

TEACHERS' BELIEFS ABOUT AND USE OF FORMATIVE ASSESSMENT
IN THE MIDDLE GRADES MATHEMATICS CLASSROOM

A Dissertation
By
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Submitted to the Graduate School
at Appalachian State University
in partial fulfilment of the requirements for the degree of
DOCTOR OF EDUCATION

December 2018
Educational Leadership Doctoral Program
Reich College of Education

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Abstract

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Research abounds on the benefits of formative assessment to both students and teachers. Those benefits include increased student achievement on summative assessments, self-efficacy of students, students' regulation of their own learning, and much more. School districts and teachers understand the benefits of formative assessment to students. However, teachers' beliefs about formative assessment are not always mirrored by their use of it in the classroom (Yan & Cheng, 2015).

The middle school level is an important transition for students from elementary school to high school. If students have a strong mathematical foundation, they are ready to take on the challenge of higher-level math courses in high school, increasing the probability of college degree attainment (Kim, Kim, DesJardins, & McCall, 2015). It bears consideration that the use of formative assessment, with its demonstrated benefits, might provide insight into middle grades' students achievement in mathematics.

This case study was designed to examine middle school math teachers' beliefs about and use of formative assessment in the classroom. The setting for this study was a western North Carolina middle school. This case study utilized a questionnaire, classroom observations and individual semi-structured interviews with data analyzed. Formative Assessment Framework and the Theory of Planned Behavior were the lenses used for this study. The data from this study revealed that teachers' use of formative assessment in the classroom aligns with *their* definition of it. However, when applying the definition of formative assessment used in this study, there are gaps in teachers' use of it.

Acknowledgements

I would like to thank my dissertation chair, Dr. Tracie Salinas, as well as committee members Dr. Roma Angel and Dr. Jennifer McGee. Thank you all for your unyielding support and encouragement, especially at my most frustrating points. Thanks also to Ari Sigal for editing my writing. Your kind words were invaluable.

I would like to thank my parents who told me as a young girl that an undergraduate college degree would not be enough. Thank you for your love, foresight, wisdom and making education a non-negotiable.

Thanks to the Almighty God who kept me at all times. At my lowest point during this process You spoke through my pastor via a sermon, on January 1, 2017, entitled “Keep Trying” (Romans 4:19-21). My pastor impressed upon the congregation to show up every day, give your best, and keep trying. Thanks, God...I needed that!

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Chapter I: Introduction

At the end of each school year in North Carolina, students take state-mandated summative assessments to determine how well they learned what has been taught. These assessments provide data on how well students understand the curriculum and can apply what has been taught. The tests are based on the standards provided by the state in the North Carolina Standard Course of Study. With the high-stakes nature of standardized testing for students, the North Carolina Department of Public Instruction (NC DPI) grades and evaluates schools on how well students perform on state summative assessments. After the assessments are administered and scored, reports are given to teachers and administrators. The reports disaggregate the data, including overall performance and performance by curricular standard. Once students complete an end-of-year assessment (“End-of-Grade” in North Carolina), teachers can no longer re-teach that material or re-test it (Stiggins, 2009). Thus, these summative assessments are not helpful in guiding teachers’ instructional choices, such as addressing student misconceptions and misunderstandings.

On the other hand, formative assessments provide data on student learning, allowing teachers to customize instruction for students as needed (Ginsburg, 2009). Schools are also evaluated on performance gaps, on these tests, between different subgroups of students. For example, if one group of students is 85% proficient on the mathematics summative assessment and another group of students is 50% proficient, that is a performance gap of 35 percentage points. Research suggests that formative assessment helps all students, especially low achievers, and reduces performance gaps (Black & William, 2006, 2009, 2010). With this knowledge of the effectiveness of formative assessment, it is imperative to understand teachers’ beliefs about and

its use in the classroom. If teachers utilize formative assessment, student learning may be positively impacted, academic gains may be realized, and performance gaps may close.

This case study examined how teachers in a western North Carolina middle school define and value formative assessment for the middle school math classroom and how their classroom actions and choices reflect their use. If formative assessment effectively increases performance and closes achievement gaps, it may allow students to enter high school better prepared to take the courses needed to graduate and be college ready. In turn, if students leave middle school with a strong foundation in mathematics and are prepared to take higher-level math courses in high school, it increases the likelihood of college entrance and college degree attainment (Kim, Kim, DesJardins & McCall, 2015; Riegle-Crumb, 2006). Disparities exist among groups of students taking higher-level math courses in high school (Riegle-Crumb, 2006). If formative assessment is utilized effectively in middle grades math, it may serve as an equalizer that allows students access higher-level math courses in high school.

Problem Statement

The benefits of formative assessment are considerable. It provides a compass for learning, which improves student achievement, and can close achievement gaps among students (Akpan, Notar, & Padgett, 2012; Black & Wiliam, 1998; Davis, 2011; Stiggins & Chappuis, 2005a). Unfortunately, teachers understand the benefits of formative assessment but do not always utilize it in their classrooms (Büyükkarci, 2014). There is a lack of research specifically devoted to the beliefs and use of formative assessment in the middle grades mathematics classroom. With middle school mathematics being a gateway to students taking higher level mathematics courses in high school, it is important to understand middle school math teachers' beliefs about and use of formative assessment. This study investigates beliefs about and use of

formative assessment among middle school math teachers in a western North Carolina middle school.

Research Questions

This case study focused on beliefs about and use of formative assessment among middle school math teachers. Both Formative Assessment Theory (Black & Wiliam, 2009) and Ajzen's Theory of Planned Behavior (1991) were used to investigate the following research questions:

1. How do middle school math teachers define formative assessment and on what are their definitions based?
2. Do teachers' value of formative assessment relate to their use of formative assessment in the classroom?
3. How well aligned are teachers' definitions of formative assessment and the ways they enact it in the classroom?

Methodology

A case study was conducted to address the research questions. This case study utilized a questionnaire, classroom observations and individual semi-structured interviews. The sources of data allowed me to observe themes that emerged, which were used to answer the research questions. The intent of the study was not to generalize to the broader population of middle school math teachers but instead to explore teachers' beliefs about and use of formative assessment in the middle school math classroom in one western North Carolina middle school. A case study approach allowed me to examine the complexities around the relationship of teachers' beliefs about and value of formative assessment (Baxter & Jack, 2008).

Significance of the Study

There are pivotal moments during the learning process that allow teachers to understand where students are in their learning and to adjust instruction to meet the needs of students (William, 2014). Formative assessment provides feedback to both the teacher and the student to improve student learning and achievement (Nichol & MacFarlane-Dick, 2006; Sadtler, 1989). Black and William (1998) found that use of formative assessment could raise student achievement by a standard deviation of 0.4 to 0.7. As middle school is a transitional place between elementary and secondary education, it is important teachers utilize formative assessment with their students.

A strong mathematical foundation in middle school will allow students to take advantage of higher-level math courses in high school, thereby increasing the probability of college enrollment. Formative assessment has been proven to be integral to student achievement (Black & William, 1998), and teachers use of it is important in the classroom. As middle school is a transitional place between elementary and secondary education, it is important teachers utilize formative assessment with their students. Yet there is minimal research on formative assessment at the middle school level, particularly middle school mathematics. This study will add to the research on teachers' use of formative assessment, specifically in mathematics at the middle school level.

Formative Assessment

In an era of accountability, it is vital that teachers know where students are in their learning and what is needed to get them to the desired learning goal (Black & William, 2009; Ramaprasad, 1983). Formative assessment is the process by which teachers and students work together towards meeting shared learning goals. Learning goals, or learning targets, provide

information to the student on the goal of the lesson. They share information on what is to be learned and how to demonstrate that learning (Moss, Brookhart, & Long, 2011). It is also important that students know where they are in their learning, and formative assessment provides students feedback on their progress. This study defines formative assessment as the process of generating feedback on what has been taught in order to improve student learning and achievement (Nichol & Macfarlane-Dick, 2006; Saddler, 1989).

Assessment may invoke thoughts of a paper-pencil test, but formative assessment can exist in many forms. As noted above, it generates feedback on what has been taught in order to improve student learning and achievement (Nichol & Macfarlane-Dick, 2006; Saddler, 1989). Formative assessment can be a conversation between teacher and student, a conversation between student and peer, a collaborative activity or even a summative assessment that is used formatively. Data from formative assessments allow instruction to be customized to meet the learning needs of the student, in order to realize the learning goal (Nichol & MacFarlane-Dick, 2006; Saddler, 1989).

Formative assessment is a process and not a product (Wiliam, 2014). It is not a destination but a journey whose direction is determined by the student and the teacher. As instruction occurs, the use of formative assessment gives feedback to the teacher, letting him or her understand student learning and address learning needs in real time. Black and Wiliam (2009) refer to these real time decisions as “moments of contingency” (p. 6). Instead of waiting until the end of a unit to administer an assessment and thereby determine student understanding, these moments of contingency are evidences that students are properly comprehending what is being taught. Teachers are immediately able to address any lack of understanding (or any misunderstandings) by students.

In contrast to formative assessment, summative assessments are administered at the end of a unit, grading period, or quarter, often to assign a grade. Schools, districts, and states use summative assessments in accountability to ensure that students are receiving a quality education and to close achievement gaps between groups of students (Pellegrino, 2009). These types of assessments are often administered when students can no longer be re-instructed to address learning deficiencies (Garrison & Ehringhaus, 2007; Shute & Kim, 2014).

Teacher Beliefs about Formative Assessment

The integral components of formative assessment are the teacher and the student (Black & Wiliam, 2009). Formative assessment allows the student to realize the learning goal by providing insights to both the teacher and the student (Warwick, Shaw, & Johnson, 2015). What teachers believe about learning influences what students learn, as their beliefs about teaching influence how they teach (Pandhiani, 2016; Volante & Beckett, 2011). It would follow that if teachers value formative assessment, they will use it with their students. Black and Wiliam (1998) noted that while the use of formative assessment is championed by school districts in the United States, as well as teachers, “tests that encourage rote and superficial learning” (p. 142) continue to be used. This inconsistency between what teachers believe about formative assessment and what actually happens in their classroom has been studied (Allal & Lopez, 2005; Black & Wiliam, 1998; Brown, Kennedy, Fok, Chan & Yu, 2009; Yan & Cheng, 2015). In the middle school math classroom, teachers’ beliefs about formative assessment may influence whether (or how often) they utilize it. This, in turn may affect student’s mathematics learning and preparation for the next academic level.

North Carolina Formative Assessment Learning Community Online

The NC DPI, an early recipient of a *Race to the Top* (RTTT) grant, used the RTTT funds to promote formative assessment and created the North Carolina Formative Assessment Learning Community Online (NC FALCON). The *Implementation Guide of NC FALCON* states that formative assessment, “provides feedback to adjust ongoing teaching and learning that will improve students’ achievement of intended instructional outcomes” (NC Department of Public Instruction, 2010a, p. 2). As a part of NC FALCON, North Carolina Department of Public Instruction (NCDPI) required teachers to complete learning modules and required schools to create professional learning communities to discuss the modules and implementation of formative assessment strategies with students. The NC DPI, in an effort to increase student achievement, implemented formative assessment training (NC FALCON) for North Carolina teachers with the hope that there would be an increase in student achievement on summative assessments and achievement gaps between students would close (NC Department of Public Instruction, 2010a).

Formative Assessment Framework

When initially presented by Black and Wiliam (1998), formative assessment was a practical application for teachers, something for them to utilize in the classroom that promoted student learning. Moss, Brookhart, and Long (2011) stated that it “provides up-to-the-minute information about where you are, the distance to your destination, how long until you get there, and exactly what to do when you make a wrong turn” (p. 66). In other words, formative assessment can be thought of as a global positioning system. Understanding where the student is in his or her learning is important when guiding the student towards the learning goal (Gotwals, Philhower, Cisterna, & Bennett, 2015).

Black and Wiliam (2009) shared five strategies related to formative assessment and integrating its strategies with the teacher, learner, and peer. Those strategies are:

1. Clarifying and sharing learning intentions and criteria for success;
2. Engineering effective classroom discussions and other tasks that elicit evidence of student understanding;
3. Providing feedback that moves learners forward;
4. Activating students as instructional resources for one another; and
5. Activating students as the owners of their own learning (p. 8).

Black and Wiliam also provided a visual of Formative Assessment Theory by intersecting the above components of formative assessment with the agents of formative assessment - teacher, learner, and peer (p. 8) as shown in Figure 1.

	Where the learner is going	Where the learner is right now	How to get there
Teacher	1-Clarifying learning intentions and criteria for success	2-Engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding	3-Providing feedback that moves learners forward
Peer	Understanding and sharing learning intentions and criteria for success	4-Activating students as instructional resources for one another	
Learner	Understanding learning intentions and criteria for success	5-Activating students as the owners of their own learning	

Figure 1. Visual representation of Formative Assessment Theory by Black and Wiliam, from *Educational Assessment, Evaluation and Accountability* (2009), Kings College, London.

As this study considers middle school math teacher beliefs of formative assessment and its use in their classrooms, it focuses primarily on the actions of the Teacher, represented in the top row of the representation of Formative Assessment Theory.

Theory of Planned Behavior and Use of Formative Assessment

For the most part, researchers have found that teachers believe in formative assessment and its benefits (Black & Wiliam, 1998). However, their use of it may not align with their reported beliefs (Yan & Chen, 2015). The inconsistency between teachers' belief in formative assessment and their use of in their classroom has been studied. The Theory of Planned Behavior (Ajzen, 1991) has been used to look at, for example, how people make choices concerning tobacco use (Norman, Conner, & Bell, 1999), and participate in exercise (Hausenblas, Carron, & Mack, 1997). Yan and Cheng (2015) referenced this theory to determine primary teachers' intentions towards and use of formative assessment. The Theory of Planned Behavior is guided by one's *intentions, attitudes toward the behavior, subjective norms, and perceived behavioral control* (Ajzen, 1991). Each of these components is described below.

An individual's *intentions* deal with their motivation towards enacting a behavior. The greater the intention, then the greater the probability one will perform the behavior, given the opportunity of resources. *Attitudes towards a behavior* include one's beliefs about it and evaluation of its outcome. *Subjective norms* are one's beliefs concerning others' expectations of a behavior and the motivation to comply with those expectations. *Perceived behavioral control* is one's belief about factors that may increase (or impede) the likelihood of performance, the perceived power of those factors and one's confidence in their ability to perform the behavior (Ajzen, 2002). Yan and Cheng (2015) studied teachers' intention and use of formative assessment. They found that attitudes toward the behavior, subjective norms, and perceived

behavioral control had an impact on teachers' use of formative assessment. A teacher's intention and perceived behavioral control had a greater impact on their use of formative assessment with students.

In this case study, the Theory of Planned Behavior is used to understand how teachers align their beliefs with the strategies enumerated by Black and Wiliam that suggests teacher's perceptions of their behavior may inform their use of formative assessment actions.

Policy and Assessment

The *No Child Left Behind Act* (NCLB, 2002) addressed achievement gaps among students and sought to increase student academic achievement. Two requirements in Section 101 of the NCLB Act mandated that public school students participate in yearly summative assessments. State education agencies also determined annual measurable goals for the improvement of economically disadvantaged students, students with disabilities, ethnic groups of students, and students who are English learners. These groups of students historically performed lower on national and state assessments than their peers.

The *American Recovery and Reinvestment Act* (ARRA), signed into law in 2009 under President Obama, authorized a fund known as Race to the Top (RTTT). The RTTT fund rewarded states for innovation in education, improving student outcomes and closing achievement gaps, while assuring students who graduated from high school were college and career ready (U.S. Department of Education, 2009). North Carolina created performance goals for all student groups (i.e., ethnic groups of students, economically disadvantaged students, students with disabilities, English Learners, migrant students, and academically intellectually gifted students). For those groups that traditionally underperform, North Carolina set goals to increase the performance of students by fifty percentage points over ten years (North Carolina

Department of Public Instruction, 2010b).

The *Every Student Succeeds Act* (ESSA), signed into law in 2015, required all students be taught to higher standards with the intent of making them college and career ready upon graduation from high school (U.S. Department of Education, 2015). A report by the U.S. Department of Education noted that while high school graduation rates had increased, too many African-American students still lacked access to educational resources that would allow them an opportunity to succeed. The achievement gaps that are often seen by grade four usually remain (U.S. Department of Education, 2016). These gaps are also reflected in the latest National Association of Educational Progress (NAEP, 2017) assessment results where the proficiency gap between White and Black students was 32 percentage points in grade four and 31 percentage points in grade eight. (NAEP, 2017). As this legislation affects students and requires reports on their progress, educators and administrators continue to search for ways to effectively teach students and close achievement gaps among them. North Carolina, in their state plan, has again set progress goals for groups of students, including aggressive goals for traditionally underperforming groups of students. There was also a renewed focus on formative assessment (North Carolina Department of Public Instruction, 2017).

Formative assessment has amassed much interest in the educational community since the introduction of RTTT. North Carolina was one of the first states to receive a RTTT grant and created the North Carolina Formative Assessment Learning Community Online (NC FALCON) professional development modules. Teachers at that time were required to complete the online training modules, and districts were required to develop a plan to implement formative assessment in the classrooms (NC Department of Public Instruction, 2010a). Clearly the state

recognized the potential impact formative assessment could bring to the learning environment and to performance on summative assessments.

Definition of Key Terms

- End-of-Grade (EOG) – This is a summative assessment given to students in North Carolina, in grades three through eight, at the end of the school year. Students are assessed in mathematics and English Language Arts. Students in grades five and eight are also assessed in Science. This study references the mathematics EOG test.
- Formative Assessment – This is a process of generating feedback in order to move learning forward.
- Learning Target – A learning target helps students understand the purpose of the lesson. Students will understand what they are to learn from the lesson and how they will be able to show they have learned it (Moss, Brockhardt, & Long, 2011).
- NCDPI – This acronym is the North Carolina Department of Public Instruction. NCDPI is the state agency that oversees education in North Carolina.
- NC FALCON – North Carolina Formative Assessment Community Online. This was a professional development activity created by NCDPI as part of the state being awarded a Race to the Top federal grant. The professional development was for all North Carolina teachers and focused on formative assessment.
- Moments of Contingency - There are moments in the learning process that allow the teacher or learner to understand what learning is taking place and can then regulate learning.
- Performance Gaps – These are gaps between student performance on assessments. For example, if on the End-of-Grade Math assessment eighty percent of White students are

proficient, and fifty percent of Hispanic students are proficient, then the performance gap is thirty percentage points between White and Hispanic students.

Organization of the Study

The study is organized in five chapters. Chapter 1 provides the significance of the study, including research on formative assessment, the frameworks used as lenses for the student and policy related to formative assessment.

Chapter 2 includes a review of the literature about to formative assessment, characteristics of formative assessment, and benefits of and concerns about formative assessment. The Formative Assessment Framework and the Theory of Planned Behavior, which are the lenses for this study, are reviewed in this chapter.

Chapter 3 addresses the study's methodology. I shared information about the participants, data sources, procedures used to collect data and the process for analyzing data.

Chapter 4 focuses on the findings of the study. The presentation of the findings includes themes, commonalities and discrepancies of the study.

Chapter 5 summarizes the study, including a summary of the results. A summary of the findings is included, along with implications for future research.

Chapter II: Review of Literature

In preparing an analysis of middle school math teacher's beliefs about formative assessment and its use in the math classroom, it is important to establish a thorough understanding of formative assessment and its many components. These include the history of North Carolina's use of formative assessment, theories related to formative assessment, and barriers to its use. The research on formative assessment is considerable. This chapter reviews and synthesizes relevant studies on formative assessment, particularly those related to teacher beliefs and use.

