

Abstract

ARISE High School is located in the heart of the Fruitvale District in Oakland, California. Given that the student population is primarily Latino at 69% and that nationally only 21% of Hispanics are performing at or above the level of proficient in mathematics, it is imperative that ARISE teachers are able to effectively implement formative assessment practices that are known to improve achievement, in particular with the lowest achieving students. Through my observations as a mathematics instructional coach I have seen a pattern of novice teachers asking few probing questions, questions that may not be aligned to the stated learning objective, generally asking students questions that don't require critical thinking, and that are not pre-planned. In order to understand what is needed to support teachers to adopt new practices my literature review focused on the achievement gap, high teacher turnover, novice teacher learning needs, formative assessment, and coaching. What emerged was the effective use of formative assessment practices that are learned collaboratively, context embedded, and sustained through coaching cycles support novice teachers in implementing new strategies. Through this action research project my goal was to use coaching cycles to engage novice teachers to examine their own practice in order to help them improve their use of formative assessment practices, in particular questioning. For each coaching cycle I observed a lesson to collect data on their patterns of questioning, we then held a debrief meeting where we reflected on their use of questioning, and followed up with a co-planning session. Throughout the action research project I collected video of lessons, coaching conferences, co-planning sessions, and post-intervention interviews. I also collected data from surveys, co-planned, and non co-planned lessons from teachers. All three participants showed growth in ability to analyze their practice with regard to questioning, and two teachers showed growth in creating daily lesson plans that reflected pre-planned questions that were aligned to the days' lesson objective. And finally all three showed growth in their use of formative assessment strategies.

Introduction and Context

ARISE High School is a public charter school grades 9-12 located in the heart of the Fruitvale District in Oakland, California. ARISE has approximately 250 students consisting of 69% Latinos, 2% Black or African Americans, 3% American Indian or Alaska Native, 5% White, and 3% Two or More Races. 83% of our students are eligible for free or reduced-price lunch. On the 2013 Algebra 1 California Standards Test (CST) the 9th grade scores were as follows: 19% Far Below Basic, 48% Below Basic, 26% Basic, 7% Proficient, and 0% Advanced. The math department at ARISE has three math teachers; all of whom are novice teachers. Over the last three years the math department has been developing a set of learning targets for all of the courses. In addition the team has created common assessments that are aligned to each learning target.

Our school-wide professional development focus is on the 5-part lesson plan and the use of formative assessment practices. As the department lead and instructional coach it is my role to support teachers to develop the skills and knowledge they need in order to effectively create and implement 5- part lesson plans and formative assessment practices.

Problem of Practice

Through my observations of the math teachers at ARISE I've found that teachers checks for understanding are inconsistent, frequently don't give them any more information than they had prior to asking and they are not sure how to address student need because their checks for understanding were insufficient. In addition very little wait time is being given. Some teachers are planning the next day's instruction without knowledge of their student's progress toward the learning objective., I have observed some teachers giving exit tickets as formative assessment, but they aren't using them to create lessons to address student need, rather they are doing another

round of group instruction. As a result there is a low passing rate of the four question quizzes given students to assess short-term acquisition of content. The passing rate is lowest amongst the students who struggle with foundational math skills, such as adding, subtracting, multiplying, and dividing integers, simplifying fractions, and graphing.

Based on my classroom observations, I have noticed the questions teachers ask are primarily on the recall level, and not always connected to the learning objective of the day. The checks for understanding are random and not planned. For the students who struggle the most, this results in them getting further and further behind. **Math teachers at ARISE, who are all novice teachers, do not use formative assessment effectively, in particular questioning with clear instructional purpose, to inform their knowledge of students' progress toward learning objectives.** For this action research project, I will use coaching cycles with the math team to support the transfer and maintenance of formative assessment practices learned during school-wide professional development.

Literature Review

Introduction

A teacher's ability to know where her student is with regard to a learning objective is not a skill that all teachers come equipped with when entering the classroom (Darling-Hammond, 2003). Nor is simply having knowledge of the definition of formative assessment enough to ensure its proper application (Otero, 2006). However, assessing for learning is an essential component to teaching and learning. In the following literature review, I examined literature on Latino's and the achievement gap, novice teachers and retention, teacher attitudes towards students, formative assessment, and coaching for novice teachers. I argued that learning how to effectively implement the practice of formative assessment through lesson study and coaching cycles will help novice teachers mitigate feelings of isolation, foster a disposition of inquiry, and

gain new skills and knowledge that will increase their capacity to use formative assessment practices to improve student achievement.

Latino-White Achievement Gap

Through examining the research on the Latino-White achievement gap in the United States, I show that meeting the needs of this group deserves our attention and has serious implications for our nation. While some researchers have pointed to income inequality, and conditions associated with poverty to name a few to explain the achievement gap, there is additional research that suggests its cause lies in pre-service teacher training programs that are not adequately preparing teachers for the profession. (Barton, 2004; Reardon, 2011; Palardy, 2001; Desimone, 2010). In addition to insufficient training of teachers, other researchers have pointed to high teacher turnover in urban schools where there are large numbers of Latino students. Poor in-service support for novice teachers, who are more likely to be in urban and high poverty schools, and teacher views and attitudes on students from different racial and economic backgrounds as contributing factors of the achievement gap (Darling-Hammond, 2003; Ingersoll, 2001; Dolan, 2004; Hanushek, Kain, Rivkin, 1999).

With regard to when the achievement gap begins and its impact, the literature is clear. The achievement gap starts when children are young, persists throughout their years in school and has devastating impacts on the number of Latino's that pursue careers in Science, Technology, Engineering, and Math (STEM) fields (The Education Trust, 2003).

The National Center for Educational Statistics (NCES) just released "The Nations Report Card: Mathematics and Reading 2013." This report compiles and compares data from 1990-2013 of 4th and 8th grade students for mathematics and reading. National average scores for all students reported show a 22-point improvement in mathematics between 1990 and 2013. When data disaggregating for race, in the same time frame, 8th grade Hispanic scores were on par with

national averages. However, nationally only 21% of Hispanics are performing at or above the level of proficient (NCES, 2013). In California, the percentage of students scoring at or above proficient was lower than the national average in mathematics in both 4th and 8th grades (NAEP, 2009). While nationally the achievement gap between Hispanic and Whites has narrowed in both reading and mathematics for students in 4th and 8th grades, the comparisons for California, where the population of Hispanics is higher, show the achievement gap is wider in mathematics for grades 4 and 8 (NAEP, 2009). In a separate report issued by NAEP called, “Achievement Gaps: How Hispanic and White Students in Public Schools Perform in Mathematics and Reading on the National Assessment of Educational Progress,” found White and Non-ELL Hispanics had a 15 point gap in reading, while the gap between Whites and ELL Hispanics is a whopping 54 points. The same report compared the achievement gap for various years between 2003 and 2009 of White students who qualified for the National School Lunch Program (NSLP) and White students who did not. In mathematics for grade 8 there was a 21-point difference between non-eligible White and eligible White students. Surprisingly non-eligible, non-ELL Hispanics scored on par with eligible White students with scores of 275 and 276 respectively (NAEP, 2009).

Statistics released by National Center for Educational Statistics (NCES) on degrees conferred to Hispanics in the Science, Technology, Engineering, and Mathematics (STEM) field would suggest that the achievement gap manifests in low representation of Hispanics in the STEM field. In a report by NCES called “STEM Attrition: College Students’ Paths Into and Out of STEM,” both males and females exit from STEM fields, but males are more likely to drop out rather than switch majors. In addition between 2003 and 2009, 23.1% of Hispanics left the stem field by dropping out of school and 26% left by choosing an alternate major. More Hispanic males compared to females earn bachelor’s degrees in the STEM field. Another report by NCES called “Higher Education: Gaps in Access and Persistence Study” reported in the academic year 2009-10, 17% of all degrees conferred in the STEM field were earned by Hispanics. This

research shows the achievement gap impacts the number of Latino's that enter and graduate with a degree in the STEM field.

Novice Teachers, Retention, and the Achievement Gap

Any successful effort to attempt to close the achievement gap must give considerable attention to the quality of in-service novice teacher training to increase likelihood of teacher retention (Darling-Hammond, 2003; Shernoff, Marinez-Lora, Frazier, Jakobsons, and Atkins, 2011). Urban schools are more likely to hire new teachers and they are more likely to leave the profession due to being underprepared, creating a revolving door which has a negative impact on student achievement and impedes school reform efforts (Darling-Hammond, 2003). Linda Darling-Hammond (2003) cites four major contributors for attrition of teachers in general as: salaries, working conditions, teacher preparation, and mentoring support in the early years. Shernoff, Marinez-Lora, Frazier, Jakobsons, and Atkins (2011) cite “effectiveness around classroom management and engaging learners; and connectedness to colleagues” as strong “predictors” of novice teacher attrition.

