the essence and tools that can assist educators must be used in instruction and assessment. Teachers must respond quickly and collectively in the areas that students need further instruction and remediation using technology to develop, administer, and interpret student data. Formative assessment practices through the use of ARSs and emerging technologies can provide on the spot assessment and remediation. iFAIT can develop cadres of professional educators assuming their own role as active participants in their students' learning. Teachers' active roles in their students' learning should not be seen as "teaching to the test", rather it should be "teaching for student achievement". Student achievement and success in

each content area comes from specific standards. iFAIT provides timely assessment and feedback with technology.

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APPENDIX A

SUMMARY OF INSTRUMENTS, PURPOSE, AND PARTICIPANT INVOLVEMENT

Instrument	Purpose	Participants	Dates Data Are Taken	Time Spent by the participant
Quantitative Methods				
Appendix B – iFAIT Participants' Beginning Survey Sept. 2012	To define the beginning attributes of study participants to their teacher experiences and perceptions of iFAIT	55 teachers in the PLC Groups	Mid-Sept. 2012	15-30 minutes
Qualitative Methods				
Appendix C -- iFAIT Participants' Beginning Interview Questions	To define PLC members common goals and practices with current technology	Four teachers from a Cross-Section of members in PLC groups	Mid-Oct. 2012 Early Nov. 2012	1 hour
Quantitative Methods				
Appendix D – iFAIT Participants' Concluding Survey Dec. 2012	To identify the use, type of use, contributions, and frequency of use of formative assessment by the PLCs.	PLC Groups (N=55)	Dec. 7-14, 2012	15-30 minutes
Qualitative Methods				Qualitative
Appendix D – iFAIT Participants Open Ended Survey items within Dec. 2012 Survey				30 minutes

APPENDIX B

SEPTEMBER 2012 SURVEY INSTRUMENT -- FORMATIVE ASSESSMENT USE SCALE AND TECHNOLOGY WITH RELATED EDUCATOR PERCEPTIONS, AND DEMOGRAPHIC INFORMATION

Given to all teachers in CMISD PLC groups to define attributes of study participants and to select 4 teachers from a representative cross-section of members in PLC groups

Thank you for completing this survey, your input is incredibly valuable. In a separate email, you will be invited to participate in a specialized group using professional learning communities to increase your efficiency in the production, administration, and data analysis of your formative assessments through technology. Select teachers 4 will be involved in the qualitative phase of the study from a representative cross-section of teachers in the PLC groups. This process will save you time with your grading, increase your student's learning capacity, and enable you to teach more effectively. The technology materials that will be used are already in place in our district. Should you choose not to participate in this study, you will still have access to professional development, the services of iFAIT, and have access to the study's wiki. Participants will be entered in a drawing for a Nook or Kindle.

I agree to the use of these responses in a study that Marcia J. Talkmitt is using for her EdD. I understand that there will be no identifying information that can be tracked back to me.

A. Yes B. No

Select the most appropriate number using the scale below.

Almost Never	***Sometimes***	***Usually***	***Almost Always***
1	***2***	***3***	***4***

Survey Part 1(S1) Teacher Perceptions of the Kinds and Frequency of Formative Assessment Strategies Used in Instruction				
1. To what extent do the following statements characterize the kinds and frequency of formative assessment strategies you use?				
a. I use planned formative assessments (questioning probes, pretests, open-ended questions) to provide me with information that guides my next steps for instruction.	*1*	*2*	*3*	*4*