Summative Assessment and Formative Assessment

When students are summatively assessed at the end of a school year, the end of a unit, or are given benchmark assessments, teachers, schools and districts are evaluating teaching and students' attainment of knowledge (Stiggins, 2009). Summative assessments also assess learning based on what has been taught in class during a school year or unit. Shute and Kim (2014) describe the benefits of summative assessment:

- (a) It allows for comparing learner performances across diverse populations on clearly defined educational objectives and standards;
- (b) It provides reliable data (e.g., scores) that can be used for accountability purposes at various levels (e.g., classroom, school, district, state, and national) and for various stakeholders (e.g., learners, teachers, and administrators); and
- (c) It can inform educational policy (e.g., curriculum or funding decisions) (p. 25).

Garrison and Ehringhaus (2007) stated that summative assessments should be viewed “as a means to gauge, at a particular point in time, student learning relative to content standards” (p. 2). In the U.S., summative assessments have been used to ensure students receive high quality

instruction, graduate from high school prepared for college or career, and that school districts close achievement gaps (RTTT, 2009).

While information gleaned from these assessments can inform student learning, they are sometimes given at a point when they cannot help the students who take them (Garrison & Ehringhaus, 2007), such as at the end of a unit, school year, grading period, or before a milestone event like college entry (Shute & Kim, 2014). After implementing NCLB, most states and schools used summative assessment for accountability purposes and not for supporting learning (Shute & Kim, 2014).

In an effort to meet the goals of summative assessments, formative assessment may be a bridge between what students know and what they need to know by the end of a unit or school year (Andrade & Cizek, 2010) because it generates feedback on what has been taught in order to improve student learning and achievement (Saddler, 1989). Teachers must know their students' learning progress and any difficulties they experience in order to adjust instruction and meet the needs of the students (Black & Wiliam, 2010). Formative assessments and summative assessments are necessary and complement each other (Burke, 2010; Gates Foundation, 2010). Figure 2, adapted from Guskey and Bailey (2001, p. 98), shows the relationship between formative and summative assessment.

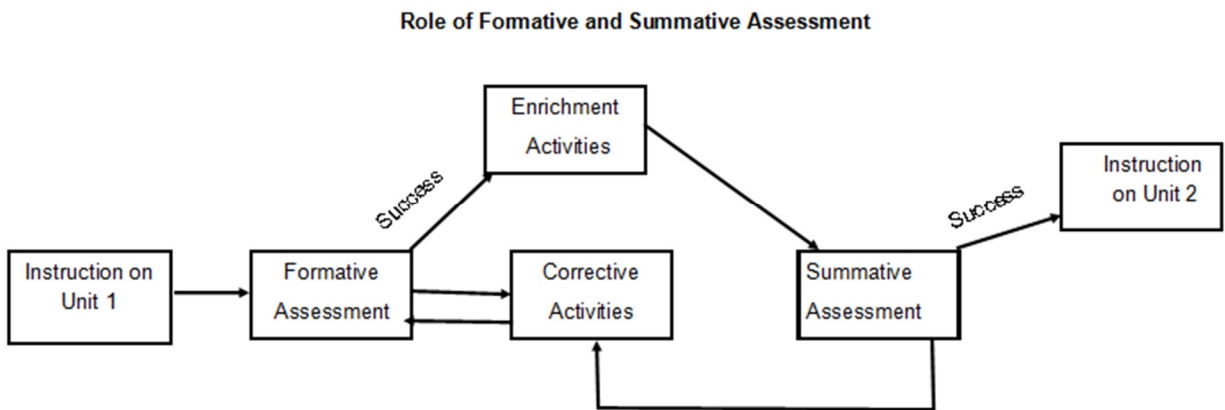


Figure 2. Role of formative and summative Assessment. Adapted from “Developing Grading and Reporting Systems for Student Learning,” Gusky and Bailey, p. 98), Copyright 2001, by Corwin Press.

Characteristics of Formative Assessment

Michael Scriven (1967), the first to use the term “formative assessment,” and differentiate it from summative assessment, wrote that formative assessment plays “a role in the ongoing improvement of the curriculum” (p. 41). Later, researchers formulated variations of his understanding (Akpan, Notar, & Padgett, 2012; Ginsburg, 2009; Gotwals, Philhower, Cisterna, & Bennett, 2015; Phelan, Choi, Vendlinski, Baker, & Herman, 2011). In this study, the following definition is used: Formative assessment generates feedback on what has been taught in order to improve student learning and achievement (Black & Wiliam, 1998; Nichol & Macfarlane-Dick, 2006; Saddler, 1989).

Burke (2010) stated that assessment "is the process of gathering evidence of student learning to inform instructional decisions" (p. 19). Thus, in order to use formative assessment effectively, teachers must be able to answer three questions:

- 1) Where are the learners in their learning?
- 2) Where are they going?
- 3) What needs to be done to get them there (Black & Wiliam, 2009, p. 7; Ramaprasad,

1983)?

Teachers must know where their students are academically and where they need to be by the end of the class, as well as by the end of a unit and school year. Teachers may use a variety of methods to determine where students are in their learning, and whether or not there are any misunderstandings (Ginsburg, 2009). Formative assessment helps teachers guide students in the right direction academically.

Moments of Contingency

Moments of contingency are integral to formative assessment theory. There are moments in the learning process that allow the teacher or learner to regulate learning. Black and Wiliam (2009) refer to these as “moments of contingency” (p. 6). Teachers, students or peers gather evidence during these small yet vital parts of the learning process which allow them to regulate learning (Wiliam, 2014). Classroom discussions and questioning elicit student responses, shedding light on their understanding of the learning goal or intention (Black & Wiliam, 2009). These moments are like hinges in the learning process where instruction is not predetermined but is determined by student responses (Pachler, Daly, Mor, & Mellar, 2010) and inform the formative assessment process. These moments allow teachers to provide the appropriate feedback to move the learner towards the learning goal. The activities utilized during the teaching and learning process allow students to gage their own learning, thereby becoming owners of their learning, and letting learners become resources for each other (Black & Wiliam, 2009).

Moments of contingency may be synchronous or asynchronous. In real time, teachers may immediately adjust instruction based on student feedback. For example, a teacher may ask students what is the coefficient of the variable x in the expression $-x - 4$? If students respond

there is no coefficient, the teacher may stop the lesson and explain the understood coefficient 1, as no number is present, and the actual coefficient is -1 as there is a negative sign in front of the x . Moments of contingency can also be asynchronous. A teacher may use evidence collected from items such as student feedback or homework to plan lessons. Another example of asynchronous moments of contingency would be a teacher using information gleaned from one class to inform instruction for another (Wiliam, 2014). If students in one class did not recognize the coefficient in the algebraic expression above, the teacher may devote more time to this topic during instruction with the next class.

Though asynchronous contingency is not unimportant, moments of synchronous contingency are particularly important in the formative assessment process. Teachers who have the skills to capitalize on these moments can regulate learning interactions as students work on a task and can more effectively monitor and evaluate the learning process (Clark, 2010). If formative assessment can be considered the bridge between what students know and success on summative assessments, then moments of contingency is the bridge between what students know and achieving the immediate learning target.

Self-regulated learning, informed by moments of contingency, is integral to formative assessment (Clark, 2011; Wiliam, 2014). It allows the learner to set goals to increase knowledge, utilize strategies to measure progress towards learning goals, and monitor their engagement (Wiliam, 2014). The information students and teachers receive from formative assessment lets students self-reflect. The internal learning process becomes visible and is valuable to students as they monitor their learning (Clark, 2011). Strategies four and five of formative assessment theory relate to self-regulated learning. The benefits of formative assessment are:

1. Clarifying and sharing learning intentions and criteria for success;

2. Engineering effective classroom discussions and other tasks that elicit evidence of student understanding;
3. Providing feedback that moves learners forward;
4. Activating students as instructional resources for one another; and
5. Activating students as the owners of their own learning (Wiliam, 2009, p. 8).

Strategy four has students as instructional resources for each other. Strategy five releases students as the owners of their own learning (Black & Wiliam, 2009). As teachers provide feedback to students to advance them towards the learning target, feedback aids students in owning their learning and becoming resources for their peers. As students own their learning, they can self-assess whether or not they are reaching the learning target and when they have achieved success (Black & Wiliam, 2009).

Feedback and Formative Assessment

Formative assessment generates feedback on what has been taught in order to improve student learning and achievement (Nichol & MacFarlane-Dick, 2006; Saddler, 1989). Modern K-12 schools operate in a data-driven culture. Data should drive instructional decisions made by schools and districts. Feedback involves an exchange between teacher and student in order to adjust instruction to meet the needs of the student (Tovani, 2012). Feedback provides data to guide teacher instruction. Information, or data, gleaned can help teachers address student misconceptions about content by indicating what concepts need to be re-addressed and allowing students to reach the learning target. Information about students' levels of understanding allows teachers to adjust instruction, as well as create a path towards deeper understanding of a concept (Nichol & MacFarlane-Dick, 2006).

In order to move student learning forward, the information gained from formative assessments answers the three critical questions: 1) Where are the learners in their learning, 2) where are they going, and 3) what needs to be done to get them there (Black & Wiliam, 2009, p. 8; Ramaprasad, 1983). Effective feedback is critical to formative assessment (Hattie & Timperley, 2007). Assessment is formative when it “moves learning forward” (Black & Wiliam, 2009, p. 8). Hattie and Timperley (2007) stated that feedback is a consequence of performance. However, when feedback and instruction mix, feedback becomes new instruction and provides students information to close the gap between where they are and where they need to be in their learning (Clark, 2010). Núñez-Peña, Bono, and Suárez-Pellicioni (2015) noted feedback is "information with which a learner can confirm, add to, overwrite, tune or restructure information in memory" (p. 80).

Sadler (1989) noted that “feedback demonstrates to the student what quality looks like” (p. 126). Teachers know and understand the learning target and what success looks like. Feedback, which is integral to formative assessment, allows the teacher to access students' prior knowledge and misconceptions, and determine how to arrive at the desired outcome. When developing tasks for students, teachers can share the learning target with them, so they in turn know what is expected in order to be successful. Moss, Brookhart, and Long (2011) stated that a “shared learning target unpacks a "lesson-sized" amount of learning—the precise "chunk" of the particular content students are to master” (p. 67). Once students know what the learning target is, continued feedback shows them where their performance relates to good performance and how to close the gap (Sadler, 1989).

Students can achieve learning targets when they understand them and assess their own progress. Otherwise, the teacher will be the only one directing learning, and students will focus

on what the teacher is saying rather than their own learning (Moss, Brookhart, & Long, 2011). Feedback eliminates the gap between what the teacher *knows* is a learning target and what the student *thinks* is a learning target (Sadler, 1989). Feedback guides students by clarifying the learning target and allowing the teacher to create structured learning tasks. For example, student performance on learning tasks provides feedback to the teacher on students' understanding of the concept presented. When students' understanding does not align with the learning goal, teachers can provide a more structured learning task to get students on the correct learning path (Butler & Winne, 1995). The student can then reflect on learning, and thereby identify and self-correct misconceptions (Nichol & Macfarlane, 2006).

Self-regulated Learning and Feedback. Learning is not a one-way street and teachers are not solely responsible for all learning that takes place. Students share in the responsibility for their own learning (Black & Wiliam, 2010). Feedback allows learners to compare where they are in relation to desired learning goals. Nicol and MacFarlane-Dick (2006) stated that self-regulation requires the student to know the goals to be achieved compared to their performance. Feedback provides information on how the student's present state of learning relates to the learning goals. When students know the learning goal and understand where they are in relation to it, they can then self-monitor, self-assess, and seek feedback to guide them successfully towards attaining the learning goal (Hattie & Timperley, 2007). When students regulate their own learning, the feedback they seek may be external, meaning from their teacher or a peer. The feedback can also be internal, as they are able to error-check themselves and know where they are headed in relation to the learning goal (Hattie & Timperley, 2007; Nicol & MacFarlane-Dick, 2006).

Self-regulated learning requires students to plan, monitor and modify their thinking, manage their effort on classroom tasks, and involves strategies students use to learn and understand tasks (Pintrich & De Groot, 1990). Students' beliefs about learning and their motivation towards learning are integral to achievement. When students remain engaged, their achievement generally improves. Managing effort on classroom tasks involves being able to persist at a task that may prove difficult and being able to block out distractions. Students must remain engaged in learning. This happens when they employ strategies such as memorizing, rehearsing and organizing.

There are various types of feedback noted by researchers (Hattie & Timperley, 2007; Nichol & MacFarlane-Dick, 2006). Much of the feedback within formative assessment is assumed to be external from the classroom teacher or students' peers. Teachers rely on the feedback they receive from students to inform them of student learning and misconceptions (Akpan, Notar, & Padgett, 2012; Black & Wiliam, 2010; Núñez-Peña, Bono, & Suárez-Pellicioni, 2015). Billman and Heit (1988) wrote that external feedback "provides success criteria for a particular learning problem" (p. 588). Some learning is observed, and the feedback is internal, meaning that as students gain knowledge of a task, they are able to detect their own errors (Billman & Heit, 1988).

Research has shown that feedback can influence how a student feels about him or herself, and can affect his or her motivation to attain the learning goal (Nichol & MacFarlane-Dick, 2006). Nicol and MacFarlane-Dick identified seven principles that facilitate self-regulation, some of which contribute to the framework of this study. They are:

1. Clarifies good performance;
2. Facilitates self-assessment;

3. Delivers high quality information to students about their learning;
4. Encourages teacher and peer dialogue around learning;
5. Encourages positive motivational beliefs and self-esteem;
6. Provides opportunities to close the gap between current and desired performance;
7. Provides information to teachers that can be used to help shape teaching (p. 205).

As already noted, students must know the learning goal, which is the outcome of a lesson or unit (Sadler, 1989). Formative assessment requires knowing where the learner needs to be in his or her learning. Students must also understand what successful attainment of the learning target is, allowing them to understand where they are in their learning, in relation to the learning target. By assessing their own progress, students can process the information they receive about their learning and monitor it.

Formative Assessment Activities

Constructivist theory states that students connect old and new knowledge to construct meaning (Juvova, Chudy, Neumeister, Plischke, & Kvintova, 2015). As teachers utilize formative assessment with their students, they are constantly enabling them to connect previous and recent knowledge, thereby constructing meaning. The formative assessment theory in Table 1 gives an overview of some formative assessment activities that address components of the theory.

Table 1.

Formative Assessment Activities

Formative Assessment Framework	Activity
Knowing where the learner needs to be in their learning:	<p>Criteria and goal setting allow the teacher to set clear learning targets and share with students the steps for reaching the learning target (Garrison & Ehringhaus, 2007). Students must understand the goal and expectations in order to monitor if they are progressing towards the goal (Nicol & MacFarlane-Dick, 2006). The clear learning target and criteria for success allows the learner to know where she is in her learning in relation to the learning goal (Garrison & Ehringhaus, 2007).</p>
Knowing where the learner is in his or her learning.	<p>Classroom dialogue is a discourse between the teacher and student, or the student and a peer. The conversations allow the teacher to understand where the student is in his or her thinking, recognize errors in a student's thoughts and use that information to refocus and guide instruction (Ruiz-Primo & Furtak, 2007).</p> <p>Questioning can address all components of the formative assessment framework and could be considered classroom dialogue. Questioning allows teachers to understand where the learner is in his or her learning, as well as assess the learner's depth of learning (Garrison & Ehringhaus, 2007). This activity can be particularly useful with students who are low achievers who have shown gains in achievement (Merritt, Palacios, Banse, Rimm-Kaufman, & Leis, 2017). In their study of a diverse elementary classroom, Merritt et al. (2017) noted that questioning was able to incorporate students' background knowledge while valuing their ideas, and required them to use academic language that also strengthened their understanding (p. 19).</p>
Knowing what needs to happen in order for the learner to reach his or her goal.	<p>Summative assessments, when used for gaining information, provide information to the teacher about a student's progress and what they have learned (Garrison & Ehringhaus, 2007). Used to evaluate instruction, as well as schools and school districts (Akpan, Notar, & Padgett, 2012), summative assessments are useful when they provide the opportunity to reflect on progress and opportunities for improvement (Farrell & Rushby, 2015).</p> <p>Observations are not merely walking around a classroom to gauge student work. It is the collection of evidence to guide instruction (Garrison & Ehringhaus, 2007). Evidence may be collected from questions, conversations between the student and teacher, conversations between students and their peers, and even completed assignments (Torrance & Pryor, 2001).</p> <p>Peer observations are useful in formative assessment. Considerable research on the topic exists in relation to teachers and teaching (Kenny, Mitchell, Chróinín, Vaughan, & Murtagh, 2014; Yiend, Weller, & Kinchin, 2014). Students would benefit from observing their peers and rating their progress in relation to their peers. Students would think about their own progress, where they are in their learning and next steps (Garrison & Ehringhaus, 2007).</p>

Benefits of Formative Assessment

Formative assessment benefits both the teacher and student. The feedback students receive can increase their motivation to learn and make them feel more competent (Harks, Rakoczy, Hattie, Besser, & Klieme, 2014). When students feel the learning goal is attainable, their self-confidence improves. The feedback students receive helps them regulate their learning and know where they are in relation to the learning goal (Black & Wiliam, 2010). When students feel confident and know where they are in relation to the learning goal, they are more likely to be successful in reaching the learning goal.

Increased Self-efficacy

Zimmerman (2000) defined perceived self-efficacy to be one's "judgments of one's capabilities to organize and execute courses of action to attain designated goals" (p. 83). There are differences in self-efficacy with respect to gender (Campbell & Hackett, 1986), as well as differences related to ethnicity (MacPhee, Farro, & Canetto, 2013). This study uses general perceived and academic self-efficacy in relation to learning goal attainment and student achievement in order to examine formative assessment in the mathematics classroom. If a student feels he or she is capable of meeting a goal, they are more apt to try (and even persist) in the face of a challenge (Schunk, 1991). When students feel a goal can be met, it can affect their academic pursuits (MacPhee, Farro, & Canetto, 2013).

A component of formative assessment is knowing how to help a learner reach the learning goal (Akpan et al., 2012; Black & Wiliam, 2010). When learners experience successes, their perceived self-efficacy increases, which has been shown to have a positive effect on performance (Campbell, & Hackett, 1986). When a new topic is introduced in math, students' perceived self-efficacy, may not be high (Schunk, 1991). As students' understand the learning

target, monitor their progress towards the learning goal and experience success, their performance and self-efficacy increase, while anxiety decreases (Ahmed et al., 2012; Zimmerman, 2000). Thus, success in math would cause one's academic self-efficacy to increase. Performance would increase for all students, especially lower achieving students (Black & Wiliam, 2006), and the performance gap would decrease.

Impact on Student Achievement

Regular use of formative assessment helps students track their progress and could raise student achievement by a standard deviation of 0.4 to 0.7 (Black & Wiliam, 1998). Schools and districts grapple with under-performing groups of students. Formative assessment would be helpful to those students. Teachers would know where students are in their learning and increase their achievement. Higher performance could also affect the fields that students choose to study after high school. A study by Hernandez-Martinez, et al. (2011) examined the lack of students choosing careers requiring high levels of mathematics in the United Kingdom. The study also investigated why some students performed better in a common course, "Use of Mathematics," than others.

The researchers looked at prerequisite courses and pedagogy in those courses and found that those students who performed better came from classes with teacher-student interactions focused on students' understanding of mathematics, their ability to problem-solve and their communication of mathematics. These characteristics supported a "formative assessment agenda," that shifted the classes' focus from teaching to learning (p. 200). When interviewed, students noted their conversations with their teachers allowed them to monitor their own progress and determine if they were headed in the right direction. (Hernandez-Martinez et. al.,

2011). The discourse provided feedback to both teachers and students, allowing both to know where the student was in their learning, and move learning forward.

Teacher Expectations as a Barrier to Formative Assessment

It is known that teachers' expectations of students can affect their academic performance. A study conducted in Belgium found that teacher expectations were lower in schools with a high percentage of nonnative speakers and students from working class families (Agirdag, Van Avermaet, & Van Houtte, 2013). When interviewed for the study, teachers in schools with such students immediately noted the makeup of their school, thereby indirectly indicating it was a reason for lower performance. Agirdag et al., (2013) found that teacher expectations of students were linked to the ethnic and socioeconomic makeup of the school; but only indirectly linked to math achievement and students' feelings of uselessness. Teachers see some students as more academically inclined than others, regardless of their ability and background.