In their look into the teaching practice of four novice and expert teachers, Livingston and Borko (1989) suggest that the student teacher placement paradigm could be having negative effects on the ways that pre-service teachers think about teaching and learning. In their research novice teachers were found to have inadequate and underdeveloped cognitive schema for teaching. Specifically they have underdeveloped pedagogical reasoning and pedagogical content knowledge (Livingston and Borko, 1989). The researchers found that the expert teachers, that student teachers were placed with, were not always making their thinking visible. The expert teachers may have shared resources in the form of lesson plans and curriculum, but that was not sufficient to build necessary cognitive schema for planning and designing curriculum for student

teachers. (Livingston and Borko, 1989). As a result, student teachers leave their placements and enter the profession largely underprepared. In short, because novice teachers lack pedagogical reasoning, ways of knowing how to break down and organize concepts, and pedagogical content knowledge, ways of knowing how to teach those concepts, they are less effective classroom teachers (Livingston and Borko, 1989).

Trained mentors and adequate planning time were among the supports that new teachers cited as needed to feel successful (Fantilli and McDougall (2009). Many researchers are calling for more carefully matched mentors for pre-service teachers as well as induction programs that have at their core well trained coaches (Hobson, Harris, Buckner-Manley, & Smith, 2012; Wood 2009; Fantilli & McDougall, 2009;Huling, Resta & Yeargain, 2012). In her review of quality induction programs, Wood (2009) describes the goals to be:

- Increase novice teacher's retention,
- Promote novice teacher personal and professional well-being,
- Improve teacher competence,
- Improve students' academic achievement through improving teacher performance,
- Satisfy mandated requirements related to induction and certify

(Wood, 2009, p. 4-5)

The real and perceived isolation that novice teachers experience contribute to poor working conditions that lead to teachers leaving the profession (Shernoff et al., 2011). For novice teachers, collegiality serves as a way to foster a sense of collective purpose and commitment to place (Shernoff et al., 2011). In order to build a desire to stay in teaching, novice teachers must experience collegial and social interactions where there are opportunities to learn from others. When they feel they are part of a school community where everyone is taking responsibility for issues around student learning and "school improvement," novice teachers gain a sense of cooperation and inclusiveness that fosters loyalty to place and commitment to teaching (Shernoff et al., 2011). Through structures such as Professional Learning Communities (PLC),

Lesson Study, and job embedded coaching, novice teachers begin to develop their practice while learning from the knowledge base that exists in the practice of others (Shernoff et al., 2011).

In addition, research shows that the self-efficacy on the part of the teacher with regard to motivating and engaging his or her students also impacts student achievement (Shernoff et al., 2011). Studies have shown that when a teacher believes in his or her own ability to achieve a task, they are more likely to try new instructional strategies in their classrooms, which builds investment and identify in their role as teacher (Shernoff et al., 2011; Taylor, 2008; Edwards & Newton, 1995). For novice teachers in particular, feelings of low self-efficacy and the lack of actual skills to engage and motivate students can be demoralizing and can lead to attrition (Darling-Hammond, 2003).

Teacher Attitudes and Beliefs about Students

In trying to understand the causes of the achievement gap, sometimes referred to as the “race gap,” research has focused on family background or policy issues, however when those factors are controlled for, the gap still exist (Bali and Alvarez, 2004). In more recent studies teacher attitudes toward children and student’s own feelings of self-efficacy are pointed to as reasons for the achievement gap (Dolan, 2004).

In a study examining the cognitive, motivational, and emotional predictors of math achievement Stevens et al (2006) found that self-efficacy is an independent actor on mathematical achievement. This finding was of particular interest because the old thinking was that self-efficacy mediated ability, when in fact, ability and efficacy have independent impacts on mathematical achievement. Stevens’ (2006) claim that "beliefs can be altered through praise and feedback" has meaningful implications for teacher practice. Essentially if teachers are holding high expectations for their students and continually monitoring their progress towards rigorous academic standards, students will build the self-efficacy needed for academic improvement. However, some studies show is that in high poverty schools, where there is a high

concentration of Latino students, the newest and most inexperienced of the teaching force are placed (Darling-Hammond, 2003). The cultural mismatch between novice teachers and their students often leads to teachers thinking their students aren't as capable, which in turn influences teachers to lower their expectations therefore causing or exacerbating the achievement gap (Smith and Smith, 2009; Talbert-Johnson, 2004).

While teachers may independently come to their own ideas about student ability, many novice or just newly hired teachers enter into schools with existing cultures communicate low expectations for children. As a result, existing school culture influences what the new teacher feels they can impact. Instead of examining their practice to improve, teachers will assign blame for poor performance on their students (Hollins, 2008; Huisman, Singer & Catapano, 2010). Conversely, when teachers belong to a teaching community that feels important and prestigious, and when teachers perceive their students to belong to a class of citizens that will one day reach the upper echelons of education, teachers hold their students as well as themselves to rigorous standards (Page, 1987).

Based on the literature review of the Latino-White achievement gap, teacher retention, induction programs, and teacher attitudes towards students, I conclude that carefully matched and trained coaches can improve a novice teacher's skill and knowledge through "fostering a disposition of inquiry" that will result in increased student achievement.

Coaching Novice Teachers for Retention and Growth.

One of the factors associated with attrition of novice teachers is the lack of coaching and mentoring in the earliest years of service (Darling-Hammond, 2003; Shernoff, 2011). According to Darling-Hammond "teacher turnover is 50% higher in high-poverty schools than in low-poverty schools, and new teachers in urban districts exit or transfer at higher rates than their suburban counterparts do". High teacher turnover has devastating effects on student achievement and on school reform efforts (Darling-Hammond, 2003). Based on my literature

review of coaching novice teachers, I argue that engaging novice teachers in a common school-wide professional development focus on formative assessment, as well as in other activities such as lesson study, will help them gain new skills and knowledge. Coaching cycles will function to support the transfer and maintenance of those skills to their daily lessons. In addition, I also argue that co-planning with novice teachers to build pedagogical reasoning and pedagogical content knowledge will support novice teacher development and combat attrition.

After learning that professional development focused on teaching strategies alone were not transferring to classrooms, Joyce and Showers (1996) proposed "peer coaching as an on-site dimension of staff development" that focused on "analysis of teaching". Moreover, they found that the collaborative nature of the peer-coaching teams contributed to the transfer of new knowledge to the classroom. Novice teachers learn best when put in reciprocal learning environments. The creation of shared knowledge contributes to professional growth of the individual and the group. Study groups, in particular, work best when the context is shared (Hollins, 2008).

Lesson Study, defined by Catherine Lewis as "a Japanese approach to instructional improvement" provides a unique opportunity for a team of teachers, who share context, to collaboratively study, plan, teach, and reflect on a lesson. Joyce and Showers (1995) assert "teachers learn from one another while planning instruction, developing support materials, watching one another work with students, and thinking together about the impact of their behavior on their students' learning", which all mirror the stages of lesson study.

The research on effective coaching is careful to point out that coaching stances that develop "dispositions of inquiry" versus emotional and technical support are what contribute to improved instructional decision making (Gardiner, 2012; Long et al., 2012.) The literature on coaching and mentoring defines mentoring as the emotional and technical support that teachers, new to a school or the profession, might receive. However, coaching is defined to be the

guidance novice teachers receive that is meant to improve their practice through observation and reflection (Gardiner, 2012). While some coaches do provide emotional support to new teachers, their main goal is to facilitate the improvement of teacher practice. In order for teachers to improve instruction, Taylor (2008) suggests there are three things required, 1) Defined desired change and outcome for instruction, 2) Motivation, which is mediated by whether or not the teacher feels their efforts will be successful and their beliefs about their own ability, and 3) Do teachers possess the skills and knowledge to implement changes in teaching practice. Taylor (2008) argues that coaching can intervene in all three of these areas. Coaches can model the desired practice, observe teachers and give feedback that helps them know if their efforts are successful, as well as support them with resources and further training. Gaining actual skills and knowledge builds the teachers' self-efficacy and improves practice, which mitigates feelings of ineffectiveness. Finally, ensuring transfer of new skills and knowledge through coaching is mediated by proximity, time and regularity of meeting, pedagogical content knowledge, shared context or at the very least knowledge of grade level and subject (Long et al. 2012).

Teacher's cognitive schema is deficient in two essential areas needed for planning curriculum and daily lessons; pedagogical reasoning and pedagogical content knowledge. Co-planning lessons, where coaches make their thinking process visible, will model for novice teachers ways of thinking about how to break down concepts for learning. Coaches can then share ways of teaching concepts to novice teachers, who may have a limited range of experiences. The coaching cycle of modeling, co-planning, observation, and feedback will over time build a new teacher's self-efficacy and desire to stay in the profession.

Based on the literature review of effective coaching for novice teachers, I conclude that in order to meet the specific learning demands of novice teachers, the coach must focus her time on creating conditions for collaboration, improving reflection, and co-planning.

Formative Assessment for Novice Teachers

Based on the literature review of formative assessment, I argue that it is a practice that improves student achievement and is the essential tool for assessing for learning (Black and Wiliam, 1998). I will also show that in order for novice teachers to implement formative assessment practices, they need to learn how to create effective learning environments that support formative assessment practices, and to interpret the responses of students in order to differentiate instruction.