Survey Part 1(S1) Teacher Perceptions of the Kinds and Frequency of Formative Assessment Strategies Used in Instruction				
1. To what extent do the following statements characterize the kinds and frequency of formative assessment strategies you use?				
b. The written or oral feedback that I give students about their work explicitly addresses how they did or did not meet the TEKS and/or national content standards.	*1*	*2*	*3*	*4*
c. My units of study include opportunities for students to engage in and get feedback on the kinds of problems that will be on their tests or exams.	*1*	*2*	*3*	*4*
d. I modify my instructional strategies when a student does not do well on a quiz or assessment.	*1*	*2*	*3*	*4*
e. I modify my instructional strategies on the spot/while teaching when a student or group of students does not seem to understand.	*1*	*2*	*3*	*4*
f. I schedule class time for students to revise their work and provide ongoing feedback to them during that process.	*1*	*2*	*3*	*4*
Survey Part 2 (S2) Kinds and Frequency of Technology Based Formative Assessments Used in Instruction				
2. To what extent do the following statements characterize the kinds and frequency of technology based formative assessment strategies you use?				
a. I use technology indirectly in my formative assessment by using test programs such as ExamView or other databases to generate questions.	*1*	*2*	*3*	*4*
b. I use technology indirectly in my formative assessment by using premade tests or make rubrics from the Internet.	*1*	*2*	*3*	*4*
c. I use technology indirectly in my formative assessment by using tests or other assessments from the Internet (including CSCOPE).	*1*	*2*	*3*	*4*
d. I use technology directly in my formative assessment by using CPS or clickers (eInstruction).	*1*	*2*	*3*	*4*
e. I use technology directly in my formative assessments which are graded via the Internet (Eduphoria!), etc.	*1*	*2*	*3*	*4*
f. I depend on younger; more technology experienced novice educators to assist me with my technology and associated formative assessments.	*1*	*2*	*3*	*4*
g. I depend on old, more experienced educators to assist me with my pedagogy and formative assessment development.	*1*	*2*	*3*	*4*

Survey Part 2 (S2) Kinds and Frequency of Technology Based Formative Assessments Used in Instruction				
2. To what extent do the following statements characterize the kinds and frequency of technology based formative assessment strategies you use?				
h. I use online materials, such as wikis or tutorials to assist me in my use and learning of technology based formative assessments.	*1*	*2*	*3*	*4*
i. I depend on other educators to steer me towards tutorials and instructional materials for technology based formative assessments.	*1*	*2*	*3*	*4*
j. I am interested in using a PLC to assist me in my technology and pedagogical expertise.	*1*	*2*	*3*	*4*
k. I use the scanner to "read" tests that my students have taken where answers and scores are uploaded to Eduphoria for further analysis.	*1*	*2*	*3*	*4*
l. I use MS Excel or other ways to visualize my student data, note their knowledge and adjust my instruction accordingly.	*1*	*2*	*3*	*4*

[1]

[2]

[1] Adapted from *Implementation of formative assessment strategies as perceived by high school students and teachers: professional development implications* (Doctoral dissertation), by R. Burns, 2010, p. 178.

[2] Adapted from *Wyoming teacher's knowledge and use of formative assessment* (Doctoral dissertation), by A.A. Gates, 2008, p. 150.

Please answer the following survey items regarding your use or perceptions of the technologies (interactive tablet (Mobi), student response pads or clickers, and Eduphoria!) for formative assessment (iFAIT) and the use of PLCs.

Survey Part 3 (S3) Teacher Perceptions of iFAIT and the Use of PLCs				
Please rate the following:	Strongly Disagree	Disagree	Agree	Strongly Agree
1. I identify strategies for using the technologies for formative assessment and associated tools.				
2. I am able to use the technologies for formative assessment.				
3. When I use technology for formative assessment, my students are engaged in learning.				
4. Using technology has a positive effect on my teaching.				
5. The teachers in my school view the use of the PLCs for technology as a positive experience.				
6. My administrators in my school view the PLC as an important component of formative assessment.				
7. Other school district leaders view the PLC as an important component of formative assessment.				
8. The PLC helps me with my professional learning goals.				
9. The use of technology in formative assessment content is connected to school improvement and student achievement.				
10. My PLC helps when I needed assistance with the technologies.				
11. I felt supported during implementation of technology based formative assessment.				
12. Our teachers' successes are recognized and shared during the PLC sessions.				

[3]

[3] Adapted from *An evaluation of professional development on using student response systems and interactive whiteboards for formative assessment in the middle schools of a southeastern school district* (Doctoral dissertation), by J. F. Fuller,2011, p. 138.