In the United States, White and Hispanic students are viewed more positively than Black students. However, teachers view Mexican immigrant students more negatively than White students (McGrady & Reynolds, 2013). Performance gaps might be indirectly related to teacher expectations of students and not as a true reflection of student ability (Agirdag et al., 2013).

Teacher Beliefs About and Use of Formative Assessment

Knowing that formative assessment has a direct impact on student learning and achievement (Black & Wiliam, 1998) - and can even double it (Wiliam, 2007) - teachers must utilize this intervention with their students. A study by Büyükkarçi (2014) stated that primary language teachers in Turkey had positive beliefs about formative assessment, yet their use of it in their classrooms was significantly less. Büyükkarçi used a questionnaire and individual interviews with 69 teachers to study teachers' ideas about formative assessment and their use of

it in the classroom. Although teachers in the study believed that using feedback, self-assessment, peer-assessment, and sharing learning goals were beneficial to the learning process, their use of these interventions was significantly less in practice. Even though the Ministry of Education in Turkey encouraged the use of formative assessment in language classes, teachers cited large classes and heavy work load for not doing them.

Yan and Cheng (2015) found that primary teachers also had good intentions for using formative assessment yet did not implement them at the same level. They noted that teachers who were more confident in their use of formative assessment seemed to utilize it more, and also did so when they felt it would have a positive effect on student learning. Like Büyükkarci, Yan and Cheng referenced heavy workload as a barrier to using formative assessment cited by teachers, along with the need to prepare students for summative assessments. The researchers referred to Ajzen's Theory of Planned Behavior when looking at the connection between teachers' beliefs about (and intention to use) formative assessment, and their actual use.

Concerns about Formative Assessment

Although researchers have pointed to the impact of formative assessment, (Black & Wiliam, 2006, 2009, 2010; Phelan, Choi, Vendlinski, Baker, & Herman, 2011; Stiggins & Chappuis, 2005a), there is not a single agreed-upon definition of the practice (Akpan et al., 2012; Black & Wiliam, 2006; Moss et al., 2011). A teacher wanting to learn more about formative assessment must choose a version from the literature. For some critics, that lack of specificity is a flaw in the research on formative assessment. It has been noted that formative assessment barely focuses on the substance of student thinking. As teachers convey a concept, they may be focused on students using certain terminology instead of thinking about what students are saying and determining if it is the correct answer (Coffey, Hammer, Levin, & Grant, 2011).

More research needs to be conducted on teacher beliefs about formative assessment versus their use of formative assessment. As North Carolina, like other states, addresses performance gaps among groups of students, and a difference between the demographics of teachers and those of the students they teach (McGrady & Reynolds, 2013), formative assessment may be the cure to this ailment. As the middle school grades are an important point in the academic continuum, this study will investigate teachers' beliefs about (and use of) formative assessment in the math classroom.

Summary

This chapter has examined research and policy regarding the assessment, and background of formative assessment in North Carolina, the meaning of formative assessment within the context of this study, various theories related to formative assessment, and factors that influence the effectiveness of formative assessment. Those factors include the teacher knowing where the learner is in their learning, the desired learning goal, and what needs to happen in order to reach the learning goal. Teacher beliefs about formative assessment were also reviewed. The next chapter describes the methodology that was used in this study to answer the research questions:

- 1) How do middle school math teachers define formative assessment and on what are their definitions based,
- 2) Do teachers' value of formative assessment relate to their use of formative assessment in the classroom, and
- 3) How well aligned are teachers' definitions of formative assessment and the ways they enact it in the classroom?

Chapter III: Methodology

The purpose of this study is to investigate the relationship between middle school math teachers' beliefs about and use of formative assessment in one middle school in North Carolina. This case study can contribute to the research focusing on middle school math teachers as there is not much research on this subject area at this educational level. However, success in middle grades math is integral to students being able to take higher-level math courses during high school, receiving a high school diploma and beginning college or a university (Kim et al., 2015). As a result, the examination of middle grades teachers' use of formative assessment is helpful in making sure students have a firm understanding of mathematics and can successfully move to the next level.

This study uses Black and Wiliam's (2009) Formative Assessment Framework to frame teacher actions in using formative assessment. Ajzen's Theory of Planned Behavior (1991) is used to view the relationship between teacher beliefs and use of formative assessment in the classroom. The results of this study describe the relationship between teachers' beliefs about and use of formative assessment in the middle school math classroom. The research questions are as follows:

1. How do middle school math teachers define formative assessment and on what are their definitions based?
2. Do teachers' value of formative assessment relate to their use of formative assessment in the classroom?
3. How well aligned are teachers' definitions of formative assessment and the ways they enact it in the classroom?

Research Design

Yin (2013) wrote that case study is best used when looking at phenomena in a real-life context and trying to explain questions of how and why. Because the intent of this study was to investigate middle school mathematics teachers' beliefs about and use of formative assessment with their students, a case study approach provided the best results by addressing the complex relationship between teachers' beliefs about and use of formative assessment. Swanborn (2010) states, "In the eyes of many scientists, the case study is more or less identical with field research in a natural context" (p. 17). This study occurred in a natural environment for the teachers: the school where they worked and a mathematics class they taught. To study the relationship between teachers' beliefs about and use of formative assessment, teachers needed to be in their natural working environment.

In deciding on the focus of this research, it was important to focus on one educational level in order to gain a thorough understanding of the relationship between teachers' beliefs about and use of formative assessment in their classroom. Baxter and Jack (2008) suggest case studies should be bound to "ensure your study remains reasonable in scope" (p. 546). Binding a case study can include "(a) time and place, (b) time and activity, and (c) definition and context" (p. 546). The case study bounds are described in detail below.

Context

Site Selection

Six teachers participated from a western North Carolina middle school, hereafter referred to as Formative Assessment Middle School (FAMS). The school chosen for the study is a diverse school (see Table 2) and traditionally a high performing school. The school resides in a district that believes in formative assessment. Teachers in the district are expected to have the learning

goal for the lesson visible to students and referred to throughout the lesson. Many mathematics teachers at the middle and high school level are participating in professional development that focuses on the use of formative assessment with students.

The school has been twice chosen as a *Schools to Watch* school. The *Schools to Watch* designation is given by the National Forum to Accelerate Middle-Grades Reform, indicating excellent and high-performing middle schools (Lipsitz & West, 2006). A school with this designation has been determined to possess the following qualities:

- Academically excellent: they challenge all of their students to use their minds well;
- Developmentally responsive: they are sensitive to the unique developmental challenges of early adolescence and respectful of students' needs and interests; and socially equitable, democratic, and fair. They provide every student with high-quality teachers, resources, learning opportunities, and supports and make positive options available to all students (p. 58).

With this nationally-recognized designation, I believed this school had the elements to derive valuable data for the case study.

Math Design Collaborative. In an effort to support the *Common Core State Standards*, the Gates Foundation funded the *Literacy Design Collaborative* and *Math Design Collaborative (MDC) Formative Assessment* lessons (Duffy & Park, 2012). One of the goals of the Gates Foundation is that 80% of low income and minority students graduate high school, college and be career ready by 2025. It is believed that long-term and correct use of the *Math Design* and *Literacy Design Collaborative* programs will help school districts realize this goal with their students.

Teachers at FAMS have participated in the MDC professional development that consisted of instructional modules and formative assessment lessons (FALs). Two teachers participated in the first professional development round offered by the school district, three teachers participated in the second round of professional development and one teacher received initial professional development in MDC this school year. The lessons direct teachers' attention to instructional tasks with formative assessment embedded in those tasks. Math teachers utilize formative assessment lessons that were created for secondary mathematics. The FALs for mathematics are used to gauge student mastery of content or to re-teach. There are modules in the program that can be used to teach new content. The FALs are taught over several days. This is the first year the teachers are using the program. Teachers are expected to use two FALs per grading period. Secondary math teachers receive ongoing professional development throughout the school year on MDC and use of FALs (Duffy & Park, 2012).

School. The area of the district served by Formative Assessment Middle School is quite diverse. The school serves students living in middle- to upper-class communities as well as students living in subsidized housing projects. A well-known retired NASCAR driver resides in the community, and his children attended the school. One of the two hospitals in the county is within the school community. FAMS houses a bustling professional community of doctors, lawyers and business people, whose children attend the school. FAMS is the only middle school in the area that offers orchestra to its students.

Schools in North Carolina receive school performance grades based on student performance on state summative assessments and their growth from one grade to the next. Schools receive a grade of A, B, C, D or F, and receive a determination of meeting, exceeding, or not meeting growth with students (North Carolina Department of Public Instruction, 2017). For

the last two consecutive school years, FAMS has received a school performance grade of B and has, on average, exceeded expected growth with students. Parents want their children to attend this school and purchase homes within this school community.

Formative Assessment Middle School is located in a small, western North Carolina school district of nine schools: five elementary schools, two middle schools, and two high schools. FAMS is one of the most diverse schools in the district (see Table 2). At the beginning of the 2017-2018 school year, there were 543 students enrolled at FAMS.

Table 2

Ethnic Diversity of FAMS

Student Groups	Grade 6	Grade 7	Grade 8
All Students	186	190	167
Asian Students	4	6	2
Black Students	35	27	24
Hispanic Students	54	51	48
American Indian Students	0	0	1
Multi-racial Students	11	16	11
White Students	82	90	81

Note: Enrollment summary as of the beginning of the 2017-18 school year as taken from *PowerSchool*, the student management program used by all districts in North Carolina.

North Carolina has defined a subgroup of students to be a minimum of thirty students with similar characteristics in the tested grade levels of a school (North Carolina Department of Public Instruction, 2017). Thus, FAMS has the following ethnic subgroups of students (see Table 2): All students, Black students, Hispanic students, Multi-racial students and White students. In

addition to ethnic subgroups, FAMS has Students with Disabilities, Economically Disadvantaged, and English Learner subgroups.

Some groups of students perform well on state summative assessments and other groups underperform on the same assessments. The school has struggled with performance gaps between students. On average, their performance gaps exceed the average performance gap for the state on summative assessments.

Participants

Six teachers from a western North Carolina middle school, participated in this study. FAMS has a new principal. The principal was a former middle school teacher and served several years as an assistant principal at a different school in the district, followed by being an interim principal at another school in the district. This is the principal's first principalship. The previous principal had served FAMS for six years.

There are seven math teachers at FAMS; three math teachers in grade six and two each in grades seven and eight. For this study, one teacher declined to participate, leaving two teachers at each grade. Teachers participating in this study have between one and 10 years of experience teaching middle school math, with five teachers having seven or more years of experience in this area. To protect teacher confidentiality, pseudonyms are used for the teacher names.

FAMS is organized into teaching teams. Two to four teachers share a group of students. For example, on a three-person team, one teacher may teach the shared students English Language Arts, another may teach the shared students Science, the third teacher may teach mathematics to the students they share, and all teachers may teach a class of Social Studies to the students they share. This study will look at each teacher's use of formative assessment in one of their math classes. It is important to know about the teachers, their teaching experience, as well

as their experience with formative assessment in order to understand the relationship between their beliefs about and use of formative assessment in their math classroom.

Parks and Blaine. The two grade 6 math teachers who participated in this study are on a two-person team and teach both math and science. Parks has taught for 10 years at the middle school level, and five years in the current grade level (grade 6). Parks was part of the first cohort of teachers participating in the MDC professional development offered by the district. Parks is seen as a leader in the grade level, school and district. Parks has experience teaching all student levels. Parks is experienced teaching higher level students, regular level students and students with learning challenges. Blaine is the other grade 6 teacher and has one year of teaching experience. All of Blaine's experience has been in the current grade level. Blaine began participating in the MDC professional development this school year.

Declan and Indigo. There are two teams in grade seven. One team is a four-person team where each teacher teaches a different subject and the math teacher only teaches math. The other team is a three-person team and the math teacher teaches math and social studies. Declan teaches on the three-person team, has taught middle school for eight years, and has spent five years in the current grade level. Declan participated in the second cohort of the MDC professional development. Declan is a leader in the school and district. Declan is known to be a highly effective teacher and utilizes quick formative assessment activities throughout the class to understand where students are at in their learning. Indigo teaches on the four-person team, has taught nine years at the middle level and all years in the current grade level. Indigo was part of the first cohort of teachers participating in the MDC professional development. Indigo is also a highly effective teacher and is providing professional development in the district for other teachers.

Phoenix and Storm. There are two teams in grade eight. One team is a four-person team, and the math teacher teaches grade 8 math and NC Math I, which is traditionally a high school math course for freshmen. The other team is a three-person team, with the math teacher teaching math and science. Phoenix teaches on the three-person team, has four years of experience at the middle grades level, and all at the current grade level. Phoenix is participating in cohort three of the MDC professional development. Phoenix is considered to be a strong teacher in the school and will most likely teach a NC Math I class the upcoming school year. Due to scheduling conflicts, Phoenix was not able to participate in the individual interview during the data collection part of this study. Storm has been teaching middle school for seven years, and six years in the current grade level. Storm is participating in cohort three of the Math Design Collaborative professional development. Storm has previous experience teaching NC Math I.

Table 3 summarizes information about the teachers participating in this study. The table includes their years of experience and grade level taught.

Table 3

Participant Summary ($n = 6$)

Participant	Total Years Taught	Number of Years at Current Grade Level	Grade Level Currently Teaching
Parks	10	5	6
Blaine	1	1	6
Declan	8	5	7
Indigo	9	9	7
Phoenix	4	4	8
Storm	7	6	8

Note: Pseudonyms are used in place of participants' actual names, with their teaching experience.

Timing

The study was conducted in the spring semester of 2018. The initial meeting occurred in late February 2018, with all classroom observations completed in late March 2018. Semi-

structured interviews occurred in April 2018. State summative assessments began in late May into early June 2018. As interviews took place, the teachers' focus was on the upcoming End-of-Grade tests.

Role of the Researcher

I had an integral role and met with the school district superintendent and the school principal to explain the research and obtain cooperation and consent. An initial meeting was held with math teachers to explain the research and the methods to be used. Participants had the opportunity to ask questions and gain a clear understanding of what is being requested, before agreeing to proceed.

Formative assessment has always been an interest to me. As a middle school mathematics teacher, I utilized formative assessment with my students and performance gaps between groups of students were, in most school years, nonexistent. From my own experience, I believe the use of formative assessment can be the cure to low performance of some student groups and be integral in eliminating the performance gap between groups of students.

Ethical Issues

In an effort to avoid ethical issues, I sought permission to conduct the research by the school district superintendent (see Appendix A) and the Institutional Review Board at Appalachian State University. This study was exempt from IRB review as it involves minimal risk (see Appendix G). Participants were not identified in this study and their confidentiality was protected. When describing teachers in this study, pseudonyms are used to differentiate the participants. Teachers signed an informed consent form (see Appendix B) confirming they understood the nature of the study and expectations for participation. They also received a copy of the consent form. Teachers had the option to discontinue their participation at any time. One

teacher declined to participate in the study, saying they felt it was “something else to do,” and would take away from their responsibilities. Due to scheduling issues, one teacher did not complete their interview with me but did complete other data collection activities. This teacher had responsibilities outside of school that took precedence, and we were not able to find a time to complete the interview. The teacher’s survey and observation data are used in this study. Information from teachers was not shared with the principal or school superintendent. The school used for this study is identified as Formative Assessment Middle School or FAMS.

I have a rich history using formative assessment and have knowledge about the middle school level. As a former middle school math teacher, I was a skilled user of and advocate for formative assessment in the classroom. Before serving in my current position, I provided workshops for teachers in its use, specifically the aspects of questioning and feedback. I have not provided professional development on formative assessment for teachers at FAMS, nor any other teachers in the school district. When NCDPI introduced the NC FALCON professional development modules, I was employed as a middle school curriculum director in a different school district. I was one of the first in the state to pilot NC FALCON professional development modules with my school district. Also, as a middle school level curriculum director, I became a nationally certified trainer for the *Breaking Ranks in the Middle* program created by the National Association of Secondary School Principals. This program trains leaders to deal with the unique issues facing middle level schools and has a strong focus on formative assessment (Rourke, 2006). I debriefed participants as a group and provided a summary of this information in order to maintain a transparent process. I am employed as a director in the same district as FAMS. I have no supervisory responsibilities for the teachers participating in this study. Participants were re-

assured that their participation was voluntary and their choice to decline participation would have no adverse consequences.

Data Collection and Sources

The instruments used for this study included a questionnaire, classroom observations and individual semi-structured interviews. I defined formative assessment for this study, these boundaries allowed the study to focus on the relationship between teachers' beliefs about and use of formative assessment in the middle school mathematics classroom. To gather needed data, participants' willingness to participate and openness was needed. Methods of gathering data included a questionnaire completed by the participants, two observations of the same class and individual semi-structured interviews with the participants.

After receiving permission from the district superintendent (see Appendix A) and school principal to conduct the interview, Institutional Review Board (IRB) approval was sought. The study was exempted from IRB approval (see Appendix G). An initial meeting was held with participants to explain the study. The definition of formative assessment used for this study was not shared with teachers as I did not want to influence teachers' definition of formative assessment. Teachers were asked to complete a Formative Assessment Questionnaire (see Appendix C) to characterize the relationship between their value of and use of formative assessment in their math classroom. Once the surveys were completed, teachers chose a class for the researcher to observe. The teachers and I settled on two dates to observe the chosen class. The final step in data collection for the study was a semi-structured interview. Both the teacher and I agreed upon a date and time, and the interviews were done.

Questionnaire

The first opportunity to gather data was with the questionnaire. I met with each grade level during their planning period, in the school conference room. As teachers entered, I offered teachers candy, again explained the consent form and then gave them the questionnaire to complete. I did not give teachers the definition of formative assessment used in the study. Teachers completed the survey individually with minimal conversation. Once completed, teachers gave me their completed surveys and left to complete their school day. I transferred teacher responses to an electronic spreadsheet, allowing me to begin to see commonalities and patterns in their responses. This data point was the first time I began to see differences, as well as alignment, with teachers' beliefs about and use of formative assessment in their classroom.

The questionnaire used was the *Formative Assessment Questionnaire* (see Appendix C). Patten (2009) described the main purpose of surveys as describing the "...attitudes, beliefs and behaviors of a population" (p. 9) and the *Formative Assessment Questionnaire* describes how much participants' value formative assessment and how they describe their use of it in their classrooms. The questionnaire contains a Likert scale, with indications of value from strongly agree to strongly disagree and indications of use from most lessons to never. The end of the survey asks participants about their teaching experience.

The questionnaire was created by the Qualification and Curriculum Authority, located in the United Kingdom (Ruland, 2011). The Authority no longer exists, and I was referred to the Standards and Testing Agency, which had no knowledge of the questionnaire when contacted. Another doctoral candidate used the survey in his research and received permission from the Qualification and Curriculum Authority, as it was still in existence at that time (Ruland, 2011, p. 83). According to Ruland (2011), The Assessment Reform Group of London commissioned

numerous studies in which the questionnaire was used to collect data. The Learning How to Learn group, also in London, established reliability using three levels (classroom, school, and district). James, Black, McCormick, Pedder, and Wiliam (2006) established validity of the questionnaire. All teachers participating in the study completed the survey via paper-pencil.

Observations

The second opportunity to gather data was classroom observations. The class to be observed was chosen by the teacher. Each class was observed twice. The dates were mutually agreed upon by the teacher and me. Each class was 60 minutes (see Appendix D) and I spent a minimum of 30 minutes in the class for each observation. When entering the classroom, I found a seat in the back of the classroom or near a corner. It was my goal to be as minimally disruptive as possible. As a designated *School to Watch*, the students are accustomed to visitors and soon ignored me and got on with class. I took field notes, which were immediately reviewed after each observation. Formative assessment activities were noted, and their frequency of use was also noted. By the end of the day, the field notes were transferred to the *AccessToday Observation Protocol*. The ratings on the protocol were transferred to an electronic spreadsheet. This allowed me to see commonalities and differences among the teachers.