Valerie Otero (2006) defines formative assessment as the “process of goal identification, assessment, and feedback,” and Margaret Heritage (2007) describes, “four core elements of formative assessment: 1) identifying the "gap," 2) feedback, 3) student involvement, and 4) learning progressions” (p. 141). Effective implementation depends on a teacher’s knowledge of each element, and their ability to interpret and use student responses to adjust instruction (Otero, 2006). In addition, many researchers agree that assessment only becomes formative when teachers use it to adjust their instruction (Black and Wiliam, 1998; Heritage, 2009; Moon, 2005). Furthermore, research has shown that when implemented effectively, formative assessment can have a positive impact on student performance and motivation, in particular, for lower performing students (Black and Wiliam, 1998; Heritage, 2007). A student who performs lower than others often perceives their low performance as a function of low ability. Feedback that informs students about their progress towards the learning objective, engages them in the learning task, and focuses the student on making improvements while communicating to them that learning is a process, where they too can be successful (Black et al., 2004).

In their article, “Working Inside the Black Box,” Black et al. (2004) focus on areas that teachers can leverage to make formative assessment more effective such as, "questioning, feedback through grading, peer- and self-assessment, and the formative use of summative tests". Effective formative assessment practices rely on a teacher’s ability to create effective learning environments (Heritage et al., 2009; Black et al., 2004; Long, 2012; Moon, 2005).

One key element of formative assessment is feedback. Teachers must change their practice to include meaningful and useful feedback to the learner, and students have to be part of the assessment process (Heritage, 2007). In the classroom where formative assessment is effectively used, students are active participants in their own learning. Feedback that is most useful to students, communicates to them what they are already doing well and what still needs to be done in order to meet the learning objective (Heritage, 2007).

In their literature review on formative assessment practices, Black and Wiliam (1998), found the practice of questioning to be insufficient. Teachers asked questions that were mostly on the recall level, and in general did not give students enough time to respond. In addition, they found that teachers accepted incorrect responses or did not ask probing questions. In their book *Checking for Understanding* Fisher and Frey (2007), report that teachers in high poverty schools talk more than teachers in non-high poverty schools. Teachers of students who are low achieving talk at “least 80 percent of the time.” For novice teachers to improve the formative assessment practice of questioning, they must first believe it is valuable to student learning, build into their plans pre-thought out questions that are genuine checks for understanding, and anticipate incorrect response in order to know how to scaffold follow up questions (Fisher and Frey, 2007).

Black et al., (2004) suggest that student self-assessment as well as peer assessment are ways to involve the student in their own learning and increase motivation and engagement. However, Heritage (2007) is careful to point out that for peer assessment and self-assessment to realize its full potential teachers must attend to teaching students the metacognitive language of assessment. By teaching students how to give feedback, the environmental expectations are ones of active learning and engagement (Heritage, 2007).

Black et al., (2004) state, effective learning environments must be “engineered” so that activities provide opportunities for collaboration, peer- and self- assessment, feedback from the

teachers, opportunities for students to process teacher and peer feedback, and teachers encourage students to focus on expressing their thinking rather than only obtaining a correct answer.

In a report about teacher “knowledge for teaching mathematics”, Heritage et al. (2009) found that some teachers could identify errors in thinking for incorrect responses to test questions, however were less clear about next steps for instruction. In general, the teachers who were unclear about next steps for instruction also lacked pedagogical reasoning and pedagogical content knowledge. These teachers were unable to adjust instruction because they were unclear of how ideas and concepts were organized.

In her work with pre-service teachers Otero (2006) explores the underlying conceptual development that teachers new to the profession need to have in order for formative assessment to be an effective tool rather than steps. Special attention has to be paid to coaching novice teachers how to examine student responses so that they don't fall back or fall into one of the three categories of thinking around formative assessment, which Otero (2006) describes as, “a) the ‘get it or don't get it’ conception, b) the ‘experienced-based knowledge’ conception, and c) a mixed conception of formative assessment and student prior knowledge path.” Otero (2006) argues that having knowledge of formative assessment and implementing it does not automatically improve student ability to understand a concept. Rather the knowledge of formative assessment must be grounded in theories about how students learn and actually develop concepts. Teachers have to be taught how to look for evidence of concept progression, rather than the three pitfalls of conception categorization. Without grounding in concept development to guide teacher thinking about student progress, teachers rely on their own lived experiences with formative assessment that mirrors one of the three conceptions of formative assessment (Otero 2006).

Based on my literature review of formative assessment and novice teachers, I conclude that developing a novice teacher's conceptions of formative assessment and supporting their

pedagogical reasoning and content knowledge will help them implement formative assessment practices and create effective learning environments.

Conclusion

Based on my literature review I conclude that novice teacher learning needs must be addressed to reduce attrition and close the achievement gap. School leaders have to attend to improving collegiality through collaboration, carefully paired mentors, include time to co-plan, and build a school culture that has high expectations for students. Coaching can support teachers to make instructional improvement by fostering a disposition of inquiry through reflection and by making time to co-plan in order to build the cognitive schema needed for lesson planning. For formative assessment practices to be effective learning environments must be engineered to support it, and teachers must use the data to adjust instruction. In addition teachers must be supported to expand their notions of formative assessment practices and purposes.

Theory of Action

Problem/Challenge of Practice	Literature Review	Intervention/Innovation	Expected Change
<ul style="list-style-type: none"> • Novice teachers focused on student behavior rather than student learning • Not using formative assessment in general to differentiate lessons • Teachers asking questions on the recall level. • Teachers lack knowledge on how to design questions that have a clear 	<ul style="list-style-type: none"> • Novice teachers need mentoring/coaching and learn best in collaborative groups coupled with one on one coaching cycles. • Formative assessment is essential to student success and to future planning • In the planning phase of instruction teachers need to pre-determine 	<ul style="list-style-type: none"> • Use individual coaching cycles to support teachers to develop lesson plans with questions that are pre-designed to meet a stated instructional purpose. • The coaching cycles follow lesson study and critical inquiry groups. They will help teachers transfer the skills and knowledge gained through those collaborative learning 	<ul style="list-style-type: none"> • Teachers will be able to articulate the purpose of formative assessment • Teacher will build formative assessment into their lessons. • They will be able to ask at least one probing or scaffolded question to students who

instructional purpose <ul style="list-style-type: none"> • Are not providing corrective feedback or coaching students to complete answers. 	instructional purpose of questions. <ul style="list-style-type: none"> • In the planning phase of instruction teachers need to use a framework to develop questions in advance to assess student progress towards learning objective. • Feedback is essential for correcting student misconceptions or partially formed conceptions of learning objective 	experiences.	give incorrect or incomplete answers to checks for understanding questions.
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Based on the literature review of coaching, formative assessment, and novice teacher needs, I designed an intervention that used coaching cycles intended to support the development of the cognitive schema needed to be effective lesson planners. I was specifically hoping to improve their use of the formative assessment strategy of questioning to check for understanding.

Intervention Action Plan

	Component	Activities	Purpose	Data to be Collected	Type of Data (process v. impact)
Meeting 1 Dana, Irene, and Matt	Pre-Observation	Observe a lesson that has not been co-planned	Obtain baseline information on how teachers are using questioning in their lesson	Observation Notes	Process/Impact
Meeting 2 Dana, Irene, and Matt	Lesson Planning	Co-plan lesson with teacher	Co-plan to support the development of cognitive schema needed for effective planning of questions that are checks for understanding	<ul style="list-style-type: none"> • Lesson Plan • Quick-Write or Survey about the experience of co-planning. 	Process Impact

Meeting 3 Dana and Irene	Observation	Observe co-planned lesson	Collect data related to teachers checking for understanding during lesson and student responses	<ul style="list-style-type: none"> • Video and observation notes • Journal 	Process/Impact
Meeting 3 Matt	Lesson Planning	Co-plan lesson with teacher	Co-plan to support the development of cognitive schema needed for effective planning of questions that are checks for understanding	<ul style="list-style-type: none"> • Lesson Plan • Quick-Write or Survey about the experience of co-planning. • 	Process Impact
Meeting 4 Dana and Irene	Coaching Conference	Individual Coaching-Lesson Planning	<ul style="list-style-type: none"> • Examine data related to checking for understanding • Coaching for improved lesson planning • Coaching for aligned questions 	Collaborative Log	process and impact
Meeting 5 Dana and Irene	Observation	Observe non co-planned lesson	<ul style="list-style-type: none"> • Collect data related to teachers checking for understanding during lesson and student responses • Observe to measure transfer of skills and knowledge learned through coaching 	<ul style="list-style-type: none"> • Video and observation notes • Journal 	Process/Impact
Meeting 5 Matt	Co-planning	Co-plan lesson with teacher	<ul style="list-style-type: none"> • Co-plan to support the development of cognitive schema needed for effective planning of questions that are checks for understanding 	<ul style="list-style-type: none"> • Lesson Plan • Quick-Write or Survey about the experience of co-planning. 	Process Impact