Demographics

1. Identify the content areas you teach:
A. ELA **B.** Math **C.** Science **D.** Social Studies **E.** Generalist **F.** Special Ed **G.** Other

2. Identify the grade level (s) you teach:
A. PK – K **B.** 1-2 **C.** 3-5 **D.** 6-8 **E.** 9-12

3. Number of years teaching: **A.** 0-5 **B.** 6-10 **C.** 11- 20 **D.** More than 20

4. Number of years teaching in CMISD: A. 0-5 **B.** 6-10 **C.** 11- 20 **D.** More than 20

APPENDIX C

BEGINNING INTERVIEWS – TEACHER PARTICIPANTS FORMATIVE ASSESSMENT AND TECHNOLOGY USES AND PERCEPTIONS (SELECT 4 TEACHERS FROM A REPRESENTATIVE CROSS-SECTION OF MEMBERS IN PLC GROUPS)

Formative Assessment Pedagogical Practices

1. How do your students know what is expected of them to learn or how do you use formative assessments in your classroom?

2. How do you know how students are progressing? What do you do with that information?

Technology Practices Associated with Formative Assessment

3. How do you use technology in your instruction at home or at school? Describe the ways you have used technology in your instruction. How does this affect your instruction and student learning?

4. How do you use the eInstruction clickers as assessment instruments? Why or why

not?

5. How do you use Eduphoria! to analyze past student data on state tests? To develop tests? Why or why not?

6. To what extent have your used technology --blog, wiki, or other social media -- for your professional development?

APPENDIX D

CONCLUDING SURVEY FORMATIVE ASSESSMENT USE SCALE WITH RELATED EDUCATOR PERCEPTIONS, AND DEMOGRAPHIC INFORMATION (ALL TEACHERS IN CMISD PLCS)

Given to all teachers in CMISD (volunteers) to define concluding attributes of study participants.

I agree to the use of these responses in a study that Marcia J. Talkmitt is using for her EdD. I understand that there will be no identifying information that can be tracked back to me.

A. Yes B. No

Select the most appropriate number using the scale below.

Almost Never	***Sometimes***	***Usually***	***Almost Always***
1	***2***	***3***	***4***

Survey Part 1(S1) Teacher Perceptions of the Kinds and Frequency of Formative Assessment Strategies Used in Instruction				
1. To what extent do the following statements characterize the kinds and frequency of formative assessment strategies you have used since the beginning of school?				
a. I have used planned formative assessments (questioning probes, pretests, open-ended questions) to provide me with information that guides my next steps for instruction.	*1*	*2*	*3*	*4*
b. The written or oral feedback that I have given students about their work explicitly addresses how they did or did not meet the TEKS and/or national content standards.	*1*	*2*	*3*	*4*
c. My units of study have included opportunities for students to engage in and get feedback on the kinds of problems that will be on their tests or exams.	*1*	*2*	*3*	*4*
d. I have modified my instructional strategies when a student does not do well on a quiz or assessment.	*1*	*2*	*3*	*4*
e. I have modified my instructional strategies on the spot/while teaching when a student or group of students does not seem to understand.	*1*	*2*	*3*	*4*

Survey Part 1(S1) Teacher Perceptions of the Kinds and Frequency of Formative Assessment Strategies Used in Instruction				
1. To what extent do the following statements characterize the kinds and frequency of formative assessment strategies you have used since the beginning of school?				
f. I have scheduled class time for students to revise their work and provide ongoing feedback to them during that process.	*1*	*2*	*3*	*4*
Survey Part 2 (S2) Kinds and Frequency of Technology Based Formative Assessments Used in Instruction				
2. To what extent do the following statements characterize the kinds and frequency of the use of technology with formative assessments that you have used since the beginning of school?				
a. I have used technology indirectly in my formative assessment by using test programs such as ExamView or other databases to generate questions.	*1*	*2*	*3*	*4*
b. I have used technology indirectly in my formative assessment by using premade tests or make rubrics from the Internet.	*1*	*2*	*3*	*4*
c. I have used technology indirectly in my formative assessment by using tests or other assessments from the Internet (including CSCOPE).	*1*	*2*	*3*	*4*
d. I have used technology directly in my formative assessment by using CPS or clickers (eInstruction).	*1*	*2*	*3*	*4*
e. I have used technology directly in my formative assessments which are graded via the Internet (Eduphoria!), etc.	*1*	*2*	*3*	*4*
f. I was able to use more technology in my formative assessments using strategies that more computer literate novice teachers within my PLC used and assisted me.	*1*	*2*	*3*	*4*
g. I was able to use more pedagogy in my formative assessments using strategies that more pedagogical oriented experienced teachers within my PLC used and assisted me.	*1*	*2*	*3*	*4*