This tool was created to be used in middle and high school math classrooms (Eddy, Harwell, & Heitz, 2017). The tool defines six areas as core constructs of formative assessment. They are learning target, question quality, nature of questioning, self-evaluation, observation of student affect, instructional adjustment and evidence of learning. As shown in Appendix H, each construct allows the teacher to be rated as a novice, apprentice, practitioner or master.

The observation protocol allowed me to see the areas where teachers are strong on formative assessment. I noted if these areas aligned with sections on the survey where teachers

both valued and utilized formative assessment strategies. For example, the questionnaire revealed that teachers value and utilize questioning with their students, and the classroom observations validated teachers' value and use of questioning in the classroom. Questions also emerged as to why other formative assessment activities were not utilized in the classroom. This prompted me to look for why some activities, such as modeling quality for students, were valued but not utilized in the classroom.

Pianta and Hamre (2009) noted that educational researchers have used classroom observations as a measurement tool for decades. The observations allowed researchers to view and document participants' use of formative assessment with their students, including types, frequency of use, and external feedback occurring with the classroom.

As I did not work at the school and was not a regular part of the learning environment, this was a nonparticipant observation. There is a concern that there may be a change in the behavior of the teacher when they know they are being observed (Patten, 2009). This was mitigated by each participant choosing a class for the researcher to observe. The date of each observation was mutually agreed upon. This put the participant in control and hopefully alleviated some nervousness about the observation. Participants were again informed I was looking for uses of formative assessment in the classroom. The observations were not evaluative, and information gleaned was only used for this study. My thoughts on the observation were not shared with the school principal or district superintendent.

At FAMS, academic classes were approximately 60 minutes long (see Appendix D). Participants were observed for at least thirty minutes of the class. During the actual observation, I took notes on the class, specifically looking for the formative assessment framework activities noted in Table 1.

Eddy, Harrell, and Heitz (2017) referred to short cycle formative assessment when researching the construct validity of the *AccessToday* observation tool (Appendix H). Short cycle formative assessment looks at its use within and between lessons. As this study involves observing teachers' use of formative assessment during one classroom period, the intent of the observation tool is for the observer to be knowledgeable about the content. The researchers limited the scope of their study to middle and high school mathematics. The authors gathered experts who found the *AccessToday* observation protocol to be "appropriate and comprehensive for gathering data on classroom observations" (p. 141). The *AccessToday* observation tool has seven dimensions that are used to rate the observed teacher. Those dimensions were connected to literature on formative assessment to prove content validity. The tool was reviewed by experts to also prove content validity. Observers conducted observations of math teachers. Most math teachers rated in the middle levels of proficiency for each dimension, which supported construct validity (Eddy, Harrell, & Heitz, 2017).

Interviews

The final opportunity to gather data was the semi-structured interview. The date and time of the interviews were mutually agreed upon. Due to numerous scheduling conflicts, Phoenix did not complete the interview. Patten (2009) stated there should be a protocol with written directions and predetermined questions. Before each interview, teachers were emailed to confirm the date and time. The email included the approximate amount of time the interview would take as most teachers wanted to do the interview during their planning period. Planning time for teachers was 90 minutes. Also included in the email was a reiteration that everything teachers share is confidential and there would be approximately 10 questions (see Appendix E). Due to numerous scheduling conflicts, Phoenix did not complete the interview.

I began the interview by thanking the teacher for their time and for being part of the study. The informed consent was again reviewed, and an additional copy was offered. All teachers declined the additional copy. Each teacher was told there would be approximately 10 questions and the interview would be recorded. I prepared my recording device and the interview began. I took notes during the interview, allowing me to note where further explanation was needed and additional questions to be asked. Teachers were comfortable sharing, even when their views did not align with their school or the district. Most interviews took place during teachers' planning period and were 15 minutes or less. The interview ended with me again thanking teachers for their participation and jokingly saying I was now out of their hair. All teachers invited me back into their classrooms at any time.

During the interviews, my field notes documented nonverbal cues that could not be recorded, as well as notes on ideas that were probed further with the participants. Transcription of the interviews cannot convey the participant's feelings, voice inflection, nor nonverbal communication. I used field notes to note those things that were not conveyed through transcription of the interviews.

As each interview was completed, the interviews were listened to several times, and then transcribed by the researcher. The interviews were listened to again, while following along with the transcription and field notes. A member check was completed where the transcriptions were shared with the teacher. The teacher was asked to inform me if anything was misrepresented. All teachers replied that the transcripts were accurate. As noted previously, the transcripts were coded.

The semi-structured interviews allowed me to ask additional questions for clarification, re-word questions, and ask probing questions to explore information revealed by the participant

(Patten, 2009). The individual interviews were an effective way to address the research questions and were better suited for individuals hesitant to speak as well as those who are comfortable sharing their ideas (Creswell, 2005).

It was important that rapport was established with the participants. As previously stated, I am employed in the school district, which could make participants feel uncomfortable and uneasy about answering questions truthfully, especially if their thoughts do not align to district and school expectations. Participants were reminded that their responses, as well as all data collected for this study, were confidential. Teachers' participation was voluntary and could be stopped at any time without adverse consequence. Participants were reminded that their participation informs research on teachers' beliefs about, and use of, formative assessment at the middle grades level in mathematics, which is integral in the kindergarten to twelfth grade continuum.

Data Analysis

The process of analyzing the data began while data was still being collected. The data gleaned from the questionnaire informed subsequent data collection. Charmaz (1996) stated that, "Simultaneous involvement in data collection and analysis means that the researcher's emerging analysis shapes his or her data collection procedures" (p. 31). The data from the questionnaire informed some of the formative assessment activities I looked for in the classroom observations and questions asked during the interviews. The questionnaire revealed that teachers value and use questioning frequently with their students. As I observed classrooms and interviewed teachers, she looked for examples of questioning and how teachers used it with students to learn where they are in relation to the learning target. Thus, questioning emerged as a theme from the

data collection across multiple data sources. I was attuned to what happened in the environment I was studying (Charmaz, 1996).

I focused on what participants were doing to derive meaning from their actions (Charmaz, 1996). This study considered the relationship between teachers' beliefs about and use of formative assessment. Teachers believe in and value formative assessment; however, their use of it does not always align with their beliefs (Büyükkarci, 2014). I used the Theory of Planned Behavior to see how teachers' intentions informed their actions (Ajzen, 1991), and to determine why the behavior happens. Classroom observations and interviews allowed me to investigate why actions did not align to values for formative assessment.

Charmaz (1996) noted that when researchers study their data, they “learn nuances of your research, participants' language and meanings” (p. 36). Each interview was recorded. The audio recordings of the interviews were listened to in their entirety. The recordings were then transcribed. The recordings were reviewed several more times and compared to the transcription to insure nothing was missed. The transcriptions were reviewed several times. As I have experience with formative assessment, it was important to insure my thoughts and feelings did not influence the information gleaned from the data.

Field notes from classroom transcriptions of interviews were first reviewed line by line and summarized or coded. This process made me see the data differently and not make assumptions about the data (Charmaz, 1996). Once completed, the line-by-line summaries allowed me to see larger categories. As those categories emerged they aligned with information gleaned from the questionnaire and *AccessToday* Observation Protocol. This iterative process insured no new themes emerged and insured the themes accurately reflected the data (Polkinghorne, 2005).

Data Alignment

As the research was collected and simultaneously analyzed, the data began to answer the research questions. Teacher responses to the questionnaire began to reveal teachers' beliefs about formative assessment. Classroom observations revealed how teachers enact formative assessment with their students and the formative assessment activities they used. Below, each research question is shared along with the data sources used to answer the research questions.

How do middle school math teachers define formative assessment and on what are their definitions based? Classroom observations revealed how teachers enacted formative assessment in the classroom, lending insight into how they defined formative assessment. The semi-structured interview revealed themes and commonalities in teachers' definitions of formative assessment, including the bases for the definitions. Interviews also confirmed what was noted in the classroom observations. Math teachers' educational preparation and participation in professional development, including the Math Design Collaborative, may have influenced their definition of formative assessment. This may be related to the fact that the district employs a curriculum specialist who specializes in math and science, who regularly works with teachers on formative assessment activities.

Do teachers' value of formative assessment relate to their use of formative assessment in the classroom? The questionnaire provided initial insight into teachers' self-reported value and use of formative assessment. This very important research question sought to reveal why the use of formative assessment in the classroom does not always align to teacher's value of it. A question of interest was to determine if participants' self-perceived use of formative assessment aligned to my discovery of use of formative assessment in classroom observations. Participants'

responses to interview questions revealed why use of formative assessment does not align to their value of it.

How well aligned are teachers' definitions of formative assessment and the ways they enact it in the classroom? The interview with participants yielded information on whether they truly understood formative assessment. The interview segued to asking teachers to expand on the basis of their definition of formative assessment. The interview and observations generated information on participants' use of formative assessment and whether they understood formative assessment activities. This research question also provides ideas for further research.

A diagram of the data sources used to answer the research questions are noted in the Table 4 below. The table shows the primary data sources used, however all data sources – questionnaire, classroom observations and interview – yielded data to answer all research questions.

Table 4
Data Sources Matched to Research Questions

Research Question	Primary Data Sources Used
How do middle school math teachers define formative assessment and on what are their definitions based?	Classroom Observations Semi-structured Interviews
Do teachers' value of formative assessment relate to their use of formative assessment in the classroom?	Questionnaire Classroom Observations Semi-structured Interviews
How well aligned are teachers' definitions of formative assessment and the ways they enact it in the classroom?	Classroom Observations Semi-structured Interviews

Limitations

Limitations on the data collected were related to participants' willingness and ability to participate, as well as their understanding of what is being asked. Participants' willingness was ensured as participation in the research study was voluntary. When participants decided not to participate or discontinued their participation, there were no adverse consequences. One teacher declined to participate in the study. Phoenix, a grade eight teacher, did not complete the interview part of the study due to continued scheduling conflicts.

Participants' understanding of and ability to complete the survey and answer interview questions was assumed. As the math teachers at FAMS participated or are participating in the MDC professional development, and some teachers participated in the NC FALCON professional development modules, it was assumed that they were familiar with and had some understanding of the term "formative assessment." Participants were asked to complete the survey questions individually and were interviewed individually.

As explained in *The Role of the Researcher*, I am employed in the same district as FAMS, but diligently worked to form a trust with the participants, and assured them the information they shared would remain confidential.

Delimitations. This case study focused on one middle school, with seven math teachers in grades six through eight. The small size of the case provided a focused view of teacher perspectives in a single middle school but also reflected common experiences and perspectives among teachers. The findings of the study are therefore not necessarily generalizable to the literature on formative assessment more broadly but instead contributes an initial description of middle school teachers' beliefs and use of formative assessment. In addition, I focused on the *teacher* as actor in formative assessment and did not consider peer and student components. That

is, the study focuses strictly on teacher actions and the external feedback occurring in the classroom between teacher and students and does not investigate how formative assessment works among peers or through a student's internal feedback.

Trustworthiness

Baxter and Jack (2008) stated "...there is no one correct way to report a case study" (p. 555). I have attempted to provide adequate details of the data collection and to report the findings in a manner that is concise and understandable. When developing themes, they needed to appear in more than one data source to be included. For example, as subsequent chapters will reveal, feedback was an important part of the formative assessment process for teachers. The importance of feedback appeared in the questionnaire, classroom observations and the transcribed interviews.

Baxter and Jack (2008) also stated that researchers should "plan for opportunities to have either a prolonged or intense exposure to the phenomenon under study within its context so that rapport with participants can be established" (p. 556). All data collection occurred in the school setting, which is the context within which the phenomenon occurs. As I was employed in the same district as the teachers, rapport with some teachers had been established before the study began. The nature of classroom observations required them to be conducted in the teacher's classroom. The initial meeting and questionnaire were conducted at the school, and interviews were conducted in the teachers' classroom.

Every effort was made to ensure trustworthiness and credibility of the data. As I has experience in the use of formative assessment, I worked to make sure my knowledge and experience did not skew the data analysis in any way. However, my knowledge may have strengthened the study, allowing me to examine the data for vital elements while conducting the

study. While protecting the confidentiality of the participants, I reached out to colleagues familiar with this type of methodology and shared interpretations of the data. Their perspective sometimes provided a different lens to view the data and also confirmed my analysis and added validity.

Summary

This chapter described the methodology used for this case study, data collection instruments and data analysis. The use of a case study aids in understanding the link between teachers' beliefs about formative assessment and use of it as the study took place in an authentic context. Formative assessment can positively affect student performance on summative assessments (Black & Wiliam, 1998). If teachers utilize formative assessment with their students, they can see performance gains with their students. The relationship between teachers' beliefs about and use of formative assessment is optimal to comprehend. To understand the link between beliefs about and use of formative assessment, the study was conducted in the teachers' natural environment (their classroom). Through the use of a questionnaire, classroom observations and interviews, I was able to collect data to answer the research questions. The next chapter shares the results of the research.

Chapter IV: Results

This study examined the relationship between teachers' beliefs about and use of formative assessment in the middle school math classroom. The following research questions guided this study:

1. How do middle school math teachers define formative assessment and on what are their definitions based?
2. Do teachers' value of formative assessment relate to their use of formative assessment in the classroom?
3. How well aligned are teachers' definitions of formative assessment and the ways they enact it in the classroom?

To answer the research questions a case study design was employed. Six math teachers, from a western North Carolina middle school participated in the study. The teachers completed a survey at the beginning of the study to describe how they value and use of formative assessment.

Teachers chose a class to be observed for the study. Each class was observed two times. Lastly, teachers were individually interviewed. Five of the six teachers participated in these interviews.

After teachers completed their Formative Assessment questionnaire, the first pieces of data were generated. As this data was reviewed and initially analyzed, it began to shape the additional data that was collected. The results from the questionnaire were the first window into seeing the relationship between teachers' beliefs about and use of formative assessment.

Charmaz and Belgrave (2007) shared that simultaneous involvement in data collection and analysis shapes data collection. As I reviewed the results from the questionnaire, I began to look for certain formative assessment activities in the classroom observations the teachers deemed valuable and used frequently. As the observations were completed, they confirmed data from the

questionnaire and shaped how I would expand upon the questions that would be asked in the interview.

Before data collection began, there were no pre-conceived notions of what would be revealed. As the data were analyzed, themes were revealed that were common across all the data sources. Charmaz and Belgrave (2007) stated that, “the researcher [derives] his or her analytic categories directly from the data, not from preconceived concepts” (pg. 32). Teachers indicated on the questionnaire that they valued feedback. As a result, during classroom observations, I looked for how teachers generated feedback, how they used the feedback they received, and how often they generated feedback. The interviews lead me to ask questions to understand teachers’ beliefs about feedback. Data analysis drives the data collection (Charmaz & Belgrave, 2007).

Utilizing the constant comparative method, I compared themes with those found in previous data (Glaser, 1965). Those themes were the same, and confirmed my analysis. The ways data were collected and the location (school) were chosen to reveal real results about teachers’ beliefs about and use of formative assessment. I believed a questionnaire would reveal teachers’ thoughts about formative assessment. The classroom observation would show teachers in their natural environment and could confirm what teachers shared in the questionnaire and reveal how they enact formative assessment with their students. Finally, the interview would let me to delve into why teachers believe what they do about formative assessment and why they enact it in the ways they do.

This chapter begins with a description of the information derived from each data collection procedure. The presentation of results includes themes common to the survey, observations, and interviews, as they provide answers to the research questions.

Formative Assessment Questionnaire Results

Once teachers agreed to participate in the study, the *Formative Assessment Questionnaire* (Appendix C) was used to understand how teachers value formative assessment and how often they use its strategies in their classroom. The first two questions on the survey were open-ended, and asked teachers to respond to “Assessment is working well” and “Assessment hinders.” When asked to respond to the statement “Assessment is working well,” two teachers referenced feedback. Blaine stated, “when it [assessment] accurately and quickly gives feedback to the teacher and student about what the student has learned.” Other teachers noted that assessment works well when it allows them to determine student learning, areas of misunderstanding and where students are in their learning.

Responses to the statement “Assessment hinders” question included that it is time consuming and takes a lot of planning. Storm said that assessment hinders “the ability of teachers to explore the curriculum in outside the box ways. Some students do not perform on assessments but are very intelligent and can perform the tasks required.” It should be noted the questionnaire is titled “Formative Assessment”; however, the statements begin with only the word “assessment.” Survey questions were not explained for teachers.

The survey had 30 questions for respondents to answer, separated into four sections. Each question asks the respondent to determine how highly they value the strategy. Respondents have the following choices: A = Very Valuable; B = Valuable; C = No strong view; D = Of little value; and E = Of no value. Respondents must then determine how often they use the strategy by choosing one of the following responses: 1 = Most lessons; 2 = Most days; 3 = Weekly; 4 = Termly; and 5 = Never. To describe teacher responses, mode, a measure of central tendency, was used. Mode is the answer that appears most. When half of the respondents had one

response and half had another response, both responses are listed. In the event there is no mode, responses were described.

The first section of the survey asked teachers how they involve students in their own learning. Table 5 shares results of the strategies in this section of the questionnaire.

Table 5

Formative Assessment Questionnaire: Involving Pupils in their Learning ($n = 6$)

	How highly do you value the following strategies?	How often do you use the following strategies?
	Mode	Mode
1-Telling pupils what you hope they will learn and (sometimes) why they are learning it	A	1, 2
2-Inviting and building on pupils' contributions	A, B	1, 2
3-Setting up tasks designed to enable pupils to "get on" by themselves	A	3
4-Getting pupils to collaborate in groups on a joint outcome	A	3
5-Spurring pupils on by making encouraging but specific, focused comments, e.g. they are on the right lines and in what way	A	1, 2
6-Getting a pupil to help another pupil	A, B	2

Note: A = very valuable; B = valuable; 1 = most lessons, 2 = most days; 3 = weekly.

In this section, and shown in the Table 5 above, all teachers rated questions one, three, four and five as very valuable. All teachers rated questions one, two, four, five, and six as valuable or very valuable. Except for questions three and four, teachers reported they utilized the strategies for most lessons or on most days. Teachers felt the strategies in questions three and four were very valuable but used them only weekly. Blaine had no strong view of question three (creating a task to help students be independent in their learning). They utilized the strategy weekly. Parks and Storm also utilized this strategy weekly but found the strategy to be valuable or very valuable. Strategy five related to giving students encouraging, but specific and focused, comments. Parks found this to be very valuable but utilized the strategy just weekly. Strategy six focused on students being a reference for each other. Again, Parks found this to be a valuable strategy but used it only weekly. The next section of the questionnaire dealt with teachers' beliefs about and use of modeling quality for their students.

Strategy four of the formative assessment framework (see Figure 1), is using students as resources for each other. Modeling quality may involve students being able to see, from their peers, what quality looks like. The teacher can also demonstrate what quality looks like for the student. Table 6 below shows how teachers' value and utilize strategies related to modeling quality.

Table 6

Formative Assessment Questionnaire: Modeling Quality ($n = 6$)

	How highly do you value the following strategies?	How often do you use the following strategies?
	Mode	Mode
1-Choosing and showing pupils examples of pupils' work for learning purposes	B	3
2-Getting a pupil to show you how s/he did something	A	1
3-Getting a pupil to demonstrate to the class how s/he did something	A, B	None
4-Getting a pupil to suggest ways something can be improved	A, B	3
5-Providing formats or structures for writing or recording findings	A	None
6-Showing pupils a range of other pupils' work to make a judgement about performance	B	4
7-Showing pupils a range of other pupils' work to make a judgement about progress	B	4
8-Showing pupils a range of other pupils' work to model (or exemplify) criteria	B	4

Note: A = very valuable; B = valuable; 1 = most lessons; 3 = weekly; 4 = termly.

Teachers felt strategies one, two, three, and four, of this section were valuable or very valuable as shown in Table 6 above. Indigo had no strong views of strategies five, six, seven and eight.