Meeting 6 Dana and Irene	Coaching Conference	Observation debrief where we reflect on the use of questioning as a checking for understanding strategy and discuss what the findings are	<ul style="list-style-type: none"> • To refine questions and to determine if the questions the teacher asked met goals of checking for understanding. • Set goals for next coaching cycle with regard to formative assessment and checking for understanding 	<ul style="list-style-type: none"> • Meeting notes and observation notes • Collaborative log or post observation log • Survey to capture teachers thought so far on their effectiveness as a lesson planner and use of formative assessment to drive instruction. 	Process/Impact
Meeting 6 Matt	Observation	Observe non co-planned lesson	<ul style="list-style-type: none"> • Collect data related to teachers checking for understanding during lesson and student responses • Look for transfer of skills and knowledge 	<ul style="list-style-type: none"> • Video and observation notes • Journal 	Process/Impact
Meeting 7 Dana	Lesson Planning	Co-plan lesson with teacher	<ul style="list-style-type: none"> • Co-plan to support the development of cognitive schema needed for effective planning of questions that are checks for understanding 	<ul style="list-style-type: none"> • Lesson Plan • Quick-Write or Survey about the experience of co-planning. 	Process Impact
Meeting 7 Matt	Coaching Conference	Observation debrief where we reflect on the use of questioning as a checking for understanding strategy and discuss what the findings are	<ul style="list-style-type: none"> • To refine questions and to determine if the questions the teacher asked met goals of checking for understanding. • Set goals for next coaching cycle with regard to formative assessment and checking for understanding 	<ul style="list-style-type: none"> • Meeting notes and observation notes • Collaborative log or post observation log • Survey to capture teachers thought so far on their effectiveness as a lesson planner and use of formative assessment to drive instruction. 	Process/Impact

Meeting 8 Dana	Observation	Observe co-planned lesson	<ul style="list-style-type: none"> • Collect data related to teachers checking for understanding during lesson and student responses 	<ul style="list-style-type: none"> • Video • Lesson Transcription • Reflective Journal Notes 	Process/Impact
Meeting 9 Dana	Coaching Conference	Observation debrief where we reflect on the use of questioning as a checking for understanding strategy and discuss findings	<ul style="list-style-type: none"> • Examine data related to checking for understanding • Coaching for improved lesson planning • Coaching for aligned questions 	<ul style="list-style-type: none"> • Coaching Conference Transcription • Survey to capture teachers thought so far on their effectiveness as a lesson planner and use of formative assessment to drive instruction. 	Process/Impact
Meeting 10 Dana, Irene and Matt	Post-Intervention Interview	Interview	Evaluate the impact of coaching intervention	<ul style="list-style-type: none"> • Video 	Process Impact

Intervention Design

My intervention consisted of a minimum of two coaching cycles conducted with the three teachers from the ARISE math department. The coaching cycles began with an observation, followed by a coaching conference to debrief the lesson observation, and were followed up with a co-planning conference.

The first meeting I conducted was a pre-intervention observation. I had initially intended to conduct a pre-intervention interview to obtain their reflections of their lesson study and how they plan to transfer what they learned to their everyday lessons, but because of time considerations I chose to use the lesson study debrief notes for that data source. For the pre-intervention observation I conducted informal observations of all three teachers. I took notes in my reflective journal where I noted the general flow of the lesson, whether or not the questions teachers were asking students appeared pre-planned and aligned to the learning objective, and I

tracked questioning patterns. These informal observations pointed to a need to include general lesson planning coaching as a part of the intervention.

A key component in the literature on coaching was the ability of the coach to foster a “disposition of inquiry” in the coachee (Gardiner, 2012; Long et al., 2012). In order to create the conditions for a focused reflection, I video recorded the lesson so that I could transcribe and code it for analysis in the coaching conference with the teacher. Before meeting with the teacher I coded each question the teacher initiated according to a Bloom’s Taxonomy chart provided in a chapter of the book *Checking for Understanding: Formative Assessment Techniques for your Classroom* by Douglas Fisher and Nancy Frey (2007, Appendix B). This was the resource we used to ground the critical inquiry group in a common understanding of the ways questioning could be used to check for understanding. This chapter also offers three different scaffolds teachers can use to support students who provide incomplete or incorrect answers to questions. During my coding of the lesson transcription, I also noted if teachers were providing these scaffolds or if they were probing thinking when students responded with incomplete or incorrect answers.

I had initially planned to use the first coaching conference to reflect on the questions that I coded, but my initial observation led me to believe that a review of the phases of the 5-part lesson plan was needed. I used an observation tool our school has been using called the Sample of Effective Teaching (SET). This tool was designed in collaboration with researchers from UC Berkeley’s Leadership for Educational Equity Program (LEEP) Graduate School of Education and the Reach Institute for School Leadership. Each lesson phase has specific behavior indicators for students and teachers that can be observed. During this initial meeting we watched the teacher’s lesson and looked for evidence of the indicators in their lesson. However, I was unable to include this component for one of participating teachers because the computer I used to record her lesson malfunctioned.

For the coaching conferences in the second cycle, I used an observation protocol to guide our reflection. We analyzed the data and made low-inference observations, discussed the teacher behaviors that we thought moved students closer to the learning objective, and we planned for next steps. I utilized a facilitative stance to foster inquiry and problem solving ability. I tried to paraphrase their reflections using the language of the lesson phases to build their cognitive schema for lesson planning. I offered concrete suggestions of how to teach something in order to build their pedagogical content knowledge. I also included a section in the coaching conference where I asked them to give me feedback on my coaching so that I could better serve their needs.

In the co-planning meetings we created a lesson using the 5-part lesson plan structure. We focused on creating pre-planned questions that were aligned to the lesson objective. During these meetings we would script out what the teacher would say during the modeling phase and plan in where the checks for understanding would be and what the teacher would say. We would talk about what would be a good hook and how the teacher would close the class. By the time I started the intervention with the math department teachers, they were consistently using exit tickets as a way to collect formative assessment data. After the end of the co-planning meetings I issued a questionnaire to solicit additional feedback about their experiences.

The number of coaching cycles varied for each teacher. Three complete coaching cycles were conducted with Dana, for both Irene and Matt two complete cycles were conducted. While Dana and Irene's coaching cycles were conducted in close sequence, Matt's coaching cycle was stretched out. To conclude the intervention and to collect data on its impact, I conducted a post-intervention interview (see Appendix B).

Research Methods

The participants of this action research project included all three of the math department teachers at ARISE High School. Dana teaches Algebra 1 and Geometry to 9th graders and is in her second year of teaching. Irene teaches Geometry and Algebra 2 to mixed graded classes and is in her third year of teaching. And finally Matt teaches Trigonometry/Pre-Calculus and Calculus to 11th and 12th graders and is in his second year of teaching.

For this action research project I collected a variety of impact and process data sources. I collected video of lessons, lesson plans, video of coaching conferences, questionnaire responses, and video of interviews. The impact data was used to assess the effectiveness of my coaching, and the process data was collected to adjust the intervention design for the purposes of improvement, and to learn about what influences teachers to change their practice.

Impact Data

The impacted data for my research consisted of lesson observation video, lesson transcriptions, lesson plans, post-coaching and co-planning questionnaires, and post-intervention interviews. During the lesson observation a computer would be set in a corner of the room to capture the entire lesson. The lesson video is a data source that has the unique function of being able to capture tone, affect, and other nuances of the teacher that transcription alone cannot. My goal was to use the S.E.T. rubric as a way to evaluate the effectiveness of their instruction within a trusting coaching environment, and for the teacher to reflect on the way they are delivering instruction. Lesson observation video allowed for changes in classroom culture to be tracked over time. In addition, watching video of lessons proved to be useful for me as I noticed things such as teachers referring to lesson plans.

With the exception of the first coaching conference, a transcription of the lesson was used for reflection. Once the transcription was created, the questions the teacher posed were coded according to Bloom's level of taxonomy for the purposes of examining content and quality of

their questions. The transcriptions were a source of low inference data that allowed for a more time efficient way to look at an entire lesson. Providing a visual representation of teacher to student talk times, and patterns in questioning, was an unanticipated way the transcription was useful. The lesson transcription along with the lesson plan allowed for the comparison of pre-planned questions and whether or not they were implemented as scripted.

Implementation Data

The implementation data for my action research consisted of a reflective journal, post-coaching interviews, post-coaching conference questionnaires, and post-intervention interviews.

I used the reflective journal to capture my thoughts related to the lesson observation, and when I would do informal observations of teachers. I also used the journal when I shadowed teachers while they were having conversations with basically when teachers would walk around the room and check in on students I would record the exchanges between the teacher and student. They helped me so to capture teacher and student interaction outside of whole group instruction.

At the end of each coaching conference and co-planning session I asked participants to complete post-coaching and post co-planning questionnaires. These two data sources helped me to assess what parts of the coaching cycle they felt was effective, and how coaching helped them try new things. Their responses were also an insight into what they were taking away from co-planning experiences.

Data Analysis Methods

As previously mentioned I collected impact and implementation data. All video data sources were transcribed and then transferred to a spreadsheet for analysis. In addition to the transcriptions I added the contents of my reflective journal and the responses from post-coaching conferences, as well as post co-planning questionnaires. I coded each line of data with a letter code that was connected to my expected outcomes and overarching research questions. After the

initial coding I sorted the data by teacher and expected outcome. I transferred that data and tracked their changes over time by color-coding emerging themes connected to the ways teacher practice was changing.

Data Analysis and Findings

Through the data analysis there were findings in terms of the what impact of the intervention had on teachers use of questioning as a formative assessment strategy and about the coaching cycle supports novice teachers to implement a new strategy.

Impact of the Action Research Project

Coaching cycles were used to improve teacher use of questioning as a formative assessment strategy. I theorized that coaching cycles that included observation, debrief of the lesson, and co-planning, teachers would improve in the following three areas: 1) Ability to articulate the purpose of formative assessment. 2) Teachers would build formative assessment into their lessons and 3) teachers would be able to ask at least one probing or scaffold question to a student who gives an incorrect or incomplete answer to check for understanding questions.