Survey Part 2 (S2) Kinds and Frequency of Technology Based Formative Assessments Used in Instruction					
2. To what extent do the following statements characterize the kinds and frequency of the use of technology with formative assessments that you have used since the beginning of school?					
h. I used the iFAIT wiki to assist me in my use and learning of technology based formative assessments.	*1*	*2*	*3*	*4*	
i. I can now use more web based tutorials and instructional materials with the support of my PLC.	*1*	*2*	*3*	*4*	
j. I am interested in using an iFAIT PLC to assist me in my technology and pedagogical expertise.	*1*	*2*	*3*	*4*	
k. I have used the scanner to "read" tests that my students have taken where answers and scores are uploaded to Eduphoria for further analysis.	*1*	*2*	*3*	*4*	*5*
l. I have used MS Excel or other ways to visualize my student data, note their knowledge and adjust my instruction accordingly.	*1*	*2*	*3*	*4*	*5*

[4]

[5]

[4] Adapted from *Implementation of formative assessment strategies as perceived by high school students and teachers: professional development implications* (Doctoral dissertation), by R. Burns, 2010, p. 178.

[5] Adapted from *Wyoming teacher's knowledge and use of formative assessment* (Doctoral dissertation), by A.A. Gates, 2008, p. 150.

Please answer the following survey items regarding your use of the technologies (interactive tablet (Mobi), student response pads or clickers, and Eduphoria!) for formative assessment (iFAIT) and the use of PLCs and their collaborative wiki.

Survey Part 3 (S3) Teacher Perceptions of iFAIT and the Use of PLCs				
Please rate the following:	Strongly Disagree	Disagree	Agree	Strongly Agree
1. I identified strategies for using the technologies for formative assessment and associated tools.				
2. I am able to use the technologies for formative assessment.				
3. When I used technology for formative assessment, my students are engaged in learning.				
4. Using technology had a positive effect on my teaching.				
5. The teachers in my school view the use of the iFAIT PLC as a positive experience.				
6. My administrators view the iFAIT PLC as an important component of formative assessment.				
7. Other school district leaders view the iFAIT PLC as an important component of formative assessment.				
8. The iFAIT PLC helped me with my professional learning goals.				
9. The use of technology in formative assessment content is connected to school improvement and student achievement.				
10. My PLC helped me when I needed assistance with the technologies.				
11. I felt supported during implementation of technology based formative assessment.				
12. Our teachers' successes were recognized and shared during the PLC sessions.				

[6]

[6] Adapted from *An evaluation of professional development on using student response systems and interactive whiteboards for formative assessment in the middle schools of a southeastern school district* (Doctoral dissertation), by J. F. Fuller,2011, p. 138.

Open Ended Response

1. Physical and/or emotional barriers of successful technology based formative assessments that I have encountered are …
2. For me, Eduphoria is…
3. For me eInstruction tools (clickers and/or Mobi) are…
4. For me, our technology tools (document cameras, projectors, current computers) are…
5. The potential of new technology (iPads, smart phones, etc.) in our school is…
6. The potential for social media and collaborative resources (including online images, videos, etc.) at our school is…
7. Consider the impact of an instructional coach (technology integration) established PLCs; self-made PLCs via friends, peers, and/or hall neighbors; or other PLCS within the region or state that you can relate and complete the following statement: Technology assistance via individuals in a face-to-face is…
8. Consider technology assistance via written methods (online resources online tutorials email central warehouses such as wikis or by other means) and complete the following statement: Technology assistance via written documentation is helpful to me through…
9. The most frustrating aspect of using technology in formative assessments is…
10. The most rewarding aspect of using technology in formative assessments is…
11. Professional development for the use of technology and formative assessments should be…