Even though most teachers saw the strategies in this section as valuable or very valuable, they

employed them only weekly or even just termly. Strategy two was utilized by most teachers on most days. Therefore, teachers realize students need to know what quality looks like yet, overall, do not model it regularly.

Feedback is an integral part of formative assessment as it improves student learning and achievement (Nichol & MacFarlane-Dick, 2006; Saddler, 1989). This section of the survey asked teachers to rate strategies related to feedback and share how often they use these strategies. The modes of teacher responses are included in Table 7 below.

Table 7

Formative Assessment Questionnaire: Giving Feedback ($n = 6$)

	How highly do you value the following strategies?	How often do you use the following strategies?
	Mode	Mode
1-Using probing questions to diagnose the extent of the pupil's learning	A, B	2
2-Analyzing completed work to work out why a pupil has or has not achieved	A, B	2
3-Giving rewards only when achievement is satisfactory for that pupil (with specific comments referring to pupil's success)	None	2
4-Expressing approval when achievement is satisfactory	A	2
5-Making a conscious decision to avoid saying a pupil is wrong	A	None
6-Telling pupils what they have achieved with specific reference to their learning	A	3
7-Telling pupils what they have not achieved with specific reference to their learning	None	3
8-Describing why an answer is correct	A	1, 2
9-Specifying a better/different way of doing something	A	1
10-Writing an evaluative note on a pupil's work for the pupil	A	3

Note: A = very valuable; B = valuable; 1 = most lessons; 2 = most days; 3 = weekly.

Strategies one and two were rated as valuable or very valuable by all teachers. Teachers utilized strategy one on most lessons or most days. While most teachers also utilized strategy two on most lessons or most days, one teacher utilized this strategy only weekly. Parks, Blaine and Declan felt strategy three was valuable or very valuable, while Indigo and Phoenix felt no strong view for this strategy and Storm had little value for the strategy. Those who felt strategy three was valuable or very valuable utilized this strategy on most days. Other teachers utilized this strategy weekly or never.

Though strategies four, five, and six were rated as very valuable by most teachers, Phoenix had no strong view on strategies four and five. These strategies were utilized during most lessons or most days, except for strategy six, which was utilized weekly by most teachers. Parks, Declan, Phoenix and Storm ranked strategy seven as valuable or very valuable, yet Declan and Phoenix only utilized this strategy weekly. Again, four of the six teachers felt strategy eight was very valuable, with the remaining rating this strategy as valuable. All teachers utilized strategy eight in most lessons or on most days. Five of six teachers felt strategies nine and ten were valuable or very valuable. Only Parks felt strategy nine was of little value. Strategy nine was used by five teachers on most lessons or most days. While valuable to most teachers, strategy ten was utilized just weekly or termly by most teachers.

When students are able to assess their own learning, they are able to see where they are in relation to the learning goal. Students may feel better about their progress and may be more apt to persist in successfully reaching the learning target (Schunk, 1991). Table 8 (see below) focuses on strategies related to self-assessment and shows how teachers value and utilize the strategies with their students:

Table 8

Formative Assessment Questionnaire: Self-Assessment ($n = 6$)

	How highly do you value the following strategies?	How often do you use the following strategies?
	Mode	Mode
1-Getting pupils to suggest ways they can improve	A	3
2-Negotiating a route to improve something	B	3
3-Providing time for pupils to reflect and talk about their learning	A	None
4-Getting students to review their own work and record their progress	B	None
5-Helping pupils to understand their achievements and know what they need to do next to make progress	B	3
6-Providing opportunities for pupils to assess their own and one another's work and give feedback to one another	B	3

Note: A = very valuable; B = valuable; 3 = weekly.

The majority of teachers found the strategies to be valuable or very valuable. Indigo had no strong view of strategy one and four, while Parks had no strong view of strategy two. Most teachers utilized strategies one and two on most days or weekly. The use of strategy three was evenly split between the six teachers, with the same number incorporating the strategy during most lessons, most days and weekly. The majority of teachers incorporated strategy four with most lessons or weekly. Blaine, Indigo and Storm utilized strategies five and six weekly with a

mixture of usage among other teachers. Once the surveys were completed, each teacher was observed twice.

***AccessToday* Observation Results**

Once the surveys were completed, each teacher was observed twice. Teachers chose a class to be observed and the dates for observation. I used field notes to record what I saw related to formative assessment during the observation. Once the observation was complete, the notes were reviewed and transferred to the *AccessToday* observation tool. As already noted, this tool was created to be used in middle and high school math classrooms (Eddy, Harwell, & Heitz, 2017). The six areas as core constructs of this formative assessment observation tool are learning target, question quality, nature of questioning, self-evaluation, observation of student affect, instructional adjustment and evidence of learning. Each construct allows the teacher to be rated as a novice, apprentice, practitioner, or master (see Appendix H). The discussion of results of the observations is organized by the constructs of the observation tool.

Learning Target

A teacher who demonstrates master level with learning targets “states, writes and restates objective(s) throughout the lesson. Students write down the learning target” (Eddy, Harwell, & Heitz, 2017, p. 146). In this district all teachers are expected to have the learning target visible for students. All teachers were rated as an apprentice during the first observation. Most teachers were also rated as an apprentice on the second observation. Indigo and Storm were rated at the practitioner level on the second observation. During my second observation of them, they referenced the learning target several times, re-stated the learning target and stopped to make students write the learning target. Students in Indigo’s class were required to state the learning target in their own words. All teachers had the learning target written on the board and verbally

shared the target with students. All teachers had the learning target written in the classroom and verbally stated the target at some point during the lesson, usually at the beginning of the lesson. It was noted that no teacher re-stated the learning target during the observation.

Question Quality

A master teacher, in this construct, “consistently and appropriately uses questions to scaffold instruction” (Eddy, Harwell, & Heitz, 2017). Scaffolding is described as “supporting the learner’s development and providing support structures to get to the next stage or level” (Vygotsky, 1978, p 176). In this construct, questioning is used to provide feedback to move the learner forward, which is strategy three of formative assessment theory (Figure 1). Most teachers were rated as practitioners in this construct for both observations. Parks and Phoenix were rated at the master level for one of their observations. They generally used questions effectively to scaffold instruction. When students were not clear in their responses, teachers asked probing and leading questions to help the student understand without explicitly stating the answer. There were two teachers rated as masters in this area. When introducing the vertical line test to determine if a graph is a function, Phoenix reviewed the characteristics of a function, the methods students used previously to determine a function, introduced the vertical line test to determine if a graph is a function, did some examples with explanation and asked students to work together in pairs to determine if some graphs were functions based on the vertical line test. The conversation between a student and Phoenix went as follows:

Student: I’m so confused right now. *The teacher goes to the student pair and asks the student to draw several vertical lines on the graph.*

Phoenix: How many times does each line touch the graph?

Student: Only one time. *The student gives the teacher a confused look and hunches their*

shoulders.

Phoenix: Pick five ordered pairs from the graph and write them down. *The student does this.* What do you notice? Think back to what we discussed yesterday.

Student: OK...each x goes to a different y.

Phoenix: That is correct. What does it mean?

Student: It's a function?

Phoenix: Yes. *Teacher draws a horizontal parabola and asks the student what the y-value is when x equals 2.*

Student: There are two y-values, 4 and -2. It can't be a function.

Phoenix: Correct. Draw a vertical line through the graph. What do you notice?

Student: The line hits the graph two times. So...if it's a function the line only hits it one time?

Phoenix: You got it.

This conversation between teacher and student led the student to an understanding by building on what they already knew to create new knowledge. Phoenix used questions to see where the student was in their learning and moved the student to understanding. When Phoenix saw that students did not have a firm understand, instruction was re-directed to address misunderstandings, thus demonstrating the importance of making instructional decisions based on formative assessment.

Nature of Questioning

Questioning generates feedback, which allows the teacher to determine any areas of misunderstanding and where the student is in their learning (Sadler, 1989). This construct revolves around teachers' use of questioning to determine problems in student understanding. A teacher

rated at the master level consistently and appropriately uses wait time and questioning effectively to diagnose problems with learning and improve instruction. On all observations, teachers were generally rated at the practitioner level, meaning they generally used wait time and questioning effectively to diagnose problems with learning and improve instruction. Storm was rated as an apprentice in this area, for both observations. Storm asked surface level or yes-no type questions. Absent were questions that probed to reveal student understanding. Other teachers were skilled at using questioning to get feedback on where students are in their understanding and utilized the MDC lessons which guided teachers in the questions to ask. I also believe the experience of most teachers has allowed them to refine and polish their questioning skills.

Self-evaluation

It is important for students to not only be resources for each other, but to become owners of their own learning (see Figure 1). To receive a master rating for this construct, teachers should allow students to use a variety of strategies and tools to self-evaluate in an effort to regulate and improve their own learning. These could include student-designed strategies and tools such as traffic lights, check lists, rubrics, drawings, a self-assessment inventory, journaling and/or a reflection statement. All teachers in both observations were rated at the apprentice level (meaning generic self-evaluation strategies or tools were employed but not tied explicitly to the regulation and improvement of student's self-learning).

In one class Storm asked students to state on their paper how they felt about the problem they just solved. Storm whispered to me that this is how they work with students to evaluate their learning. The teacher was attempting to lead the students in a meta-cognitive exercise to become conscious of their thinking. This exercise is not tied to students' evaluation of their learning on the topic discussed in class. During the observations, Indigo asked students to take an equation

and draw a picture to represent the equation. The teacher then randomly asked students to explain their drawing to the class. As the questioning progressed, other students adjusted their own drawings as they better understood the equation. They used their drawings and their peers' explanations to evaluate their own learning. Indigo used an avenue students could access by having them draw a picture to represent their understanding. As students listened to their peers explain their own drawings, students evaluated their learning by evaluating their pictorial representation of the equation.

Observation of Student Affect

To be rated at a master level on this construct, teachers are sensitive to student affect, collecting evidence through body language, facial expression, and/or class work, and adjusting instruction accordingly. Teachers demonstrate expertise and polish in balancing content with student affect. Students are active learners when they interact regularly. While most observations rated teachers at the apprentice level, there were some who were solidly rated at the practitioner level. Those teachers were attuned to their students. For example, Parks was building on the previous day's lesson of solving equations. The current lesson involved using equations to solve word problems. Parks went through several examples, asking students questions to gauge understanding. When students were given their first problem to do independently, Parks noticed that once students read the problem, most had a bewildered look. Parks stopped everyone and begin asking questions such as, "What is the first sentence telling us?," "what is the last sentence asking us to find?," and "what is our unknown?" It does not always take a class assignment to realize that students do not understand or have mis-conceptions.

Instructional Adjustment

Teachers should adjust instruction to meet the needs of their students in order to move learning forward. A master rating on this construct means a teacher consistently and effectively uses adjustments during instruction. Most teachers were rated at the practitioner level. As this is a high performing school, I was surprised that no one, during either observation was rated at the master level. FAMS has consistently earned high school performance grades and teachers are regularly rated as highly effective with their students. Storm was rated at the apprentice level during both observations. Blaine, a newer teacher was very good at adjusting instruction. The class had many students who struggled mathematically. When teaching a lesson on solving equations, the students had begun to master the concept, yet when decimals were introduced the students began to have problems. This was a calculator inactive lesson. Blaine stopped the lesson and said, “Hey guys, let’s do a short re-cap on decimals. I know you got this.” The teacher reviewed multiplication of decimals and the lesson continued.

As students were working on solving a system of equations graphically, Phoenix noticed that students were not re-writing the equations in slope-intercept form but were plugging in numbers to find ordered pairs. The teacher began asking questions of students, determined the issue, and worked with students on re-writing the equations properly and using the equation to graph the line. In other classes, teachers continued instruction instead of adjusting instruction to address misunderstandings.

Evidence of Learning

Teachers must know their students are learning and there must be ongoing evidence of learning. A master rating on this construct indicates there is evidence of learning for almost all of the students for the following indicators: all-student responses, individual responses and artifacts

of learning. While most observations resulted in a practitioner rating, other ratings were evenly split between apprentice and master. Most teachers had students produce several evidences of learning throughout the lesson, whether it was group work, answering questions, classwork or homework. Teachers knew where most students were in their learning. After the first observation, Indigo was planning to give a unit test in a few days. As I spoke with Indigo, they shared with me the students' expected performance. When I returned for the second observation, I remained after class to follow up with the teacher on student performance on the test. Indigo was accurate in their predications and worked with those students who did not perform well to strengthen weak areas.

Individual Interviews

Before each interview, a date and time was mutually agreed upon by the teacher and researcher. Before each interview I emailed the teacher to confirm the date and time, as well as let the teacher know there were only 10 questions. The questions were not shared before the interview, as I did not want the teachers to prepare responses. After each interview, I transcribed the recording. The transcripts of the interviews were read, reviewed, summarized, and analyzed.

Each interview consisted of the same ten questions (see Appendix E). As it was a semi-structured interview, I was able to ask teachers questions to get them to expound upon responses and get clarification from their questionnaire responses and classroom interview. The questions focused on teachers' definition of formative assessment, its benefits, and impact on summative assessments. The data gleaned from these interviews are structured in this way.

Definition of Formative Assessment

This study defined formative assessment as the process of generating feedback on what has been taught in order to improve student learning and achievement (Nichol & Macfarlane-

Dick, 2006; Saddler, 1989). All teachers described formative assessment as giving them feedback. Most felt the feedback allowed them to know where students were in their learning and guided them on the next steps. Indigo stated “I can get a very good handle on the kids where they are ...just some way of grasping where they are and using data to move forward.” Teachers felt that if they knew where the students were in their learning, they could pace instruction.

When asked about their definition of feedback, Parks stated it was “just continually getting feedback from the students. Kinda see where they are at on a daily basis. Quick little snapshots.” Storm commented that formative assessment was a way to see if students had reached proficiency on a topic. As this research took place near the end of the school year, teachers were concerned about student performance on end-of-year summative assessments.

All teachers stated their definition and understanding of formative assessment had changed since they began teaching. Most stated they initially they felt formative assessment was a test to be given. Indigo shared, “I thought you just taught, took a test, taught, took a test. Now I realize there’s so many ways to assess as you teach.” Initially, teachers stated they only focused on the word “assessment” and used tests or quizzes to determine where students were instead of using quick checks to see where students were in their learning. Declan noted:

In the beginning I would say that, ummm, since beginning teaching I would use it and say that this is a unit test and I would just have the grade and just go to the next thing. Now I frequently use activities such as small group, talk to your partner and journaling to see if students are understanding the little concepts that feed into the big learning goal.

Several teachers noted that formative assessment was a continuous process of assessing their students. Early in their career they felt that checking for understanding at the end of each class

was enough. Parks stated, “I used to think if you did fist-to-five at the end of class once in a while, that was good. Now I see the circle of learning and always check and re-check.”

Teachers were asked what caused the shift in their definition on formation assessment. They said professional development and collaboration with other teachers. Parks noted that veteran teachers, and their principal, were instrumental in shifting their definition. Parks noted that early in their career a veteran teacher constantly posed the questions, “what are you teaching, what are they learning, have they got it, what are you going to do if they haven’t got it,” in their department meetings. It made them realize that checking for learning at the end of class or using a quiz at the end of a unit was not enough. The teacher learned, from their peers and professional development activities to use to check student learning and pace instruction. Parks stated, “if I’m teaching my heart out and the kids aren’t getting it, what is it worth? There is no benefit to anyone.”

Benefits of Formative Assessment to the Teacher

Each teacher praised of formative assessment and how it helps instruct their students. Teachers noted the benefit of feedback and how it helps them re-direct and even inform approaches in the next class. Parks shared,

I think that it helps me be able to regroup and teach them in a different way. A lot of times it’s when we are talking and they ask a question and I realize I have to approach this in a different way and show it in a different way.

This practice was evident during both of Parks’ classroom observations. Parks used the feedback from students to guide the lesson and move them towards the learning goal. Declan stated, “it lets me know – do I need to go back and re-visit certain things, slow down, do I need to make adjustments? Did we meet the learning goal?” Declan knew what student performance needed to

be in order for them to successfully attain the learning goal. Declan used feedback to know where the students were in their learning. In discussing the benefits of formative assessment, Indigo stated “If I get 17 different answers for a one-step equation, I certainly can’t move forward. On the other hand if formative assessment activities are telling me they are getting it, then I quicken the pace in another class.” Teachers also noted that using formative assessment with students keeps them engaged in the lesson. They said they cannot write a lesson plan and teach the whole class; they must constantly assess to see if they are in the process of meeting the learning goal.

Benefits of Formative Assessment to the Student

Teachers were initially mixed in their thoughts on the benefits of formative assessment with their students. Parks felt that formative assessment lets students know it is alright to be wrong as long as they keep trying. Storm believed the benefits to students were really benefits for them, and stated,

It benefits students because it gives me an idea of where they are. Because I feel like I’m doing my job to go look and say hey this student isn’t getting this and it makes me aware and I therefore go back to help them.

When I rephrased question nine (see Appendix E), teachers expounded upon their thoughts. Most referenced their learning goal and making sure students understood the goal. They felt if students understood what the learning goal looked like, then they could compare where they were to where they needed to be, as Indigo stated,

When I go back to the learning goal throughout the class, the kids seem to ask more questions and better questions. This is my average class with some low students. As I go

back to that goal and talk about it, their questions are more on point and not all over the place. I think they are able to see what they do and don't understand.

Storm felt their students were maturing but not quite mature enough to take full ownership of their learning and stated,

If students take ownership of their learning it can be beneficial. They can say this is what I need to do to move forward. The benefits...we can get them in that mindset to say here we are and we want to move to here...and I think that would help.

The teacher commented they felt their students were on that journey of learning to own their learning.

Impact of formative assessment on summative assessment

Data collection for this study took place during the second semester of the school year, so teachers were very concerned how students would perform on their upcoming state End-of-Grade assessments. While teachers believed that formative assessment let them know where students were in their learning, many were not fully sure of its impact on the state summative assessments. Parks indicated, "yea, we'd like to say that everything we do with formative assessment will give us perfect validation of what we are doing is right. But...it is hard to know how it correlates to the EOG."

However, all teachers felt that formative assessment gave them an idea of their students' academic attainment. I asked teachers to approximate how many of their students they felt would be proficient on the EOG. Most teachers felt that between 60-70% of their students would demonstrate proficiency on the EOG math test. I then asked how they came up with that answer. Most teachers stated the formative assessment they do in class lets them know where their students are, as Indigo commented

I say 70 percent because as I do review questions and get into more integrated material, that's the amount of students who seem to have a grasp on the material. I use white board for students to show me their answers to questions, and I know who will be proficient, who might be proficient and who probably won't be proficient.

Teachers felt they were thoroughly teaching the curriculum but noted they do not have total control over students' performance on the state summative math assessment.

Findings

A thematic content analysis approach was used for this study. As the data were analyzed, including transcripts from the interviews, answers to the research questions were identified, including examples to support those answers (Burnard, Gill, Steward, Treasure, & Chadwick, 2008). The iterative coding process required the data to be reviewed multiple times to thoroughly to reveal themes and answer the research questions. The interview transcripts, questionnaire responses and classroom observation data were again reviewed (Polkinghorne, 2005). Words and phrases were reviewed, and similar phrases were combined to reduce the list to a manageable size (Burnard et al., 2008). Data were reviewed and analyzed several more times to answer the research questions. Responses to the questions surfacing in at least two of the three data sets were considered enough to answer research questions (see Table 4).

Once the classroom observations were completed, I noted two themes that emerged: *feedback* and *questioning*. The questionnaire revealed teachers found feedback very valuable and used it in most lessons. It was also shown that questioning was integral to student learning and used in most lessons. Classroom observations revealed that teachers were adept at using questioning to determine student understanding of concepts. They used the feedback received to move learning forward.