The data analysis revealed changes in the practice of two teachers with regard to creating detailed lesson plans, implementing pre-planned questions, and probing student thinking. For all three teachers the data analysis showed a shift in their thinking about questioning as a formative assessment strategy.

As previously mentioned I conducted an initial observation where I observed for the lesson phases of the 5-part lesson, collected baseline data on questioning patterns, and whether the questions asked by teachers were generally aligned to the learning objective. My analysis of the initial observation data revealed a line of questioning that was evident with all of the math department teachers. Questioning was primarily being used for engagement, or to coach students

to the correct answer by asking questions that were intended to set students up to make an inference or draw a conclusion, yet the teacher primarily made the conclusion. The questions that were used for engagement were aligned with the steps of the procedure the teacher was modeling, however they appeared improvised, provided students with little to no wait time, and because there was no equitable participation strategy employed during questioning, participation was not widely distributed. In my first observation of Matt's class he asked, "What do we do with the numerator?" When few students responded he asked without pause, "What happens when we multiply $\sqrt{5}$ with $\sqrt{5}$?" To this question a few students responded. Without wait time or posing the question first, Matt follows up by asking, "When we had \sqrt{x} times \sqrt{x} what did we get?" Again a few students respond. This back and forth interaction is representative of the way questioning was used in Matt, Dana, and Irene's classrooms.

Building formative assessment into lessons and engineering environments.

In their book *Checking for Understanding* Fisher and Frey (2007) state the "first step" to using questions to check for understanding is "to formulate the question." However, in order for formative assessment practices to be effective they must exist within classroom environments that have been "engineered" to support its use (Black et al., 2004). All three teachers built formative assessment into their lessons by pre-planning questions that were aligned to the learning objective and implemented them using of their questions. For two teachers the data points to a sustained change in practice. For the third teacher the data is insufficient to conclusively claim that the changes exhibited in Matt's final observation will be lasting.

Prior to the intervention teachers used questioning in two ways: 1) For engagement and 2) to coach students to a correct answer by setting them up to make an inference or draw a conclusion. When a student would answer an engagement question incorrectly a follow up

question would be issued without wait time, which led to the student either saying “I don’t know,” or no response at all. During the intervention all three teachers began implementing an equity stick protocol for pre-planned questions that had the effect of mitigating the questions for engagement and the lack of wait time that frequently led to incorrect response or no response at all. In addition, by the end of the intervention Irene and Dana created detailed lessons without collaboration.

Teachers create detailed lesson plans with pre-planned questions, and ensure participation is widely distributed.

By the end of the intervention Dana created detailed lesson plans that included questions that were checks for understanding, initiated more pre-planned questions, ensured equitable participation, and did less redirecting of her students.

During my first observation I noticed that Dana spent the majority of her time redirecting students, did not refer to a lesson plan, and as previously mentioned questioning was used for engagement. The content of her questions were about the problem she was modeling, however she directed her questions to the whole class, which led to only a few students participating, and the other students engaging in side conversations. In the event that Dana did ask a question for understanding she would often reword the questions to the degree of changing its meaning. In the first observation I recorded her asking students, “Why am I able to, or what property and how does it work, how am I splitting this one equation into two equations where they are both set equal to zero? Name the property and explain how it works.” Her question begins as a comprehension question and moves to a knowledge question where students are only being asked to recall the name of a property.

The change in questioning for engagement was immediate. As soon as we began to co-plan her lessons and built in the equity stick protocol which required her to pose the question

first, give students the opportunity to turn and talk with an elbow partner, and then chose a student who shares out with the whole class, this type of questioning halted. The equity stick protocol communicated to her students the importance of listening and being ready to respond to a question. Dana's rewording of questions, however, persisted. During a coaching conference Dana reflected on her observation data and said, "I would say I am still frustrated with myself with the way I constantly rephrase a question when I am asking it to the whole class. I keep reformulating it as I go, so I don't have that one thing that I say and that is it and I stop I just have to keep talking for some reason." While the rephrasing of her pre-planned questions did continue, she did not rephrase to the point of changing the meaning.

In my final observation she consistently planned detailed lessons and asked her pre-planned questions that were aligned to the learning objective with little to no rephrasing. In addition she routinely implemented her pre-planned questions using an equity stick protocol. After watching the video of the final observation, I noted in my reflective journal that throughout the lesson Dana referred to her lesson plan, which helped her make the significant change of not rephrasing her questions.

At the end of the intervention Irene was also creating detailed lesson plans, consistently pre-planning questions aligned to the learning objective, and implemented them using an equity stick protocol.

Irene's questioning pattern and habit of rewording questions was similar to Dana's, however Irene did not need to ask for her student's attention nearly as much. The following excerpt is from an exchange with a student who was called to the board to explain her solution. It was representative of the line of questioning present in Irene's practice initially.

Irene: Tell us what you did.

Student: I don't know what I did. I can't explain it. I can't find the right words.

Irene: What was your first step?

Student: Subtracted three.

Irene: Why?

Student: Because it was easy.

Irene: You could have added three?

Student: It just seemed like the right thing to do.

Irene: -3 in the opposite of positive three.

Student: I added that to cancel that.

Irene: You added that?

In these exchanges Irene would attempt to coach the student to the correct answer or use tone to indicate an incorrect response. Both do not offer the kind of feedback necessary to support the student to know where they are in relationship to the desired learning (Heritage, 2009), nor does she provide a scaffold for the student to come to a correct response. While Irene used an equity stick protocol to choose the student who was called to the board, she did not use the protocol for the rest of the lesson.

In my second observation of Irene I noted two significant changes: 1) She had a lesson plan in hand with pre-planned questions and 2) she used an equitable participation strategy throughout. Similarly to Dana, using the equity stick protocol mitigated the use of questioning for engagement, as well as supported her to stay with the pre-planned question as scripted. However, the habit of asking questions for engagement still continued. This was most evident in an exchange between Irene and a student where she engaged him in questions that were not pre-planned and where he was not given wait time to respond. In response to whether she had pre-planned a question she said, “No. That was not planned. As I was doing it I was just like oh that would be kind of an interesting question so that shows it wasn’t, that is probably why it didn’t translate as well.” Additionally she remarks, “The questions that weren’t planned, I was like oh you don’t really get what I mean when I say to you did anything change.”

By the end of the intervention Irene was consistently lesson planning and including pre-planned questions that were clearly aligned to the learning objective. In addition to her pre-planned questions she generally asked her questions as scripted. While debriefing her lesson in our final coaching conference she noticed the following about her questioning, “I am not rewording the question five different ways for the questions that were planned.” This is a significant change compared to the first observation where she reworded her questions several times.

By the end of the intervention Matt’s practice changed both in the way he was asking questions and what he was asking, however the data is inconclusive as to whether the changes will be lasting.

In the first observation of Matt, he also used questioning for engagement, but he used it during modeling of new content. Dana and Irene used questioning for engagement during the guided practice. The questions that he did ask did not appear to be pre-planned, but were connected to steps in the process of the problem the students were working on. Like Dana and Irene the questioning for engagement questions were asked with no wait time. The three vocal students who answered the majority of Matt’s questions for engagement made the lack of an equitable participation protocol obvious. Unlike Dana and Irene’s classes Matt students were extremely diligent with asking questions when there was confusion. In addition, I noted in my reflective journal that there were no clear instructional phases, which led me to believe he did not have a lesson plan.

In our first coaching conference he indicated that the questions about new content were not really questions, rather he tended to phrase statements as questions. The observation data revealed that he was posing actual questions back to back with statements phrased as questions, which left students confused. Hypothesizing about the impact of that on students he remarked,

“Especially if I move on from it so quickly and don’t give them time to think about it and then ask them another question that is a genuine question then that could be confusing.”

In Matt’s final observation, his lesson demonstrated clear instructional phases, he asked pre-planned questions that were aligned to his learning objective, and he implemented them using an equitable participation strategy. While he had a detailed lesson plan for the final observation, it was co-planned over several weeks. There is not enough observation data to conclusively show this change will be lasting. In the post-intervention interview Matt was asked if he writes detailed daily lesson plans; he said he did not. Fewer coaching cycles conducted with Matt, and not enough practice co-planning in particular, is likely the reason he did not yet embody the practice of daily detailed lesson plans and pre-planned questions.

Scaffolded and Probing Questions

Connected to initiating a question that was a check for understanding, impacting the way teachers responded to incorrect or incomplete answers was an aim of the action research project. The anticipated changes were 1) Teachers would be able to ask one scaffolded or 2) probing question to students who give incorrect or incomplete answers to questions that are checks for understanding. In their book *Checking for Understanding* Fisher and Frey (2007) offer three different types of scaffolds teachers can provide to students who give incorrect or incomplete answers: 1) Reception Scaffolds “directs a student to information necessary to formulate an answer.” 2) Transformation Scaffolds “provide a way of structuring the information to help students develop an answer.” and 3) Production Scaffolds “provide a student with a way of producing an answer.” The scaffolds are intended to coach the student to a correct answer. With regard to asking scaffolded questions my data analysis shows a change in the practice of Irene and Dana, however the changes can’t be directly attributed to the content of the coaching conferences. For Matt data did not show a change in practice. With regard to asking probing

questions Dana and Irene demonstrated shifts in thinking about probing questions as well as asking more of them. While Matt self reports that he asks probing questions, I was unable to confirm with the data that it was actually taking place on a regular basis in his instruction.