Demographics

1. Identify the content areas you teach:

A. ELA B. Math C. Science D. Social Studies E. Generalist F. Special Ed

G. Other

2. Identify the grade level (s) you teach:

A. PK – K B. 1-2 C. 3-5 D. 6-8 E. 9-12

b. Number of years teaching:

A. 0-5 B. 6-10 C. 11- 20 D. More than 20

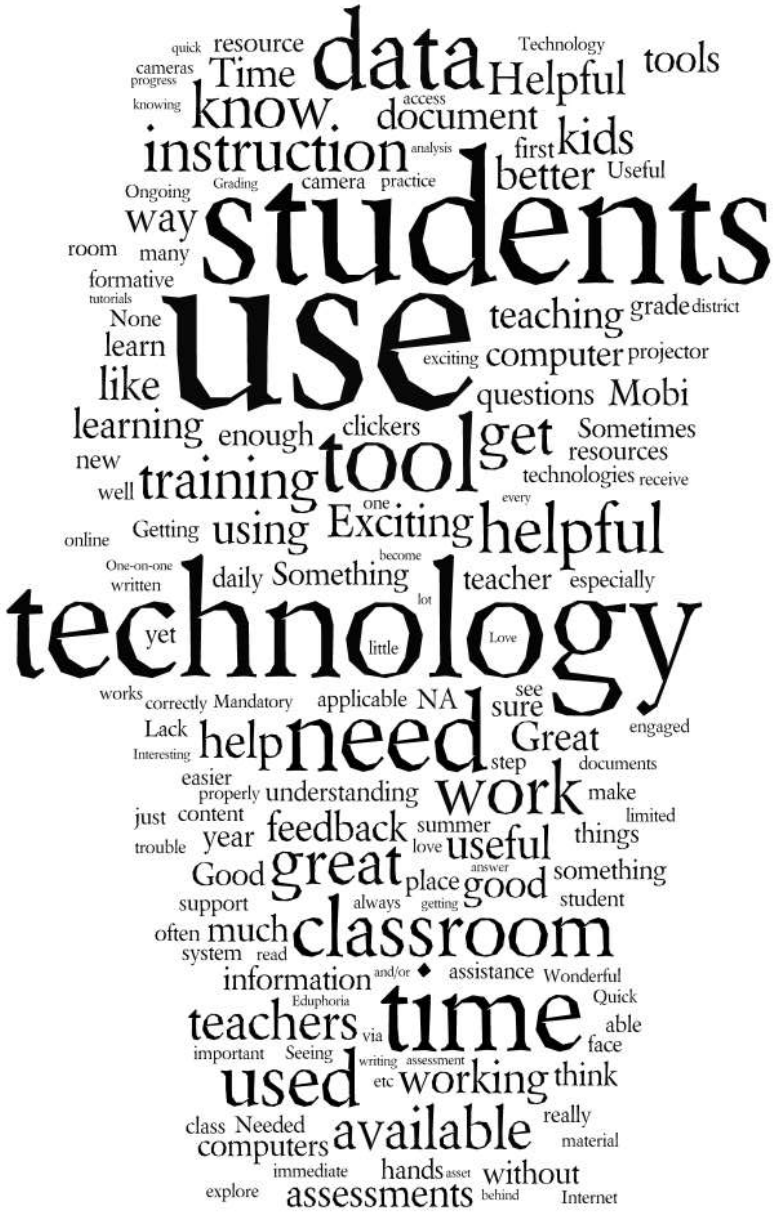
c. Number of years teaching in CMISD:

A. 0-5 B. 6-10 C. 11- 20 D. Greater than 20

APPENDIX E

WORD CLOUDS FROM QUALITATIVE DATA

Word Cloud 1 Interviews (Please note the increasing font size is an indication of the word or word phrase used more frequently in the open-ended responses.)