Themes already noted were confirmed. *Student learning* was an additional theme that was revealed from all three data points. Formative assessment is about student learning and moving it forward. The importance of student learning was revealed in the questionnaire, classroom observations and interviews. The last theme revealed was *Intent and Perceived Behavioral Control*. While investigating the relationship between teachers’ beliefs about, and use of, formative assessment in the middle school mathematics classroom, it was important to consider how teachers’ intent translated into use. Table 9 below shows the data points used to derive the core themes.

Table 9

Four Core Themes

Data Points Used to Derive Themes

Core Themes	Questionnaire	Classroom Observation	Semi-structured Interview
Feedback	X	X	X
Questioning	X	X	X
Student Learning	X	X	X
Intent and Perceived Behavioral Control		X	X

Note: An “X” indicates data were shown to help develop the core theme.

In the following sections, I discuss data from the questionnaire, classroom observations and semi-structured interviews to address the themes derived from the analysis.

Feedback

To move learning forward, teachers must know where students are in their learning. Formative assessment generates feedback on what has been taught in order to improve student learning and achievement (Nichol & MacFarlane-Dick, 2006; Saddler 1989). In this study, teachers’ exchanges with students created moments of contingency, or pivotal moments in the

learning process. Teachers utilized their exchanges with students to adjust instruction and meet student needs (Tovani, 2012). The formative assessment questionnaire revealed how much teachers valued giving feedback. Most teachers found the strategies in this section (see Table 7) valuable or very valuable. Teachers utilized the strategies on most lessons or most days. Strategy three of formative assessment theory is “providing feedback that moves learners forward” (Wiliam, 2009, p. 8). Classroom observations revealed teachers used the feedback they received from their students to understand where students were in relation to the learning target, and to move learning forward. Whether they used a quick formative assessment activity to elicit feedback, questioning or an assignment, teachers used the information gleaned to help students successfully reach the learning target. Semi-structured interviews also revealed that teachers value feedback. Most teachers mentioned they needed to know where students are in their learning, so they can know if they are on track with instruction.

Overall teachers indicated through their interviews, questionnaires, and classroom observations that formative assessment involves feedback to guide their instruction. Though most teachers did not mention the word “feedback” in their interview, their definition of formative assessment was based on the feedback they received from their students. Declan noted that formative assessment was “like an ongoing way to teach...always checking the pulse of individual students in your class.” The questionnaire indicated that teachers find giving feedback to be valuable or very valuable and use the majority of strategies during most lessons or on most days.

Teachers valued the feedback they received from their students. They did not reference the feedback they gave to their students, nor the feedback students received from each other. I cannot say that teachers did not value other types of feedback, just that it was not mentioned. As

students share in the responsibility for their own learning (Black & Wiliam, 2010), it is important they use feedback to know where they are in relation to the learning target (Nicol & MacFarlane-Dick, 2006). During a classroom observation, Indigo used a group activity that allowed students to use each other as resources. Indigo noted there is not always time for this and it can be difficult to keep students on task. Storm shared that students may not be mature enough to take responsibility for their own learning.

Questioning

One way to elicit the feedback needed to move learning forward is the use of questioning. This is a formative assessment activity (see Table 1) that can address all components of the framework (Garrison & Ehringhaus, 2007). Teachers are adept at using questioning, a form of discourse with students, to elicit feedback and move learning forward. Classroom observations revealed that teachers were rated at the practitioner or master level on all observations in the area related to question quality. Storm was rated at the apprentice level in this area. Teachers asked questions to not only gage if students understood a concept but also their depth of understanding.

The nature of questioning was also evident in classroom observations. Teachers used wait time to diagnose student learning and its depth (Garrison & Ehringhaus, 2007) in order to adjust instruction. Interviews showed that teachers valued the feedback they received from questioning. It allowed them to adjust instruction for the current class and subsequent classes. Interviews revealed that teachers know the value of questioning to the learning process. Blaine stated that formative assessment “helps me know if kids understand now, or do I need to re-teach and talk about this again.” In applying the Theory of Planned Behavior, teachers value the information revealed from questioning and are confident in their abilities to utilize questioning. They use it frequently to gage student learning and improve student performance (Ajzen, 2002).

Most teachers rated on the practitioner and master level in their nature of questioning. Teachers used wait time and questioning to determine areas of misunderstanding and used the information gleaned from questions to guide both classroom instruction and instruction with subsequent classes. During a lesson, Phoenix was discussing types of angles and properties of each. The conversation between a teacher and student was as follows.

Phoenix: What do we know about vertical angles? *No one answers. The teacher waits approximately five seconds before asking the next question.* What are vertical angles? *A student raises their hand.*

Student: They are angles on a cross. *The teacher draws a picture of two intersecting lines.*

Phoenix: Is that right? *The class responds "yes."* Who can point out vertical angles? *After a few seconds someone volunteers. The student goes to the board and marks the vertical angles.* Is this correct? *Some students respond yes.* OK. I can see you guys aren't totally sure about vertical angles. We are going to talk about them again. *The teacher then begins to review vertical angles with the class.*

Based on this interchange, the teacher realized that students do not fully understand vertical angles and their properties. After the class, the teacher told me this was not the lesson they had planned to teach. However, through the questions asked by students, it was evident the teacher needed to re-teach vertical angles. This would be background knowledge for upcoming lessons. Regularly during classroom observations, teachers used questioning to determine student understanding. Much to the surprise of students, one teacher, Storm, cancelled the homework assignment when they realized students did not have a grasp of functions. Storm replied "there's

no sense in you doing it wrong. We will work on this again tomorrow. That also pushes your quiz to Monday.”

The quality of teachers’ questions during the classroom observations was evident. Most teachers were rated as practitioner in this area. They used questions effectively to scaffold instruction. Teachers asked questions to determine students’ level of understanding and to inform whether remediation was needed or if they could continue with the lesson. Teachers also used questioning to help students answer their own questions:

Student: There is no solution! There is a mistake with this problem.

Storm: Rewrite the two equations in slope-intercept form. What do you see?

Student: *After a few seconds.* The slopes are the same.

Storm: Graph the lines. Where do they intersect?

Student: They don’t intersect. They are parallel lines.

Storm: When lines intersect, we get an ordered pair solution. If the lines don’t intersect, then...

Student: We don’t get a solution?

Storm: Correct. So what kind of lines do we have if we don’t get a solution?

Student: Parallel lines. So, parallel lines do not have a solution.

Storm: You got it!

Student Learning

The main focus of instruction is to improve student learning and achievement. Formative assessment has been shown to increase student achievement on summative assessments (Black & Wiliam, 1998). Teachers in North Carolina receive effectiveness ratings based on their students’ performance on end-of-year state summative assessments. The questionnaire, classroom

observations, and interviews revealed teachers know that formative assessment moves learning forward. NC DPI also knew the value of formative assessment when they created NC FALCON, an online professional development activity related solely to formative assessment. In an effort to increase student learning, the FAMS district has mathematics teachers at the middle and high school level participating in MDC professional development, related to teaching mathematics using formative assessment lessons. In the interviews, teachers referenced how formative assessment allowed them to know where students were in their learning. This information lets teachers know if re-teaching was needed, or if they were on the right track, and informed them how to proceed in subsequent classes.

The district is implementing the MDC, developed by the Gates Foundation. It has formative assessment lessons for teachers to use as part of the program (Duffy & Park, 2012). The district offers professional development sessions for teachers, and formative assessment is part of the offering. Teachers repeatedly referenced needing to know where the students are in their learning in order to get them moving in the direction towards the learning goal. Teachers were able to re-direct students who were not understanding the material and get them on track to reaching the learning target.

During the interview, Parks stated that formative assessment allows them to “get a very good handle on the kids where they are. It is some way of grasping where they are and using that data to move forward.” Declan said, “it’s an ongoing way to teach. I feel like you’re not teaching if you’re not having formative assessment, always checking the pulse of individual students in your class” and that formative assessment is “just continually getting feedback from the students...constantly trying to monitor to see where they are.” Teachers use feedback to know where students are in their learning. This information guided teachers in determining the flow of

their instruction for the class. Blaine stated, “formative assessment helps me monitor to see where the students are.” Parks stated that “if you’re not having formative assessment, always checking the pulse of individual students in your class, in order to gage pace and subject matter that you will not have direction for the next day.” As evidenced by the questionnaire, classroom observation and interviews, teachers’ definition of formative assessment was based on knowing where the students were in their learning and leading them towards the learning goal.

Intent and Perceived Behavioral Control

A teacher’s intent and perceived behavioral control had the most impact on whether a teacher used formative assessment with their students (Yan & Cheng, 2015). Teachers valued formative assessment and knew it was beneficial to both them and their students. Teachers knew its use gave them valuable insights into where students were in their learning.

In applying Ajzen’s Theory of Planned Behavior (1991), teachers’ attitudes towards using formative assessment is positive. Teachers believe in its value as they use it to guide their instruction. Teachers know they are expected to utilize formative assessment with their students. Parks noted that during PLC meetings the principal and a colleague always asks the following questions, “What are you teaching? What are they learning? Have they got it? What are you going to do if they haven’t gotten it?” Parks noted they must always question students to determine if they are understanding the intended learning target. Teachers, via participation in the MDC professional development and school expectations, understand they are to utilize formative assessment with their students and comply with the expectations, as they value formative assessment.

However, teachers were less convinced of its effect on student performance on end-of-year assessments. Storm stated that “at this point in the year we are focused on EOGs. Formative

assessment is great, but I don't know how it predicts performance on the EOGs. I'm judged by how students do." I believe teachers were confident in their ability to enact formative assessment, but many were not confident in its positive effect on student performance on summative assessments. As the end of the year approached, teachers were not as motivated to utilize formative assessment with students as they prepared for end-of-year assessments. The interviews took place later in the school year, after teachers completed the questionnaire and once classroom observations were finished. Teachers were beginning to revert to teaching test taking skills.

Summary

This study examines teachers' beliefs about and use of formative assessment in the middle grades mathematics classroom. This chapter provided results from the questionnaire teachers completed, classroom observations and semi-structured individual interviews. The core themes derived from the data analysis were elaborated. The Formative Assessment Framework (Black & Wiliam, 2009) and the Theory of Planned Behavior (Ajzen, 1991) provided the lens used to review the data collected. Based on the data collected, teachers' beliefs about formative assessment determined their use of it in their classroom. Implications for further research are included in the next chapter.

Chapter V: Conclusions

This study investigated the relationship between teachers' beliefs about and use of formative assessment in the middle school mathematics classroom. Through case study methodology, involving a questionnaire, classroom observations and semi-structured interviews, data was revealed to answer the research questions. Formative assessment, for this study, was defined as the process of generating feedback on what has been taught in order to improve student learning and achievement (Nichol & Macfarlane-Dick, 2006; Saddler, 1989). As teachers check for understanding, instruction can be immediately shifted to best benefit where students are in their learning and lead them to successfully attaining the learning target (Black & Wiliam, 2009). Ajzen's Theory of Planned Behavior (1991) shed light on the relationship between the value placed on a belief and acting upon it. To examine this relationship, the following research questions were posed:

1. How do middle school math teachers define formative assessment and on what are their definitions based?
2. Do teachers' value of formative assessment relate to their use of formative assessment in the classroom?
3. How well aligned are teachers' definitions of formative assessment and the ways they enact it in the classroom?

This chapter provides conclusions derived from the study. Findings about formative assessment are discussed, arranged by research question, and related back to the relevant literature. Limitations of this study are reviewed, and opportunities for further research are presented.

Analysis

The data from the questionnaire, classroom observations and semi-structured interviews revealed four core themes: feedback, questioning, student learning, and intent and perceived behavior control.

Classroom observations were conducted earlier in the spring semester and teachers were utilizing formative assessment with their students. Teachers seemed motivated to use formative assessment as it gave them feedback to move students towards the learning goal. Teachers' valued formative assessment was positive as revealed by the questionnaire, classroom observation and interviews. The school district and FAMS expected teachers to utilize formative assessment with their students. Teachers were required to have the learning target visible to students. The study shed light on teachers' beliefs about and use of formative assessment with their students.

Research Question One

How do middle school math teachers define formative assessment and on what are their definitions based? This study defined formative assessment as the process of generating feedback on what has been taught in order to improve student learning and achievement (Nichol & Macfarlane-Dick, 2006; Saddler, 1989). It has also been noted there is not one universally accepted definition of formative assessment (Akpan et al., 2012; Black & Wiliam, 2006; Moss et al., 2011). Classroom observations and interviews revealed that teachers have a narrow definition of formative assessment, which was the feedback they receive from students to guide instruction. Missing from teachers' definition was the feedback they give to students, as well as, the feedback students receive from each other during the learning process.

Classroom observations revealed that teachers applied feedback to determine where the students are in their learning. Teachers' questioning of students generated feedback that allowed them to address misunderstandings, redirect students, and lead them towards attaining the learning target. The learning tasks they created, and the questioning used to elicit feedback, provided evidence of the depth of student understanding. Teachers' definitions addressed strategy two of the formative assessment framework (see Figure 1), suggesting that feedback they receive from the student helped them determine how instruction will flow in the class. Garrison and Ehringhaus (2007) found that questioning allows the teacher to know the depth of student learning and can be quite beneficial for low achievers. Most of the classrooms observed contained mostly "students in the middle," with some lower achieving students. The teachers used the questioning to determine students' understanding of content. Teachers saw questioning and the feedback it generated, as the main characteristic of formative assessment. The data sources revealed how much teachers value questioning and feedback. Their definitions of formative assessment centered around the feedback they receive from students. Classroom observations revealed them using quick activities to generate feedback on student comprehension of what was being taught.

When interviewed and asked to articulate their definitions of formative assessment, teachers again referenced the feedback they receive from their students. Declan stated it is "a way to get a good handle on where the kids are...get a grip on what they have mastered in class...and use that data to move forward." As teachers shared their definition of formative assessment in interviews, their definitions aligned to the three questions teachers must answer to effectively use formative assessment: 1) Where are learners in their learning, 2) Where are they

going, and 3) What needs to be done to get them there (Black & Wiliam, 2009; Ramaprasad, 1983).

In interviews and classroom observations, teachers did not directly reference feedback the students receive from them. However, as teachers *interacted* with students, they provided feedback to the student on where they were in their learning, in relation to the learning goal. Students were able to determine where they were in their learning and how close they were to successfully answering the asked question and meeting the learning target. Based on the data from this study, I do not believe teachers' definitions of formative assessment included the feedback students receive from the formative assessment process. They were self-centered in their definition of formative assessment. I believe the emphasis on student performance on end-of-year summative assessments leads teaches to focus on knowing if students are learning and the dept of their learning. However, to a much lesser extent do they focus on students owning their learning and being resources for each other.

All data sources, and especially the classroom observations and interviews revealed, that teachers believe in the feedback they receive from the questions they ask students and they can use it to move students forward in their learning. Ajzen's (2002) research revealed that perceived behavioral control is one's belief about factors that may increase (or impede) the likelihood of performance. Teaches are confident in their questioning abilities and their ability to use feedback to move learning forward. The data lead me to believe that when teachers think about student performance, they were looking towards the end of the school year to the summative assessments.

Research Question Two

Do teachers' value of formative assessment relate to their use of formative assessment in the classroom? What teachers believe about learning influences what students learn, just as their beliefs about teaching influence how they teach (Pandhiani, 2016; Volante & Beckett, 2011).

The questionnaire, classroom observations, and interviews revealed that teachers value formative assessment. They know the use of it shows them where students are in their learning, and where they are in reference to successfully attaining the learning target. However, teachers' value of formative assessment does not always reflect their use of it.

There are aspects of formative assessment that teachers utilize more than others. Teachers are adept at using questioning to determine where students are in their learning and their depth of understanding. Teachers also value and use feedback they receive from their students to guide instruction, specifically the feedback generated from questioning. There are other aspects of formative assessment, though, that are used less frequently. A section on the questionnaire focused on modeling quality for students. As shown by teachers' responses to the questionnaire and Table 6, teachers value modeling quality for students. Most teachers believed the strategies in this section were valuable or highly valuable. However, for most questions, teachers employed these strategies only weekly or termly. For example, teachers value showing students their peers' work so they can make a judgement about their own performance. Nonetheless, most teachers only utilized this activity termly as evidenced in Table 6. During an interview with Indigo, I asked about formative assessment activities used. Indigo replied that they use activities that are easy and quick. I pressed about using students as resources for each other:

I try to use groups so that students collaborate. But it takes a lot of time to put students in groups, get them started and make sure they stay on task. As we get closer to the EOGs I

find myself just using questioning to figure out what the kids know and what I need to re-teach.

Based on the data from the study, I concluded that teachers' use of formative assessment aligns with their value of it in some areas, specifically questioning and feedback. The section of the questionnaire related to feedback (see Table 7) shows that teachers value or highly value all the strategies. Their use of the strategies occurs during most lessons or most days. This was also evident during classroom observations. In the areas of question quality and nature of questioning, teachers were rated at the practitioner or master level.

Teachers used questions effectively to scaffold instruction, diagnose problems with student learning and to improve instruction. Based on questionnaire data, teachers see the value in modeling quality for students and student self-assessment, as most rated all strategies in this area as valuable or very valuable. However, when the teachers rated their use of these strategies, they were not generally utilized for most lessons or on most days. As indicated in Tables 6 and 8 their use was only weekly or termly. Some teachers indicated they never utilized some of the strategies. In an interview, Declan stated the following about a Formative Assessment Lesson (FAL) from the MDC professional development.

I really like the FALs. They look for deep student understanding. They like for the students to talk to each other, write about what they learned, what they don't understand and stuff like that. It's good, but I just don't have time to do all of that and get through the curriculum before testing. The FALs aren't like what the students will see on the EOG.

Parks also stated, "you get so pressed for time, you don't always get to do the things like taking time to let students work together through a problem." North Carolina summative assessments

are multiple-choice and have very few open-ended questions. They also carry a lot of weight in how districts, schools and teachers are evaluated. Teachers want their students to perform well on these assessments and prioritize what they do in class with students accordingly, which may not always align with formative assessment strategies. Strategies four and five of the formative assessment framework (Figure 1) are not always evident. Teachers generally do not spend time allowing students to be instructional resources for each other, nor helping them to own their learning. I believe some strategies are not used due to perceived time constraints. To a lesser degree, teachers have not spent the time developing their use of some strategies as they have questioning to generate feedback. The interviews, classroom observations and questionnaire revealed teachers value the feedback they receive from questioning their students. Teachers use this feedback to guide their instruction and moving students towards the learning goal.

This study took place when teachers were readying students for the end-of-year summative assessments. Teachers were focusing more on test-taking skills and the rote learning that corresponds to summative assessments (Black & Wiliam, 1998). I wondered if the results would be different if the study was conducted at a different time during the school year. The district participates in state benchmark assessments, and local diagnostic assessments. Note the assessments are not used in an evaluative manner but yield valuable student data to inform instruction. I believe the results would be the same. Teachers feel there is always an assessment around the corner. While the district values formative assessment, they also value student performance on end-of-year summative assessments.

I believe that teachers' perceived behavioral control may impede their use of some parts of formative assessment. The data for this research was collected during the spring semester. This is the time of the school year that teachers begin to focus on the upcoming summative

assessments. One of the questions asked to teachers was their feelings on the impact their use of formative assessment will have on the upcoming summative assessments. Parks stated that through the use of formative assessment, “I’m teaching the students to check, re-check and check again. I’m hoping they will do that on the EOG.” Parks was unintentionally teaching students a strategy to own their learning and check their accuracy. Storm stated:

I know that formative assessment lets me know where the students are in their understanding, but I can’t predict how they will perform on the EOG. As we get closer to the EOG, I find myself focusing more on test taking strategies and skills. When I use formative assessment I am looking for deeper understanding. But, I’m judged on how my students perform on the EOG.

The summative assessments used in North Carolina consist predominately of multiple-choice questions. Teachers receive an effectiveness rating based on student performance on the EOG assessments from one year to the next.