Providing scaffolds. Dana's practice changed in two ways regarding asking scaffolded questions or probing questions to incorrect or incomplete responses: 1) Dana coached students to a correct response by providing transformation scaffolds and 2) using her one-on-one interactions with students to probe their thinking.

While Dana was tracked in many instances over time, providing a transformation scaffold by directing students to refer to their notes, the data shows she was not thinking of this as a transformation scaffold. In response to a question about whether or not she felt coaching helped her scaffold questions she replied, "I don't know that we really talked about scaffolding that much, do you mean developing, like in terms of making it easy to difficult?" This statement along with coaching conference data clearly show that our conversations were not grounded in the article where scaffolds were defined, coaching to this intended outcome was not explicit. In the same post-intervention interview she adds, "That was something I had done a bunch in the past (referring students to use notes), but I think in my head that is what I wanted them to do, and in the moment I was often just verbally coaching them through, so I think the practice and the observation that you have done have brought it more to my attention that that is what I have been doing." This statement shows the change in practice can however be attributed to the space that the coaching conference opened. Coaching allowed her to see the difference between her intent and what she is actually doing in the class.

The analysis of the data did not show that Irene had any change in practice with regard to asking scaffolded questions. Irene continued to coach students to the correct answer by asking them questions that set them up to make an inference or draw a conclusion. While she self reports that she directs students to use their notes as a resource, evidence of this practice could

not be found in the observation data. One possible reason for no change occurring could be that she described the line of questioning that I mentioned above as scaffolding questions. Coaching conference data shows we spent more time on thinking about the question she was going to initiate and reflecting on the level of Bloom's taxonomy of the questions she had asked, rather than on how to design a follow up question that used one of the three scaffolds the article suggests.

As previously mentioned, the data did not show a change in Matt's practice. One reason for this could be that in the final observation, Matt's students did not get to the guided instruction phase. This would generally be the phase where he would have the opportunity to ask scaffolded questions.

Probing thinking. Dana's most significant change in practice came with the use of probing questions. She not only asked more probing questions at the end of the intervention her thinking about the instructional purpose of questioning shifted.

During my final observation Dana had twenty interactions with students. Of the twenty interactions she only used questioning to set a student up to make an inference or draw a conclusion twice, where the other eighteen times she asked probing questions or prompted a student to use their notes. This change in practice was primarily evident in her one-on-one conferences with students during the independent practice phase. There was no change with asking probing questions in the whole group. If a student gave an incomplete or incorrect response she would give more wait time and conference individually with the student and coach them to the correct response.

With regard to asking probing questions, Irene's practice did change in one significant way. Towards the end of the intervention instead of assuming the student's misconception, she began to interpret what students were saying before she gave them feedback or asked them more questions. In a coaching conference we analyzed an interaction Irene had with a student about

an incorrect response the student had given. In the interaction Irene responds to the student in a way that assumes the student's misconception. Irene was able to see that she proceeded with feedback without a clear understanding of the student's misconception. We talked about ways she could ask for clarification by saying, "This is what you are saying means. Is that what you meant to say?" We also talked about how English language learners will often use an incorrect word choice or phrase a response in way that does not convey their intended meaning. The goal was to try to understand the student and to give them a chance to correct their own response. Referring to our coaching conference Irene states, "rather than saying you wrote this wrong, especially with this project, I say this is what I am reading, this is what I am interpreting, is that what you meant?" Irene's statement is significant as it shows her ability to interpret student responses so that she can effectively implement formative assessment (Otero, 2006).

The purpose of formative assessment

The third anticipated outcome was that teachers would be able to articulate the purpose of formative assessment. All three teachers were able define at least one element of formative assessment, give examples of how they use it to adjust instruction, and how they think about the instructional purpose of questioning.

Defining Formative Assessment. As mentioned above in the literature review on formative assessment Margaret Heritage (2007) describes, "four core elements of formative assessment: 1) identifying the "gap," 2) feedback, 3) student involvement, and 4) learning progressions" (p. 141). In the post-intervention interview all three teachers provided a definition of formative assessment that is most characteristic the of "gap" identification element. Irene stated, "Formative assessments are meant to basically help you understand along the way, what students know or don't know or don't know so instead of doing an assessment at the end, it allows you to catch little misconceptions along the way so that the big understanding can be had."

Dana states, “So as I understand it formative assessment is a way of assessing where students are along the process of teaching as opposed to an end.” Dana’s definition emphasizes that formative assessment is process, rather than a thing that teachers do or give; yet it still speaks to the “gap” identification element.

Matt states, “I think formative assessment is a way to gauge what students already know about something, whether it is something I have taught them or something I am about to teach them.” In addition to a definition that alludes to “gap” identification, Matt’s includes the notion of pre-assessment as formative assessment.

Using formative assessment to adjust instruction. Irene explained that depending on the issues that surface in her exit ticket data, she may decide to revisit the topic with a do now or in more extreme cases exit do a whole class reteach. In addition to exit ticket data, Irene cites the questioning she does during guided practice as a way to identify “specific kids that I know need extra attention.”

In response to a post-intervention interview question about how Dana uses questioning to inform her instruction she states, “questioning as a way of uncovering student understanding or not understanding and being able to go and decide in the moment or the next day whether you need to do some re-teaching or just need to work with an individual student more one-on-one.” Dana also names exit tickets as a formative assessment source she uses to adjust instruction for the following day, and white board checks for “immediate feedback to see what mistakes they are making.”

Matt’s cites exit tickets as his main source of formative assessment data, and says he uses them to adjust next day whole group instruction. When asked how he uses questioning to inform his instruction he replies, “well depending on how students answer questions I would be able to adjust a lesson, or if I need to do a reteach on a particular thing or if you know the students are

perhaps equipped to handle more on that particular day based on my questioning then I can speed it up or do a little more challenge type questions.”

Shifts in thinking about instructional purpose of questioning. While the intervention goal was to get teachers to build formative assessment into their lessons and to ask scaffolded and probing questions, understanding why those two things are important also emerged in the data.

In a post-intervention interviews I asked how coaching has shifted their thinking around the instructional purpose of questioning. Irene commented, “I see it more now not as simply a check for understanding, but to actually help kid process and learn.” Dana explains, “So one of the shifts is questioning to get the correct answer vs. questioning to uncover student understanding...recognizing that there are uses for both, but focusing more on uncovering understandings.” Finally Matt shares, “Through co-planning, we have talked about what information is important for students to know, and in doing so, have decided what type of question(s) will show me that they do (or don't) know what I want them to.” All of their comments combined demonstrate a shift in thinking about questioning. They recognize questions can be used to uncover student thinking, have a particular purpose, and need to be pre thought out.

In conclusion, my data analysis yielded the following findings: 1) Two teachers independently planned detailed lessons with aligned pre-planned questions that were checks for understanding, and ensured participation was widely distributed. The third teacher did as well, but not independently. 2) One teacher began to provide transformation scaffolds, yet the other two teachers did not. 3) All teachers could articulate the purpose of formative assessment, give examples of how they used it to adjust instruction, and demonstrated shifts in thinking about questioning as a formative assessment strategy.

Implementation of the Action Research Project

To assess the implementation of the project I collected responses from post-coaching questionnaires and post-intervention interviews. Anticipating low completion rate of post-coaching questionnaires, I included a short interview at the end of each coaching conference. Taylor refers to four sources of information needed for learners to construct new schemata: 1) Enactive attainment 2) Verbal persuasion 3) Vicarious experiences and 4) Information about physiological and emotional states. Enactive attainment, also called “mastery experience, is direct personal experience derived from acting out the performance and experiencing the effects of those actions.” The observation element of a coaching cycle makes enactive attainment possible. Taylor points out enactive attainment is only successful if, in our case, teachers have a mental model and understanding of the desired practice. The coaching conferences supported understanding of the “desired practice,” and provided motivation to try new things. While co-planning built the knowledge and skills needed to independently plan, and the observation created the conditions for teachers to implement their lesson plan. Through my data analysis the following themes emerged. Dana and Irene appreciated the protocol used during the coaching conference. The act of being observed created urgency around being prepared with a lesson plan and created the conditions to get feedback. Co-planning lessons was critical to building the cognitive schema necessary for teachers to independently create detailed lesson plans. Finally, the data revealed tight coaching cycles were needed to support transfer of skill and knowledge learned from the coaching cycle.

Use of protocols for coaching conferences. With the exception of the first coaching conference I used a protocol given to me by a colleague from Lighthouse Community Charter School. The protocol consists of time to review, process, and reflect on the data, and then consider next steps.

In the short interview conducted at the end of the coaching conferences Dana cited the protocol as being useful and in particular the section where we process the data. In this section of the protocol we examined the data, make low-inference statements, and then teachers get an opportunity to reflect on what is surprising and affirming about what they are seeing. She names the first part of the protocol “What do you see? What do notice?” as prompts that were helpful. I noted in my reflective journal that the protocol helped focus the conversation on the data that the teacher pointed out rather than what I was seeing. I also noted that I went off protocol with my own observations of her lesson. For the next conference I made a concerted effort to stay with the protocol. In the post conference interview of the second conference she cites the entire structure of the conference rather than just the first part.