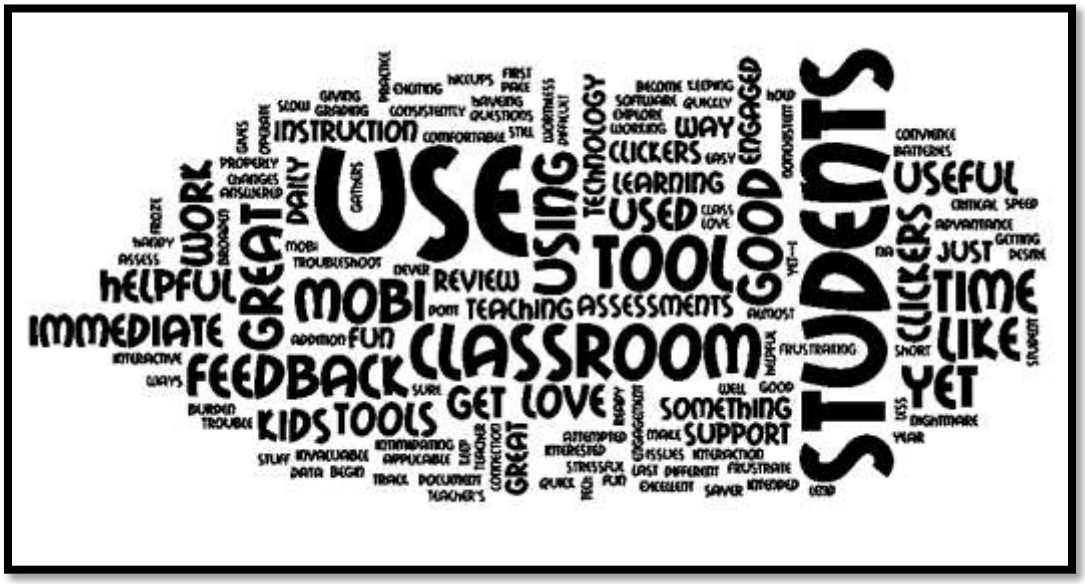
Word Cloud 2 All Open-Ended Responses (Please note the increasing font size is an indication of the word or word phrase used more frequently in the open-ended responses.)

Open Ended Survey items

Physical and/or emotional barriers of successful technology based formative assessments that I have encountered are…(75% response rate) (Please note the increasing font size is an indication of the word or word phrase used more frequently in the open-ended responses.)

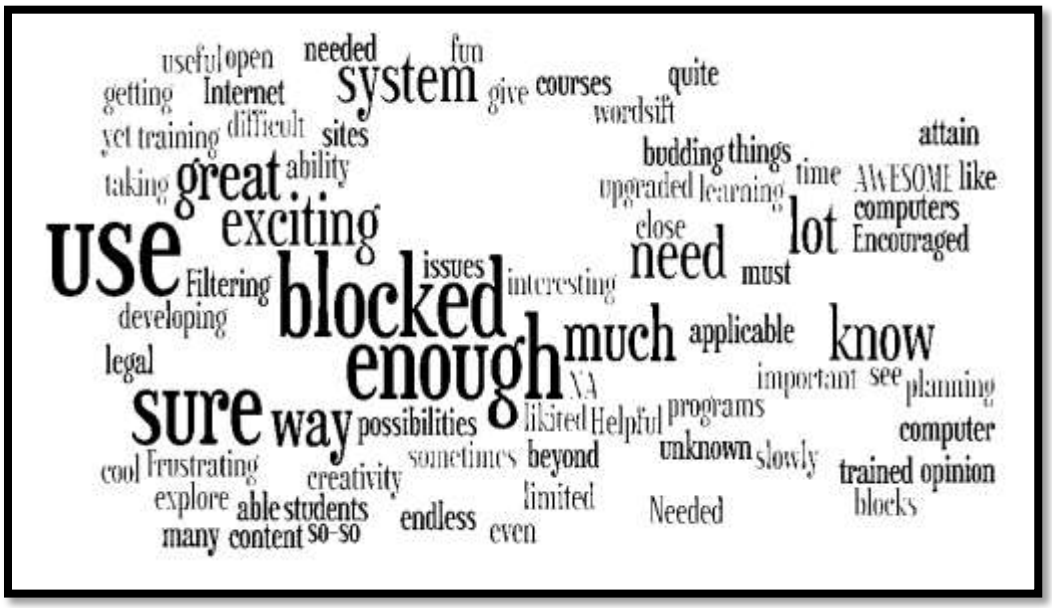
The most rewarding aspect of using technology in formative assessments is… (87% response rate) (Please note the increasing font size is an indication of the word or word phrase used more frequently in the open-ended responses.)