I found it interesting that teachers believed in the value of formative assessment and knew it moved learning forward, yet they did not fully believe that its use would have a positive impact on student performance on end-of-year assessments. The behavior was student performance on end-of-year assessments, and teachers perceived that the use of formative assessment may not positively impact student performance. Teachers seemed to be missing the link between formative assessment and student performance on summative assessments (Andrade & Cizek, 2010). If formative assessment impacts student learning and moves learning forward, then it will also impact student performance on summative assessments (Black & Wiliam, 1998).

Teachers use certain aspects of formative assessment more than others, as revealed in the questionnaire, classroom observations and interview. They were adept at the use of questioning and asking the right questions to generate feedback to help them understand where their students were in the learning process. The questionnaire and interviews revealed that while teachers may value it, some aspects of formative assessment such as modeling quality (see Table 6) and using self-assessment for students (see Table 8), are not utilized as often with their students. The study has shown that though teachers find the use of formative assessment to be very valuable, but their use of it does not always mirror the value they report placing on it.

Research Question Three

How well aligned are teachers' definitions of formative assessment and the ways they enact it in the classroom? Moss, Brookhart, and Long (2011) said that formative assessment provides instantaneous information on where a student is in their learning, and teachers' definitions reflected this sentiment. The questionnaire revealed a window into how teachers value formative assessment strategies and use them in the classroom. The classroom observations revealed how teachers enacted formative assessment with their students, and the interviews shed even more light on teachers' beliefs about formative assessment. Teachers definitions about formative assessment centered on the feedback they generated from questioning and using that feedback to both understand where their students were in the learning process and move learning forward. The study found the ways teachers enacted formative assessment in the classroom aligned with *their* definition of it.

As teachers discussed formative assessment and what they do to enact it in their classroom, it centered around feedback they receive from their students and quick things they do to get feedback from them. Parks discussed using a fist-to-five activity in which students show

how well they understand what is being taught. Showing their fist means they do not understand, and showing all five fingers means they understand well.

While working on word problems with the class, Phoenix asked a student what the problem was asking them to solve. After the student shared their answer, Phoenix asked the students to put their thumbs up if they agreed and their thumbs down if they did not agree. Half of the students put their thumbs up. Phoenix then shared that the student was correct and reviewed the problem and what was being asked. Students were then asked, using thumbs up or thumbs down, to share if they understood the problem. There were only two thumbs down. The students were instructed to write and solve an equation to answer the question, while the teacher was able to then focus on the two students who did not understand.

In another class observation, the class had been working on solving one-step inequalities and were now solving multi-step inequalities. The interaction between the teacher and students follows:

Indigo: I am going to write an inequality on the board. Show your steps on your whiteboard and circle your answer. *The teacher writes the following inequality on the board, $7 - 3x \leq 23$. The students work on their whiteboard.*

Student: I'm stuck. *The teacher goes to the student and helps them work through the issue.*

Indigo: Thumbs up if you are finished. *Most students give a thumbs up. Sixty more seconds. After about a minute, hold up your white boards. Make sure your answer is circled. Students raise their white boards. Wow! You all worked it out correctly, but some of you forgot to do one thing. The teacher calls two students to the front of the classroom. What is different in the two answers?*

Student: The signs are different.

Indigo: What sign?

Student: The greater than or less than sign.

Indigo: OK. So, which one is correct.

Student: Jada's is correct because she switched the sign. *Jada's answer is $x \geq -10$.*

Indigo: Why did Jada switch the sign?

Student: Because she divided by a negative number. You switch the sign when you divide by a negative number. *Several students groan as they realize they forgot to switch their inequality sign.*

Indigo: Thumbs up if you understand and are ready to try another one. *Most students give the thumbs up sign. The teacher writes another problem on the board and goes to the students needing more assistance.*

The questionnaire revealed teachers' value all the strategies under Giving Feedback and utilize most strategies during most lessons or most days (see Table 7). However, interviews revealed teachers' definitions of formative assessment center around feedback from their students. Classroom observations revealed teachers continually elicit feedback from their students to understand where they are in their learning and to guide ongoing instruction. The analyzing of the data revealed teachers seemed to understand but did not reference the feedback they give to students. Teachers also did not reference the feedback students receive from each other, nor did they allow much time for students to work together and use each other as resources. As previously stated, the questionnaires revealed that teachers valued strategies such as modeling quality and using students as resources for each other but did not always utilize these strategies in their class. Teachers' definitions of formative assessment were shaped by their own

experiences and participation in professional development. I wonder if the school district had an accepted definition of formative assessment and expectations of the different ways it can be enacted, would teachers' definitions of it be different.

Only one classroom observation used students' peers as a resource, as described by strategy four of the Formative Assessment Framework (Black & Wiliam, 2009). Students were solving a word problem. After a couple minutes, Blaine instructed students to talk to their neighbors, compare answers and explain how students arrived at their answer. When pairs of students had different answers, students were heard correcting themselves as they explained their answer, and partners could be seen reviewing their own work, catching and correcting mistakes. After class Blaine shared that students love doing this type of activity, but it takes time they do not always have. The Formative Assessment Framework notes it is important to activate students as instructional resources for one another (Black & Wiliam, 2009), but classroom observations revealed there was not time allowed for student self-assessment, as ultimately students should become owners of their own learning and regulate their learning. Teachers utilized the strategies of questioning and feedback. The data showed teachers felt these strategies gave them the most benefit in the classroom. The answer to this research question is that teachers' definition of formative assessment is aligned to the ways they enact it in the classroom. Their definitions are narrow and revolve around feedback and questioning as evidenced in the questionnaire, classroom observations and interviews. The data sources revealed teachers value other formative assessment strategies. However, they overwhelmingly utilize those strategies that give them the information they need quickly. The feedback generated by questioning and quick activities gives them information on student learning.

When looking at the relationship between teachers' belief about formative assessment and their use of it in the classroom, questionnaire data, classroom observations and interviews revealed there is a relationship between the two. There is not one agreed-upon definition of formative assessment (Akpan et al., 2012; Black & Wiliam, 2006; Moss et al., 2011). This study defines formative assessment as the process of generating feedback on what has been taught in order to improve student learning and achievement (Nichol & Macfarlane-Dick, 2006; Saddler, 1989). The interviews revealed that teachers have a narrow definition of formative assessment, and define it as generating feedback from their students to determine where they are in their learning.

Teachers value formative assessment and understand its benefits, but they use only *some* formative assessment strategies (see Table 1). Teachers used discourse with their students to determine questions to ask. The feedback they received guided instruction and moved students towards the learning target. Classroom observations revealed teachers observed student work to help understand where students were in their learning. In reviewing the formative assessment framework (Figure 1), teachers utilized learning goals to clarify learning intentions and criteria for success. Teachers also use learning tasks that reveal student understanding. The feedback they receive was used to move students forward in their learning (Black & Wiliam, 2009).

The ways teachers enact formative assessment in their classroom and elicit feedback from their students is aligned with *their* definition of it. It can be argued that the teachers' definition of feedback is narrow, as well as the ways they elicit feedback. The data suggests that teachers miss the link between the use of formative assessment and student performance on summative assessments. As summative assessments approached, teachers reverted to teaching test taking

strategies rather than using formative assessment strategies and less traditional teaching approaches.

Teachers use of formative assessment is aligned to *their* belief about its value to the instructional process and in moving students towards their learning goal. Teachers perceive formative assessment to be valuable and utilize it frequently in their classrooms. They believe formative assessment informs them of where their students are in their learning and allows them to move them towards the learning goal. As teachers have participated in professional development related to formative assessment and use formative assessment lessons as part of the MDC, they are expected to use it with their students. Yan and Cheng (2015) referenced the Theory of Planned Behavior when looking at formative assessment use among primary teachers. Intent and believed perceived behavioral control had the greatest impact on teachers' use of formative assessment. Perceived behavioral control is one's belief about factors that may increase (or impede) the likelihood of performance and the perceived power of these factors (Ajzen, 2002). When teachers think about student performance, they are thinking about their performance on state summative assessments at the end of the school year.

As noted previously, Storm shared that formative assessment activities do not necessarily mirror what students will see on the EOG test. I believe this is why some formative assessments activities are not used. As evidenced by data from the questionnaire, classroom observations, and interviews, teachers strongly rely on questioning and feedback, yet lightly (or not at all) utilize other strategies such as students using each other as instructional resources. Because teachers are evaluated by student performance on summative assessments, they utilize those formative assessment activities they believe will positively impact student performance on those assessments.

FAMS resides in a district that values formative assessment and expects teachers to use it with their students. The district also requires that teachers have the learning target visible to students each day and provides professional development for teachers that focuses on formative assessment. The district enables the conditions for teachers to develop confidence in using formative assessment and its tools. The data sources revealed that teachers use some formative assessment activities. They rely on quick formative assessment activities that give them rapid feedback. Teachers value activities such as allowing students to be resources for each other, but do not always employ these type of activities. Indigo noted it can be hard to keep students on track and some activities take time teachers do not always have. As the school year came to an end and summative assessments loomed, teachers used it less and less. Instead, they focused on getting students ready for the test.

Frameworks Used for the Study

The frameworks used for this study were the Formative Assessment Framework (Black & Wiliam, 1998) and the Theory of Planned Behavior (Ajzen, 1991). Figure 1 shows the five strategies integrated with the three agents – teacher, peer and learner. This study focused on teachers’ beliefs about and use of formative assessment. Strategies one, two and three of the Formative Assessment Framework allowed me to focus on the teacher, which aligned with the study. The actions of the students were not a part of this study. The strategies were: (1) Clarifying and sharing learning intentions and criteria for success; (2) Engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding; and (3) Providing feedback that moves learners forward. These three strategies require the teacher to know where the learner is going, where the learner is in their learning and how to get the learner where they need to be (Black & Wiliam, 2009).

Data sources allowed me to determine if the three strategies were being addressed. Teachers had learning targets visible for students, even though they may not have always referenced them throughout the observation. Teachers used questioning to determine student understanding and lead students towards successfully attaining the learning target. Feedback was indirectly a two-way street for teachers. They used the feedback they generated to move the learner forward. While not intentional, they provided feedback to the students to help them regulate their learning and move forward academically.

The Theory of Planned Behavior included one's intentions, attitudes towards the behavior, subjective norms and perceived behavioral control (Ajzen, 1991). The behavior for this study was the use of formative assessment. It is important to understand why teachers' use of formative assessment does not mirror the value they give it. Intent and perceived behavioral control had the greatest impact on teachers' use of formative assessment. Teachers were generally motivated to use formative assessment. It was an expectation of the school and the school district that formative assessment be utilized with students. Professional development was provided to teachers on its use in the mathematics classroom. Opportunity to use formative assessment and resources to enact it were readily available to teachers (Ajzen, 1991).

The data sources revealed teachers' belief in the use of formative assessment. Teachers knew the feedback generated would reveal student misunderstandings, if they existed, and where students were in their learning. This information allowed them to adjust their instruction and move learning forward. Classroom observations and interviews revealed teachers' confidence in their ability to generate feedback and use it to positively affect student learning. Thus, teachers' perceived behavioral control was positive towards formative assessment (Ajzen, 2002), but only

to a point. As state summative assessments loomed, teachers were not as confident about formative assessment's impact on student performance on the assessments.

Teachers did not fully understand the link between formative and summative assessments. The Theory of Planned Behavior, along with Formative Assessment Theory, allowed me to understand the relationship between teachers' belief about and use of formative assessment.

Limitations

There is not much research on using formative assessment in the middle school mathematics classroom. There is also not much research on teachers' beliefs about and use of it in middle school mathematics. As middle school is a gateway between the elementary and high school, it is important that students have a firm mathematical foundation in order to take advantage of higher-level courses at the high school level.

A limitation of this study was the time of year this study was conducted. I had planned to collect data earlier during the the school year, between November and February. Due to issues beyond my control, the data collection began in late March. As the data collection progressed, teachers' emphasis began to be on the upcoming summative assessments as evidenced in their interviews. As the end of the school year approaches, schools become very busy with end-of-year activities. In some instances, it was difficult to schedule classroom observations and interviews with teachers. Only five of the six teachers participated in the semi-structured individual interview. Phoenix had several scheduling conflicts, that did not allow them to complete the interview. Every effort was made to complete all data collections by the end of April.

This study was conducted at one urban middle school in North Carolina. While this was a diverse middle school (see Table 2), the data was not generalizable to the entire population of North Carolina middle schools, nor middle schools nationally or internationally. The data gleaned from this study adds to the body of educational research and more specifically the research surrounding formative assessment in the middle school math classroom. As the research on teachers' beliefs about and use of formative assessment at the middle school mathematics level is lacking, this study may serve as a springboard for other studies in this area.

Implications

The implications of this study are very broad. There are implications for those that affect learning at every level. A few of those are discussed below.

Teachers and Schools

It is important teachers know where students are in their learning and how to move them forward. Formative assessment is a proven strategy that has been shown to increase student achievement (Black & Wiliam, 1998). As teachers and schools are held accountable for student performance on summative assessments, formative assessment is akin to a global positioning system that can give teachers continuous feedback on where students are in relation to the immediate learning goal and in understanding the grade-level curriculum. Teachers' use of formative assessment is critical to students learning and achieving academically. As school districts grapple with overall student performance and performance gaps between groups of students, formative assessment can be a strategy that both improves performance and begins to close those gaps. This case study shows that when teachers believe in a technique's value, they will utilize it with their students, or they will use the parts of it they value the most. If used to

fidelity, formative assessment can positively impact the performance of underperforming groups of students.

School leaders must also have a thorough understanding and value of formative assessment, and its value to students. It is important they explicitly state their expectations of its use in the classroom. As instructional leaders, school principals must understand all that formative assessment entails and model what they expect to see in the classroom.

School Districts

As the teachers in this study had only a narrow definition of formative assessment, school districts may want to have their own definition of formative assessment. The teachers in this study defined it as the feedback they receive from their students to guide their instruction. The teachers utilized questioning and feedback. They generally employed quick activities to generate feedback from their students. As school districts define formative assessment for teachers, they may consider providing professional development on expectations and how to enact formative assessment in the classroom. Emphasis on what the feedback should look like may be included.

Teachers in this study shared their participation in professional development has helped to develop their use of formative assessment. Indigo stated, “the workshops were good, they provided different ways for me to use it with my kids. I picked what I wanted to use from the workshops.” The data noted that teachers used activities that were quick. Less time was devoted to using activities that allow students to be resources for each other and become owners of their learning. As districts and schools provide professional development focusing on formative assessment, they should make sure to include activities that focus on student collaboration and skills to help students think about their own learning. There needs to be an expectation that teachers utilize these types of activities in their schools. In providing that expectation, districts

will need to inspect what they expect. This means they need to observe classrooms specifically looking for examples of these type of activities.

It is important that districts help teachers understand the link between the use of formative assessment and student performance on summative assessments. A full understanding of formative assessment may provide an avenue for teachers to understand the link between formative and summative assessment. As state assessments loom, an enhanced focus on formative assessment will have a greater impact on student achievement on such assessments.

Institutions of Higher Education

In the interviews, teachers revealed they really had no idea of what formative assessment entailed when they began teaching. Declan stated, “when I started teaching, I thought you give a test to see where the kids were. I would teach and test, teach and test.” College students who plan to become teachers may need a more thorough understanding of what formative assessment is and how to enact it in their classroom. When students begin their student teaching, institutions of higher education may want to be purposeful in sharing what formative assessment is and what it looks like in the classroom, as well as look for formative assessment activities when observing student-teachers. During the classes before students begin student teaching, there should be focused sharing on formative assessment. It is important that institutions of higher education define formative assessment for its students. Their definition of it and how their students employ it will affect K-12 organizations. Hopefully when the college students become teachers and have their own classes, they will know what formative assessment is and can immediately begin to enact it in their own classroom.

State Departments of Public Instruction

Accountability will always be part of educating students. As states emphasize the value of formative assessment, summative assessments should mirror the learning that is expected. Summative tests may need to include more open-ended questions that look for deeper learning. Some North Carolina summative math assessments, administered in an online environment, have numeric entry items. This means that students enter their answer, there are no answer choices to choose. This is a step in the right direction, but not far enough. As states know the value of formative assessment, they must employ summative assessments that mirror the type of learning they want to take place. Failure to do so will result in teachers focusing on test taking skills and teaching to the test, as teachers did in this study.

Data for this study was collected during the second semester of the school year as teachers were focusing more on test-taking strategies and the End-of-Grade assessments. Storm noted that the formative assessment lessons they do in class do not mirror the end-of-year tests. The teacher's use of formative assessment lessons was less than it had been during the first semester. States may need to look at how they assess students and determine if one end-of-year assessment is the best way to determine student performance.

Though this case study is not generalizable to all middle schools, it does provide a basis of looking at formative assessment at the middle grades level. This level is important as students transition from elementary to high school. It is also important that teachers have a full understanding of formative assessment and how to implement it in their classroom. Professional development in this area will help new teachers entering the profession, as well as veteran teachers.

Recommendations for Future Research

Formative assessment is not a new concept. Everyone has their own definition of what formative assessment entails. Even those who have conducted substantial research on the topic cannot agree on a singular definition (Akpan et al., 2012; Black & Wiliam, 2006; Moss et al., 2011). The teachers in this study defined formative assessment as the feedback they receive from their students that guided instruction. More research on how schools and district define it would add to the body of research on formative assessment and may lead to a single definition of formative assessment. More research is needed on the relationship between teachers' definition of formative assessment and how they enact it in their classrooms, at all academic levels.

Teacher expectations impact student achievement and those expectations can be a barrier to student achievement (Agirdag et al., 2013). More research is recommended on the relationship between teacher expectations of students and use of formative assessment. Research on the relationship between the types of formative assessment used with students and teacher expectations will add to the knowledge on the variation of teacher decisions on the instructional strategies used with students. As districts work to improve the achievement of underperforming students and close performance gaps, research in this area would shed light on and make teachers conscious of how their biases and expectations of students affect learning.

This study examined teachers' beliefs about and use of formative assessment at the middle school mathematics level. The Formative Assessment Framework and the Theory of Planned Behavior were the lenses used in this study. It is widely accepted that formative assessment positively impacts student learning and achievement (Black & Wiliam, 1998). This study can serve as a springboard for more research on the impact of formative assessment on student achievement. Student achievement from one year to the next could be compared to

determine increase in achievement. Performance gaps could be studied to determine how the use of formative assessment impacts those gaps. As districts struggle to close performance gaps, formative assessment may serve as a strategy to be used for closing those gaps. The school used for this study was an urban school. Larger studies, including urban, rural and suburban schools, should be used to replicate this study and compare the data.

Conclusion

Based on the findings of this study, teachers believe formative assessment is the feedback they receive that guides their instruction. Teachers in this study elicit feedback primarily through questioning and quick activities they do with their students. Data from the questionnaire, classroom observations, and interviews revealed teachers value the use of formative assessment. Their use of formative assessment activities aligns with their definition of it. Teachers use questioning and activities to generate feedback to guide their instruction. Less utilized are activities that allow students to become resources for each other and owners of their own learning to regulate their learning. The feedback teachers receive from the use of formative assessment reveals pivotal moments, or moments of contingency, where teachers continue on with instruction or change course, in order to meet students' needs (Pachler, Daly, Mor & Mellar, 2010).

The use of formative assessment is integral to teachers determining what students understand and what misconceptions they may have. Teachers' beliefs about teaching influence how they teach (Pandhiani, 2016; Volante & Beckett, 2011). The teachers in this study believe that formative assessment makes them better because they are able to understand where their students are in the learning process and provide the instruction their students need. When that

happens, students are getting what they need to access the learning goal. Formative assessment is an invaluable strategy that benefits teachers, students and education in general.

It is my hope that more attention will be given to the use of formative assessment at the middle school mathematics level. A strong mathematical foundation in middle school allows students to access higher level math courses in high school, providing a greater likelihood of high school completion and college degree attainment (Kim, Kim, DesJardins, & McCall, 2015; Riegle-Crumb, 2006). As disparities exist among groups of students taking higher-level math courses at the high school level, a strong mathematical foundation in middle school may serve as an equalizer that increases achievement among underperforming groups of students and close performance gaps.