Irene does not cite the protocol directly, but the following statement does offer some insight into the impact of the protocol. She states, “I also always appreciate how you are always very evidence based it makes it really easy for me to not feel judged or criticized.” Because the protocol by design asks participants to make low inference statements based on the evidence at hand, it serves to focus the conversation on what can be seen rather than inferred. In Irene’s case in particular, but also in general, using a protocol can be a tool help the coach create the conditions for relational trust.

For Matt the protocol was only used once and he did not comment on its effectiveness. Matt did comment on the ways in which being observed and co-planning supported his practice.

Observation and enactive attainment. Observation not only provided data for the teacher to reflect upon, it made enactive attainment possible. When asked about how being observed impacted teacher practice there was a resounding theme: Observation induced pressure to perform. Irene, Dana and Matt’s statements convey a similar message.

In post-intervention interviews Dana shares her views on how observation impacted her practice by saying, “I always want to present myself well and present like my teaching

well...and planning it all out helped me do that so, the lesson plan was the thing I felt I needed.”

Irene responded, “Observation is a good way to be coached because then you get to see stuff in real time right so it is just more the understanding and the being able to like talk about what did or didn’t happen or what did or didn’t go well is more authentic.” And finally Matt replied, “well first of all any time you are being observed you put a little bit more effort into your pre-planning of something um I know in particular that is the case for me.” Matt adds, “I think in addition, like you just said if you can’t always watch yourself...so having another set of eyes on the practice and the student. I think it is useful to get that type of feedback so I can apply it to future lessons.” All three of their candid remarks show a desire for feedback and being observed motivated them to be prepared.

However observation alone is not enough for teachers to gain the knowledge and skills necessary to create detailed lesson plans. The following section will be a discussion of how co-planning was the critical component of the coaching cycle that supported teacher growth.

Co-planning lessons. The analysis of the data supports the assertion that co-planning built the knowledge and skills needed for Dana and Irene to independently lesson plan. The data supports the claim that for observation to be an effective element of the coaching cycle for novice teachers, it must be accompanied by reflection and co-planning.

While two coaching cycles were conducted with Matt, they were done over a several weeks. We co-planned a lesson that had many complex concepts that needed ample time to address. Matt had the least tight coaching cycles and he showed the least amount of change with respect to independently lesson planning. In contrast, co-planning conferences with Dana and Irene were completed in one session. The data from Irene and Dana is a compelling factor in showing that completing the co-planning conferences in one session made the difference with regard to consistently and independently lesson planning.

Dana cites the format of the planning template and the act of co-constructing the lesson as the supports she needed to create detailed lesson plans. “The format and the way of thinking through the lesson plan became more fluid in my brain and easier to do. So it was taking less time and energy so I felt like I could [create a lesson plan].” This statement shows that once she began to create the necessary cognitive framework needed for lesson planning, the process itself became less labor intensive. When asked what helped her to begin to consistently create lesson plans she states, “I think just we would co-plan and then I would see the results of that co-planning, and the results of the lesson had more concrete questions and student understanding...I think just seeing that cycle and the improvements and the small gains I guess.” Dana seeing the effects of her lesson planning on her students learning contributed to building a sense of self-efficacy and motivation she needed to keep planning.

Irene similarly comments, “You know once I had that feeling of success and like it felt good, and it seemed like it got good results from the kid, then um for that was what it was for me.” Again, this comment demonstrates Irene’s progress towards self-efficacy; she sees that her work is having an impact, which is significant because it compels a sustained change in her practice. When asked about how co-planning helped her to independently lesson plan she states, “...it is a combination of confidence building and what you already come to the table knowing and then resources to get past the hurdles that are there.” Taken together these statements show Irene’s progress towards self-efficacy; she sees that her work is having an impact and that she is gaining the skills and knowledge to overcome challenges.

For Matt, the data did not point to a sustained change in practice with regard to creating detailed daily lesson plans. For the last observation he had a lesson plan, but it was co-planned over several weeks. In the post-intervention interview Matt self reported that he does not create detailed lesson plans. Given that Dana and Irene attributed the change in their practice to co-planning and tight coaching cycles, I concluded loose coaching cycles with Matt led to there

being no change in his practice with regard to daily lesson planning. However, Matt's practice did change in one extremely important way. In a post co-planning questionnaire Matt said, "After co-planning, I know I spend too little time thinking of what questions I need to ask students to check that they understand something." This statement shows Matt's growth with regard to pre-thinking what to ask. He also comments, "Through co-planning, we have talked about what information is important for students to know, and in doing so, have decided what type of question(s) will show me that they do (or don't) know what I want them to. So, talking through what I want students to do and say is helping with that skill." With regard to lesson planning Matt shares, "Coaching helped me in terms of think about what the objective is first rather than starting with here is a broad topic, and then teach the topic." These statements show his growth in the development of the cognitive schema necessary to be able to lesson plan efficiently and effectively.

The interplay between co-planning, being observed, and then debriefing the observation with a protocol cannot be understated. Each provided a necessary role in building the capacity and self-efficacy of the teacher. Coaching conferences supported understanding of the "desired practice," co-planning built the knowledge and skills needed to independently plan, and observation provided an opportunity to try new things in front of the coach.

Tight Coaching Cycles. For the purposes of this action research project, tight coaching cycles are defined to be complete coaching cycles that happen within the same week. The two teachers, Dana and Irene, who showed the most growth in relationship to the expected outcomes, both cited tight coaching cycles as contributing to the growth in their practice. Tight coaching cycles created the conditions for more timely feedback that they could use in the near future.

When asked for feedback on what about the coaching cycles did they feel helped them move their practice, Irene and Dana both commented on the shorter cycles, where Matt referred

to having a focus and something to work towards as ways that coaching has improved his practice.

In two separate instances Irene mentioned the coaching cycle length. In a post-coaching interview she asserted, “I think it works even best when it has been as close as it has been recently...I can transfer what I have learned to the next lesson.” When asked again in a post-intervention interview about what she attributes changes in her practice to, she without pause stated, “I think keeping the coaching cycle shorter, I think was a really significant difference.”

For Dana her comments about what helped move her practice are strikingly similar. In a post-coaching interview she notes “the consistent cycle” and “seeing what is changing from week to week or what is not changing is useful; as opposed to having a giant gap in between.”

Dana and Irene’s comments convey the how tighter coaching cycles allowed them to monitor their own progress. The improvements could be seen because the coaching conference and lesson planning quickly followed the observation. Dana and Irene’s statements together with the change in practice give credibility to the assertion that tight coaching cycles lead to improved practice.

For future leaders wanting to implement this project design, I recommend using a protocol for the coaching conference to provide a structured conversation that is focused on the observation data. In addition, leaders should strongly consider making time to co-plan with their novice teachers. Finally leaders have to ensure tight coaching cycles to see the benefits of co-planning, observation, and reflection.

Implications and Conclusions

This action research project set out to accomplish three goals: 1) Teachers will have the ability to articulate the purpose of formative assessment 2) build formative assessment into their

lessons and 3) would be able to ask at least one probing or scaffold question to a student who gives an incorrect or incomplete answer to check for understanding questions. The action research project was successful at meeting some elements of all three expected outcomes, with data the strongest for building formative assessment into lessons and for articulating the purpose of formative assessment. In the following sections I will discuss what was successful and what was not and offer possible reasons. I will also make suggestions for future leaders considering this project design.

The literature review on the achievement gap, novice teachers, and formative assessment indicates that school leaders hoping to close the achievement gap will need to focus on meeting the needs of their novice teachers, and support them to implement formative assessment practices that have been shown to increase student achievement (Darling-Hammond, 2003; Black and Wiliam, 1998). According to Livingston and Borko novice teachers lack the cognitive schema needed to be effective lesson planners. To that end I sought to include co-planning in the intervention to increase the teachers technical competence in lesson planning. The data supports the claim that co-planning was the essential piece in supporting teachers to develop the two areas needed for effective lesson planning; pedagogical reasoning and pedagogical content knowledge. During the co-planning session, I modeled how to think about how to create a lesson plan, and offered concrete ways to teach the lesson. During our co-planning time we built in the questions that were checks for understanding and determined how they would be implemented.

Observation provided opportunities and “good” pressure for teachers to implement the co-planned lessons. The observation also served to provide formative assessment data to the teacher with regard to the effectiveness of their lesson. Finally teaching gains were made possible when the coaching cycles were tight. The opportunity for timely reflection and feedback were cited as reasons for the change in practice from Irene and Dana.

There is data to show that engaging in structured dialogue shifted teacher thinking about the instructional purpose of questioning and its use as a formative assessment practice. The protocol that was used to debrief the coaching conferences served to create the conditions for a reflection that was focused on the observation data. Teachers had an opportunity see how they were implementing their lessons as well as the questions they had pre-planned. By the end of the intervention all teachers expressed their new thinking about how questioning could be used in the classroom.

There is no data to support the conclusion that coaching cycles helped teachers to ask scaffolded or probing questions. After analyzing the data the primary reason is likely the content of the coaching conferences. The co-planning sessions were spent developing questions that were the initial check for understanding question, however the follow up questions were not co-planned.