For me, Eduphoria is… (97% response rate) (Please note the increasing font size is an indication of the word or word phrase used more frequently in the open-ended responses.)



For me, eInstruction tools (clickers and/or Mobi) are… (89% response rate) (Please note the increasing font size is an indication of the word or word phrase used more frequently in the open-ended responses.)

Consider technology assistance via written methods (online resources, online tutorials, email, central online data warehouses such as wikis, or by other means) and complete the following statement: Technology assistance via written documentation is helpful to me through… (65% response rate) (Please note the increasing font size is an indication of the word or word phrase used more frequently in the open-ended responses.)



The potential for social media and collaborative resources (including online images, videos, etc.) at our school is… (80% response rate) (Please note the increasing font size is an indication of the word or word phrase used more frequently in the open-ended responses.)

APPENDIX F

TAMU HUMAN SUBJECTS CONSENT FORM

Project Title: Professional Learning Communities: Mechanism for Teacher Support of Innovative Formative Assessment and Instruction with Technology (iFAIT)

You are invited to take part in a research study being conducted by Marcia J. Talkmitt, a researcher from Texas A&M University. The information in this form is provided to help you decide whether or not to take part. If you decide to take part in the study, you will be asked to sign this consent form. If you decide you do not want to participate, there will be no penalty to you, and you will not lose any benefits you normally would have.

Why Is This Study Being Done?

The purpose of this study is to determine the effectiveness of professional learning communities (PLCs) supported with an online collaborative wiki to use the ARS and online data compiler, Eduphoria!. Effective formative assessments are partnered with immediate feedback, feedback within minutes provided by technology, rather than feedback given days later in numerical values and abbreviated commentary. This study will provide a basis for teacher support of Innovative Formative Assessment and Instruction with Technology (iFAIT).

Why Am I Being Asked To Be In This Study?

You are being asked to be in this study because you are a certified teacher in Slaton ISD and have access to the technologies of Audience Response System (ARSs) and Eduphoria!.

How Many People Will Be Asked To Be In This Study?

Approximately a hundred people (participants) will be invited to participate in this study locally. Overall, a total of forty people will be invited at Slaton ISD.

What Are the Alternatives To Being In This Study?

The alternatives for being in this study are to carry on as you have before without the benefit of personalized assistance with formative assessments with technology support.

What Will I Be Asked To Do In This Study?

You will be asked to participate in a professional learning community (PLC) to learn and share both pedagogy (methods of teaching) and technology in formative assessments of your students as core teachers. You will provide feedback through likert instruments (questionnaires) and interviews at the beginning of the study (August 2012)

and at the end of the study (December 2012). Your participation in this study will last up to 4 months and includes at least 6 visits to either provide assistance or to interview.

You may be removed from the study by the investigator for these reasons:

- YOU DO NOT USE TECHNOLOGY IN YOUR FORMATIVE ASSESSMENTS.
- YOU DO NOT MEET OR CONTRIBUTE TO YOUR GROUP IF YOU ARE WORKING AS A PLC.
- YOU CHOSE TO BE REMOVED FROM THE STUDY BY CONTACTING THIS RESEARCHER

Will Photos, Video or Audio Recordings Be Made Of Me during the Study? ***Yes***

The researchers will make audio recordings during the study so that your perceptions of innovative formative assessment with instruction and technology can be documented. Group audio recordings are desired. If you do not give permission for the audio recordings to be obtained, you cannot participate in this study.