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APPENDIX A
Letter of Agreement for Superintendent

Shawn D. Clemons

4111 Ore Bank Drive, Lincolnton, NC 28092
sc32901@appstate.edu; sdclemons@gmail.com
828-705-1245

Dr. Robbie Adell
Superintendent
[REDACTED] Schools
432 4th Avenue SW
[REDACTED] NC [REDACTED]
July 18, 2017

Dear Dr. Adell,

I am Shawn Clemons, a doctoral student at Appalachian State University, Boone, NC. I am conducting research on teachers beliefs about and use of formative assessment in the middle grades math classroom.

At [REDACTED] Middle School, I would like to survey math teachers of grades six, seven and eight to assess their beliefs about and use of formative assessment. I will also observe them during a classroom lesson. During teacher's planning period or a convenient time, I will ask them questions related to their definition of and use of formative assessment. All survey, observation and interview data will remain confidential and will be securely destroyed at the end of this study. Teachers will not be identifiable in this study.

Please carefully review the enclosed information concerning my study. If you will allow me to survey, observe and interview willing teachers, please complete the information below. Thank you in advance for your consideration.

Sincerely,
Shawn Clemons
ASU Doctoral Student

I grant permission for Shawn Clemons to request volunteers, at the middle grades level, for this research study. I understand teacher data will not be identifiable and will be securely destroyed at the end of this study.

Superintendent Name (printed):

Robbie Adell

Superintendent Signature:

Robbie Adell

Date:

11/14/17

APPENDIX B
Informed Consent

Consent to Participate in Research

Information to Consider About this Research

Teachers' Beliefs About and Use of Formative Assessment in the Middle Grades Mathematics Classroom

Principal Investigator: Shawn Clemons

Department: College of Education

Contact Information: Faculty Advisor – Dr. Tracie Salinas, Walker Hall, Appalachian State University, Boone, NC 28608; 828-262-2376

You are being invited to take part in a research study about teachers' beliefs and use of formative assessment in the middle grades classroom. If you take part in this study, you will be one of about seven people to do so. By doing this study we hope to learn if teachers' value of formative assessment correlate to their use of formative assessment in the middle school math classroom..

The research procedures will be conducted at via an online survey, by teacher observations and interviews.

You will be asked to complete an anonymous survey sharing your beliefs about the use of formative assessment. Participants will also be asked to allow the researcher to observe one or more math classes during the 2017-2018 school year and participate in an interview.

You cannot volunteer for this study if are not a teacher at the school.

What are possible harms or discomforts that I might experience during the research?

To the best of our knowledge, the risk of harm for participating in this research study is no more than you would experience in everyday life.

What are the possible benefits of this research?

There may be no personal benefit from your participation but the information gained by doing this research may help others in the future by exploring how one's beliefs about formative assessment correlates to the use of formative assessment in the classroom.

Will I be paid for taking part in the research?

We will not pay you for the time you volunteer while being in this study. However, participants who complete the study will receive a \$20 gift card for their time and participation.

How will you keep my private information confidential?

We will make every effort to prevent anyone who is not on the research team from knowing that you gave us information or what that information is. Participant names will not be used, and school location will be kept confidential. Your data will be protected under the full extent of the law.

The data and identifying information will be kept confidential until the end of this research study. Once the study has concluded, data will be securely destroyed.

Who can I contact if I have questions?

The people conducting this study will be available to answer any questions concerning this research, now or in the future. You may contact the Principal Investigator, Shawn Clemons, at 828-705-1245. If you have questions about your rights as someone taking part in research, contact the Appalachian Institutional Review Board Administrator at 828-262-2692 (days), through email at irb@appstate.edu or at Appalachian State University, Office of Research and Sponsored Programs, IRB Administrator, Boone, NC 28608.

Do I have to participate? What else should I know?

Your participation in this research is completely voluntary. If you choose not to volunteer, there will be no penalty and you will not lose any benefits or rights you would normally have. If you decide to take part in the study you still have the right to decide at any time that you no longer want to continue. There will be no penalty and no loss of benefits or rights if you decide at any time to stop participating in the study. If you decide to participate in this study, let the research personnel know. A copy of this consent form is yours to keep.

This research project has been approved by the Institutional Review Board (IRB) at Appalachian State University.

This study was approved on: _____

This approval will expire on _____ unless the IRB renews the approval of this research.

Participant's Name (PRINT)

Signature

Date

APPENDIX C
Formative Assessment Questionnaire

Formative Assessment Questionnaire for Teachers

Introduction

Much recent research indicates that formative assessment raises standards and in practice it could be working for you.

Please complete these sentences, by giving a reason.

Assessment is working well:

Assessment hinders:

Part One

Please circle the number and letter that most closely matches your opinion of the following strategies.

Please circle how highly you value the following strategies.

Please circle how often you use the following strategies.

A = Very valuable
B = Valuable
C = No strong view
D = Of little value
E = Of no value

1 = Most lessons
2 = Most days
3 = Weekly
4 = Termly
5 = Never

Involving Pupils in their Learning

1-Telling pupils what you hope they will learn and (sometimes) why they are learning it

A B C D E

1 2 3 4 5

2-Inviting and building on pupils' contributions

A B C D E

1 2 3 4 5

3-Setting up tasks designed to enable pupils to "get on" by themselves

A B C D E

1 2 3 4 5

4-Getting pupils to collaborate in groups on a joint outcome

A B C D E

1 2 3 4 5

5-Spurring pupils on by making encouraging but specific, focused comments, eg they are on the right lines and in what way

A B C D E

1 2 3 4 5

6-Getting a pupil to help another pupil

A B C D E

1 2 3 4 5

Modeling Quality

1-Choosing and showing pupils examples of pupils' work for learning purposes

A B C D E

1 2 3 4 5

2-Getting a pupil to show you how s/he did something

A B C D E

1 2 3 4 5

3-Getting a pupil to demonstrate to the class how s/he did something

A B C D E

1 2 3 4 5

4-Getting a pupil to suggest ways something can be improved

A B C D E

1 2 3 4 5

5-Providing formats or structures for writing or recording findings

A B C D E

1 2 3 4 5

6-Showing pupils a range of other pupils' work to make a judgement about performance

A B C D E

1 2 3 4 5

7-Showing pupils a range of other pupils' work to make a judgement about progress

A B C D E

1 2 3 4 5

8-Showing pupils a range of other pupils' work to model (or exemplify) criteria

A B C D E

1 2 3 4 5

Giving Feedback

1-Using probing questions to diagnose the extent of the pupil's learning

A B C D E

1 2 3 4 5

2-Analyzing completed work to work out why a pupil has or has not achieved

A B C D E

1 2 3 4 5

3-Giving rewards only when

A B C D E

1 2 3 4 5

achievement is satisfactory for that pupil (with specific comments referring to pupil's success)

4-Expressing approval when achievement is satisfactory A B C D E 1 2 3 4 5

5-Making a conscious decision to avoid saying a pupil is wrong A B C D E 1 2 3 4 5

6-Telling pupils what they have achieved with specific reference to their learning A B C D E 1 2 3 4 5

7-Telling pupils what they have not achieved with specific reference to their learning A B C D E 1 2 3 4 5

8-Describing why an answer is correct A B C D E 1 2 3 4 5

9-Specifying a better/different way of doing something A B C D E 1 2 3 4 5

10-Writing an evaluative note on a pupil's work for the pupil A B C D E 1 2 3 4 5

Self Assessment

1-Getting pupils to suggest ways they can improve A B C D E 1 2 3 4 5

2-Negotiating a route to improve something A B C D E 1 2 3 4 5

3-Providing time for pupils to reflect and talk about their learning A B C D E 1 2 3 4 5

4-Getting students to review their own work and record their progress A B C D E 1 2 3 4 5

5-Helping pupils to understand their achievements and know what they need to do next to make progress A B C D E 1 2 3 4 5

6-Providing opportunities for pupils to assess their own and one another's work and give feedback to one another A B C D E 1 2 3 4 5

It would be useful to know the following information about you.

What grade do you teach?

6 7 8

How many years have you taught at the middle grades level?

<5 years 5-10 years 11+ years

How many years have you taught at your current grade level?

<5 years 5-10 years 11+ years

Thank you for your participation. If you would be willing for me to use your data in my study, please complete the information below.

Name: _____

School Name: _____

This information will be securely destroyed at the end of my study.

Sincerely,
Shawn Clemons
ASU Graduate Student

APPENDIX D
Sample Student Schedule at FAMS

Sample Student Schedule

7:00 am	Homebase Grade 6 Teacher Name 110 07:35 AM - 07:40 AM
8:00 am	Math Grade 6 Teacher Name 110 07:43 AM - 08:45 AM
9:00 am	Science Grade 6 Teacher Name 110 08:48 AM - 09:48 AM
10:00 am	ELA Grade 6 Teacher Name 108 09:51 AM - 10:51 AM
11:00 am	Social Studies Grade 6 Teacher Name 108
12:00 pm	10:53 AM - 12:32 PM
1:00 pm	Visual Arts Grade 6 Teacher Name 264 12:35 PM - 01:25 PM
2:00 pm	Health and Physical Education: 6 Mackie, Michael Alden GYM Teacher Name

Note: This is the schedule of a typical grade six student, pulled from PowerSchool the student management system used by all districts in North Carolina. Class schedules for students in grades seven and eight are similar.

APPENDIX E
Semi Structured Interview Questions

Semi structured Interview Questions

1. How long have you been teaching middle school math?
2. How long have you been in your current grade level?
3. What is your definition of formative assessment?
4. Has your definition of formative assessment changed over time?
 - a. If so what was your *initial definition* of formative assessment and what is your current definition of formative assessment?
 - b. What caused the shift in your definition of formative assessment?
5. Have you participated in any formative assessment trainings or workshops? What did you gain from those? How did they affect your practice?
6. Have you participated in NC FALCON online training? If so, when?
7. Did you participate in MDC last school year (2016-17)?
 - a. What are your thoughts on the program and its use?
8. Describe how formative assessment helps you, as the instructor, as you work with your students?
9. What do you feel are the benefits of formative assessment to your students?
 - a. What characteristics of formative assessment make it helpful to students?
10. If you reflect on your students' standardized test achievement (whether district benchmarking or EOGs/EOCs, can you see evidence of where your use of formative assessment has had an impact? Please describe at least one example.

APPENDIX F
Interview Consent

Teacher Beliefs About and Use of Formative Assessment in the Middle School Math Classroom

Principal Investigator: Shawn Clemons

Department:

Contact Information: Faculty Advisor - Dr. Tracie Salinas, Walker Hall, Appalachian State

University, Boone, NC 28608; 828-262- 2376

Consent to Participate in Research ***Information to Consider About this Research***

I agree to participate as an interviewee in this research project, which concerns teachers' value and use of formative assessment in the middle school math classroom. The interview(s) will take place at a mutually agreed upon date and time. The interview will last approximately thirty minutes. I understand the interview will be about my understanding of, value of and use of formative assessment in my classroom.

I understand that there are no foreseeable risks associated with my participation. I also know that this study may add to the body of research concerning the use of formative assessment in the middle school math classroom.

I understand that the interview(s) will be audio recorded and may be published. I understand that the audio recordings of my interview will be securely destroyed once this research study is complete.

I understand if I sign the authorization at the end of this consent form, photos may be taken during the study and used in scientific presentations of the research findings.

I give Shawn Clemons ownership of the tapes, transcripts, recordings and/or photographs from the interview(s) s/he conducts with me and understand that tapes and transcripts will be kept in Shawn Clemons' possession, in a secure location. I understand that information or quotations from the tapes and/or transcripts will be used as part of the research study. I understand I will not receive compensation for the interview.

I understand that the interview is voluntary and there are no consequences if I choose not to participate. I also understand that I do not have to answer any questions and can end the interview at any time with no consequences.

If I have questions about this research project, I can call Dr. Tracie Salinas at 828.262.2376 or the Appalachian Institutional Review Board Administrator at 828-262-2692(days), through email at irb@appstate.edu or at Appalachian State University, Office of Research Protections, IRB Administrator, Boone, NC 28608.

This research project has been approved on _____(date) by the Institutional Review Board (IRB) at Appalachian State University. This approval will expire on [Expiration Date] unless the IRB renews the approval of this research.

I request that my name **not** be used in connection with tapes, transcripts, photographs or publications resulting from this interview.

I request that my name **be used** in connection with tapes, transcripts, photographs or publications resulting from this interview.

By signing this form, I acknowledge that I have read this form, had the opportunity to ask questions about the research and received satisfactory answers, and want to participate. I understand I can keep a copy for my records.

Participant's Name (PRINT)	Signature	Date
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[If you wish to waive the signature, remove the above items and use this wording:

By proceeding with the activities described above, I acknowledge that I have read and understand the research procedures outlined in this consent form, and voluntarily agree to participate in this research.

Photography and Video Recording Authorization

With your permission, still pictures (photos) and/or video recordings taken during the study may be used in research presentations of the research findings. Please indicate whether or not you agree to having photos or videos used in research presentations by reviewing the authorization below and signing if you agree.

Authorization

I hereby release, discharge and agree to save harmless Appalachian State University, its successors, assigns, officers, employees or agents, any person(s) or corporation(s) for whom it

might be acting, and any firm publishing and/or distributing any photograph or video footage produced as part of this research, in whole or in part, as a finished product, from and against any liability as a result of any distortion, blurring, alteration, visual or auditory illusion, or use in composite form, either intentionally or otherwise, that may occur or be produced in the recording, processing, reproduction, publication or distribution of any photograph, videotape, or interview, even should the same subject me to ridicule, scandal, reproach, scorn or indignity. I hereby agree that the photographs and video footage may be used under the conditions stated herein without blurring my identifying characteristics.

Participant's Name (PRINT)

Signature

Date

APPENDIX G
IRB Review

To: Shawn Clemons
Doctoral Program
CAMPUS EMAIL

From: Monica Molina, IRB Associate Administrator
Date: 1/22/2018
RE: Notice of IRB Exemption

STUDY #: 18-0136

STUDY TITLE: Teachers' Beliefs About and Use of Formative Assessment in the Middle Grades Mathematics Classroom.

Exemption Category: (1) Normal Educational Practices and Settings

This study involves minimal risk and meets the exemption category cited above. In accordance with 45 CFR 46.101(b) and University policy and procedures, the research activities described in the study materials are exempt from further IRB review.

All approved documents for this study, including consent forms, can be accessed by logging into IRBIS. Use the following directions to access approved study documents.

1. Log into IRBIS
2. Click "Home" on the top toolbar
3. Click "My Studies" under the heading "All My Studies"
4. Click on the IRB number for the study you wish to access
5. Click on the reference ID for your submission
6. Click "Attachments" on the left-hand side toolbar
7. Click on the appropriate documents you wish to download

Study Change: Proposed changes to the study require further IRB review when the change involves:

- an external funding source,
- the potential for a conflict of interest,
- a change in location of the research (i.e., country, school system, off site location),
- the contact information for the Principal Investigator,
- the addition of non-Appalachian State University faculty, staff, or students to the research team, or
- the basis for the determination of exemption. Standard Operating Procedure #9 cites examples of changes which affect the basis of the determination of exemption on page 3.

Investigator Responsibilities: All individuals engaged in research with human participants are responsible for compliance with University policies and procedures, and IRB determinations. The Principal Investigator (PI), or Faculty Advisor if the PI is a student, is ultimately responsible for ensuring the protection of research participants; conducting sound ethical research that complies with federal regulations, University policy and procedures; and maintaining study records. The PI should review the IRB's list of PI responsibilities.

To Close the Study: When research procedures with human participants are completed, please send the Request for Closure of IRB Review form to irb@appstate.edu.

If you have any questions, please contact the Research Protections Office at [\(828\) 262-2692](tel:8282622692) (Robin).

Best wishes with your research.

APPENDIX H
AccessToday Observation Tool

Core constructs of formative assessment	Novice	Apprentice	Practitioner	Master
Learning target	Zero or one of the indicators is observed during the class period.	Two of the four indicators are observed during the class period.	Three of the four indicators are observed during the class period.	Teacher states, writes and restates objective (s) throughout the lesson. Students write down the learning target(s).
Question quality	Teacher does not use questions effectively during instruction.	Teacher rarely uses questions effectively to scaffold instruction.	Teacher generally uses questions effectively to scaffold instruction.	Teacher consistently and appropriately uses questions effectively to scaffold instruction.
Nature of questioning	Teacher does not use wait time and questioning effectively during instruction.	Teacher rarely uses wait time and questioning effectively to diagnose problems with learning and improve instruction.	Teacher generally uses wait-time and questioning effectively to diagnose problems with learning and improve instruction.	Teacher consistently and appropriately uses wait time and questioning effectively to diagnose problems with learning and improve instruction
Self-evaluation	Teacher does not use student self-evaluation strategy(ies) or tool(s) during instruction.	Generic self-evaluation strategy(ies) or tool(s) were employed but not tied explicitly to the regulation and improvement of student's self-learning.	Teacher provides the strategies or tool(s) students use for self-evaluation during instruction in an effort to regulate and improve the student's self-learning. Self-evaluation strategies or tools are primarily teacher-driven and could include techniques such as the use of traffic lights, checklists, rubrics, drawings, a self-assessment inventory, journaling, and/or reflection statements.	Students use a variety of strategy (ies) and tool(s) to self-evaluate in an effort to regulate and improve their own learning. These could include student-designed strategies and tools such as traffic lights, checklists, rubrics, drawings, a self-assessment inventory, journaling, and/or a reflection statement.
Observation of student affect	Teacher does not attend to how feedback is received by the student. Total emphasis is on teaching specific content. Few students are active learners who rarely interact.	Teacher shows limited sensitivity to student affect and tailors feedback for only a few students. Most emphasis is on teaching specific content. Some students are active learners who interact infrequently.	Teacher is sensitive to the affect of most students and shows general evidence of balancing teaching content with affect. Many students are active learners whose interactions are developing.	Teacher is sensitive to student affect, collects evidence through body language, facial expressions, and/or class work, and adjusts instruction accordingly. Teacher demonstrates expertise and polish in balancing content with student affect. Students are active learners who interact regularly.
Instructional adjustment	No adjustments to instruction are observed.	Teacher uses minimal adjustments during instruction.	Teacher predominately and effectively uses adjustments during instruction.	Teacher consistently and effectively uses adjustments during instruction.

(Continued)

(Continued).

Core constructs of formative assessment	Novice	Apprentice	Practitioner	Master
Evidence of learning	There is minimal evidence that learning occurred. There is evidence of learning for few of the students for the following indicators: All-student responses, individual responses, and artifacts of learning.	There is episodic evidence that learning has occurred. There is evidence of learning for some of the students for the following indicators: All-student responses, individual responses, and artifacts of learning.	There is evidence of learning for many of the students for the following indicators: All-student responses, individual responses, and artifacts of learning.	There is evidence of learning for almost all of the students for the following indicators: All-student responses, individual responses, and artifacts of learning.

Source. From Eddy & Harrell, 2013.

VITA

Shawn D. Clemons was born in Hickory, North Carolina to Lucille and the late Willie James Clemons. She attended from North Carolina State University, Raleigh, North Carolina to study mathematics education. Shawn graduated with a Bachelor of Science degree in May 1993. In August 2000, Shawn began working on her first graduate degree, earning a Master of Arts degree in Educational Media, from Appalachian State University, Boone, North Carolina, in July 2002. Shawn earned the remainder of her graduate degrees from Appalachian State University. In December 2006 she earned her Masters of School Administration degree, then earned her Educational Specialist degree, with a concentration in K-12 administration, in December 2009. In December 2018, Shawn earned her Doctorate in Educational Leadership, with a concentration in K-12 administration.

Shawn is a member of Phi Kappa Phi, Delta Kappa Gamma Sorority and Delta Sigma Theta Sorority, Inc. She is active in her church, volunteers at the Catawba Science Center, and volunteers with students helping them prepare for life after high school. Shawn continues to advocate for equity and opportunities for all students regardless of their ethnicity or socio-economic status.