Future leaders considering this design must make time to co-plan with teachers, and should considering using a protocol to focus on how the teacher uses questioning to check for understanding instead of to run through the entire lesson. Never the less I do see the protocol as an essential component of the design. If time restrictions prohibit leaders from including the planning session with individual teachers, one possibility would be to conduct a lesson study where teachers collaboratively plan a lesson whose focus is using questioning for understanding. The literature review on novice teachers shows that they benefit from collaborative learning experiences.

The data suggests a few possible foci for further exploration. The first is supporting teachers to construct the environments necessary to implement effective formative assessment practices. One of the major barriers to implementing formative assessment practices was classroom culture. Second, the study also showed that time was a factor that impeded my ability to implement the intervention as planned with all three teachers. If this project design were

going to be implemented with teams of teachers, other ways to co-construct knowledge and develop skills with the guidance of an instructional leader should be considered (See Appendix A). Lesson study is one possible way this could be accomplished.

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Appendix A: Revised Intervention Plan

	Component	Activities	Purpose	Data to be collected	Type of Data
Meeting 1	Constructing Knowledge	<ul style="list-style-type: none"> Teachers read article related to questioning as a formative assessment strategy Complete the K and W of KWL chart 	<ul style="list-style-type: none"> To come to a shared knowledge base that will be referenced in coaching conferences To assess what teachers already know and still want to know 	KWL chart Questionnaire Journal Notes	Process
Meeting 2	Lesson Planning	The group will meet again to discuss ways they can implement questioning as a formative assessment strategy Create individual lesson plans that have pre-planned questions.	Novice teachers learn better in reciprocal learning environments and through collaboration	Lesson Plans Video from Lesson Plan Questionnaires Journal Notes	Process
Meeting 3	Individual Teacher Observation	To collect data related to teachers pre-planned questions and student responses	To collect data related to teachers pre-planned questions and student responses	Video Observation Notes Journal entries	Process/Impact
Meeting 4	Individual Teacher Debrief	Teacher and coach will meet to examine student responses to questions	To give one-on-one support to teacher To provide coaching on using initiating questions that are checks for understanding	Video Journal Notes Questionnaire	Impact
Meeting 5	Group Share	Teachers will	To share and	Video	Process/Impact

	Out	reconvene to share their learning on pre-planning questions and complete the L of the KWL Examine student responses and teacher responses Create KWL for asking probing or scaffolded questions	learn from each others experience Collect pre-assessment data on teachers knowledge of asking probing questions to plan for next meeting	KWL Chart Questionnaire Journal Notes	
Meeting 6	Constructing Knowledge	Read literature related to questioning for understanding and coaching a student to a correct answer Complete the K and W of KWL chart	<ul style="list-style-type: none"> To come to a shared knowledge base that will be referenced in coaching conferences Pre-assess what teacher already know and what they want to learn 	KWL chart Questionnaire Journal Notes	Process
Meeting 7	Lesson Planning	The group will meet again and use the literature and lesson observation to design questions that are probing or scaffolded questions Create individual lesson plans that have pre-planned follow up questions.	Novice teachers learn better in reciprocal learning environments and through collaboration	Lesson Plans Video from Lesson Plan Questionnaires Journal Notes	Process
Meeting 8	Individual Teacher Observation	To collect data related to teachers pre-planned questions and student responses	To collect data related to teachers scaffolded or probing questions	Video Journal Notes Questionnaire	Impact
Meeting 9	Individual Teacher Debrief	Teacher and coach will meet to	To give one-on one support to teacher	Video Journal Notes Questionnaire	Impact

		examine student responses to questions	To provide coaching on asking scaffolds or probing questions		
Meeting 10	Group Share Out	Teachers will reconvene to share their learning on pre-planning questions Examine student responses and teacher responses Complete L of the KWL chart	Teachers will reconvene to share their learning on scaffolded or probing questions and complete the L of the KWL chart. Examine	Video KWL Chart Questionnaire Journal Notes	Process/Impact
Meeting 11	Post-Intervention Interview	Interview	Evaluate the impact of coaching intervention	Video	Process Impact
Meeting 12	Follow with individual coaching cycles				

Appendix B: Bloom's Taxonomy Chart used for coding questions

Figure 3.3 Bloom's Taxonomy		
Level	Key Words	Prompts
Knowledge: Recall data or information.	define, describe, identify, know, label, list, match, name, outline, recall, recognize, reproduce, select, state	Where is ... What did ... Who was ... When did ... How many ... Locate it in the story ... Point to the ...
Comprehension: Understand the meaning, translation, interpolation, and interpretation of instructions and problems.	comprehend, convert, defend, distinguish, estimate, explain, extend, generalize, give examples, infer, interpret, paraphrase, predict, rewrite, summarize, translate	Tell me in your own words ... What does it mean ... Give me an example of ... Describe what ... Illustrate the part of the story that ... Make a map of ... What is the main idea of ...
Application: Use a concept in a new situation or unprompted use of an abstraction.	apply, change, compute, construct, demonstrate, discover, manipulate, modify, operate, predict, prepare, produce, relate, show, solve, use	What would happen to you if ... Would you have done the same as ... If you were there, would you ... How would you solve the problem ... In the library, find information about ...
Analysis: Separate material or concepts into component parts so that its organizational structure may be understood.	analyze, break down, compare, contrast, diagram, deconstruct, differentiate, discriminate, distinguish, identify, illustrate, infer, outline, relate, select, separate	What things would you have used ... What other ways could ... What things are similar/different? What part of this story was the most exciting? What things couldn't have happened in real life? What kind of person is ... What caused _____ to act the way he/she did?

Figure 3.3 Bloom's Taxonomy (continued)		
Level	Key Words	Prompts
Synthesis: Build a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure.	categorize, combine, compile, compose, create, devise, design, explain, generate, modify, organize, plan, rearrange, reconstruct, relate, reorganize, revise, rewrite, summarize, tell, write	What would it be like if ... What would it be like to live ... Design a ... Pretend you are a ... What would have happened if ... Why/why not? Use your imagination to draw a picture of ... Add a new item on your own ... Tell/write a different ending ...
Evaluation: Make judgments about the value of ideas or materials.	appraise, compare, conclude, contrast, criticize, critique, defend, describe, discriminate, evaluate, explain, interpret, justify, relate, summarize, support	Would you recommend this book? Why or why not? Select the best ... Why is it the best? What do you think will happen to ... Why do you think that? Could this story really have happened? Which character would you most like to meet? Was _____ good or bad? Why?

Appendix B: Coaching Conference Protocol

1 hour

Data & Observation debrief: What does the data tell us? What are the next steps?

(5) Read data silently

(10) Process data:

What do you notice? (ONLY low inference observations- no inferences)

What is surprising?

What is affirming?

(10) Reflect on data:

What strategies have I implemented to improve _____(my goal)?

What do I need to work on now? Why?

(10) What are my next steps?

What new strategies will I try? Why? What is the intended outcome?

What data will give us the best information about this new goal?

(10) Burning questions and additional things

Appendix B: Post Co-planning Questionnaire

1. What was your main take-away from the coaching session?
2. How will you use what you learned to design your next lesson?
3. How has coaching informed your thinking about the instructional purpose(s) of questioning?

Appendix B: Post Coaching Conference Informal Interview Questions

1. What specific things in the coaching cycle, or coaching has helped you?
2. In what ways has this process supported your professional growth?
3. How has coaching shifted your thinking around the purpose, the instructional purpose of questioning?

Appendix B: Post Co-planning Questionnaire

1. What new thing did you learn as a result of co-planning?
2. How do you think about lesson planning as a result of co-planning?
3. What parts of the co-planning process did you find useful or do you think will help you become a better lesson planner?
4. Specifically, with regard to developing questions for checking for understanding, what part of the co-planning process is helping you develop that skill?

Appendix B: Post Intervention Interview Questions

1. On a scale of 1 to 10 how would you rate yourself in terms of knowledge of lesson phases? How would you have rated yourself at the beginning of the year?
- 2.
3. What helped you increase your knowledge of lesson phases?
4. Do you lesson plan daily?
5. On a scale of 1 to 10 how would you rate yourself in terms of competence with regard to lesson planning? How would you have rated yourself at the beginning of the year?
6. What helped you transfer your knowledge and put it into practice?
7. Questions about formative assessment
8. In your own words describe how you understand formative assessment and its purpose.
9. How do you build formative assessment into your lessons?
10. Do you pre-plan check for understanding questions?
11. Do you use any resources to create questions that are checks for understanding, if so which ones?
12. If you think about questioning as formative assessment strategy, and the purpose of formative assessment, how do you use questioning to inform your instruction?
13. When a student answers a question incorrectly, what do you do? How do you scaffold a follow up question? Can you give me an example of what you do or say?
14. How equipped do you feel to design questions that assess student understanding?
15. When a student responds incorrectly do you ask probing questions? How do you follow up?
16. What do you need to feel really competent at designing questions that assess student understanding? What about to ask probing questions?
17. Did coaching inform your knowledge of F.A.? In what ways?

18. To what extent do you think coaching impacted your ability to scaffold questions?
19. In what ways did coaching help you think about lesson planning?
20. We co-planned quite a few lessons this year. What did you learn from the co-planning experience that you apply to your independent lesson planning?
21. How did being observed impact your practice?