_____ I give my permission for audio recordings to be made of me during my participation in this research study.

_____ I do not give my permission for audio recordings to be made of me during my participation in this research study.

Are There Any Risks To Me?

The things that you will be doing are no more risks than you would come across in everyday life as a schoolteacher. Every attempt will be made to secure your privacy and confidentiality as you participate in the questionnaires and interviews.

Although the researchers have tried to avoid risks, you may feel that some questions/procedures that are asked of you will be stressful or upsetting. You do not have to answer anything you do not want to.

Are There Any Benefits To Me?

The direct benefit to you by being in this study is that you will be able to assess your students quickly using technology so instructional time can be refined and effective. At least one Nook Color or Kindle Fire will be given to participants through a drawing at the end of the study.

Will There Be Any Costs To Me?

Aside from your time, there are no costs for taking part in the study.

Will Information From This Study Be Kept Private?

The records of this study will be kept private. No identifiers linking you to this study will be included in any sort of report that might be published. Research records will be

stored securely and only the investigator, Marcia Talkmitt and her advisors, graduate school personnel, and others as listed below from Texas A&M University will have access to the records.

Information about you will be stored in a locked file cabinet and in computer files protected with a password in the home of Marcia Talkmitt. This consent form will be filed securely in an official area at the office of Slaton ISD Superintendent Julie Becker.

People who have access to your information include the Principal Investigator and research study personnel. Representatives of regulatory agencies such as the Office of Human Research Protections (OHRP) and entities such as the Texas A&M University Human Subjects Protection Program may access your records to make sure the study is being run correctly and that information is collected properly.

We may be legally obligated to disclose information under the Texas Public Information Act. Information about you and related to this study will be kept confidential to the extent permitted or required by law. The Texas Public Information Act provides a mechanism for the public to request public information in Texas A&M University's possession, which may include information about you and/or information related to this study. If Texas A&M University receives a request for public information relating to this study, the university will seek to withhold information about you and/or this study to the extent such information may be considered confidential by law and to the extent legally permitted and authorized by the Texas Attorney General's Office to do so.

Who may I Contact for More Information?
You may contact the Principal Investigator, Dr. Lynne Masel Walters, PhD, to tell her about a concern or complaint about this research at 979-845-8384 or lynne-walters@tamu.edu. You may also contact the Protocol Director, Marcia J. Talkmitt at 806-928-7303or marcia.talkmitt@valornet.com . You may also contact the faculty advisor, Dr. Valerie Hill-Jackson, PhD at 979-845-8384 or vhjackson@tamu.edu .

For questions about your rights as a research participant; or if you have questions, complaints, or concerns about the research, you may call the Texas A&M University Human Subjects Protection Program office at (979) 458-4067 or irb@tamu.edu.

What if I Change My Mind About Participating?
This research is voluntary and you have the choice whether or not to be in this research study. You may decide to not begin or to stop participating at any time. If you choose not to be in this study or stop being in the study, there will be no effect on your employment, evaluation, or relationship to Slaton ISD. Any new information discovered about the research will be provided to you. This information could affect your willingness to continue participation.

STATEMENT OF CONSENT

I agree to be in this study and know that I am not giving up any legal rights by signing this form. The procedures, risks, and benefits have been explained to me, and my questions have been answered. I know that new information about this research study will be provided to me as it becomes available and that the researcher will tell me if I must be removed from the study. I can ask more questions if I want, and I can still receive services if I stop participating in this study. A copy of this entire consent form will be given to me.

_____ _____

Participant's Signature **Date**

_____ _____

Printed Name **Date**

INVESTIGATOR'S AFFIDAVIT:
Either I have or my agent has carefully explained to the participant the nature of the above project. I hereby certify that to the best of my knowledge the person who signed this consent form was informed of the nature, demands, benefits, and risks involved in his/her participation.

_____ _____

Signature of Presenter Date

_____ _____

Printed Name Date