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TEACHERS' BELIEFS AND EFFECTIVE USE OF FORMATIVE ASSESSMENT IN SECONDARY SCHOOL MATHEMATICS CLASSROOM

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TEACHERS' BELIEFS AND EFFECTIVE USE OF FORMATIVE ASSESSMENT IN

SECONDARY SCHOOL MATHEMATICS CLASSROOM

by

Abeda Banu

Kennesaw State University

A Dissertation Submitted in Partial Fulfillment

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Committee Chair & Members

Dr. Sutton-Brown-Fox (Chair Dissertation Committee)

Dr. Belinda Edwards (Member Dissertation Committee)

Dr. Guichun Zong (Member Dissertation Committee)

Abstract

Formative assessment is a valuable tool that may be used to track academic progress and increase student learning. The purpose of formative assessment is to collect evidence of students' thinking and learning, thereby modifying teaching to meet students' needs based on the collected information. The literature has well established the significance of formative assessment in assisting students' learning. However, defining and implementing this in the classroom is a complicated task.

The purpose of this study is to examine mathematics teachers' beliefs and practices of formative assessment in mathematics teaching and to determine how their beliefs affect their use of formative assessment practices in a mathematics classroom. The research for this study was carried out over a semester in a rural high school classroom in eastern Georgia. Multiple types of data were collected from the three mathematics teachers through classroom observations of teachers' experiences with formative assessment, semi-structured interviews, and artifacts. The qualitative case study method was used to gather and analyze data. The framework used for this study was the Formative Assessment Model by Black and Wiliam (2009).

Teachers discussed their experiences with the practice of assessment during semi-structured interviews. The analysis of teachers' interview responses shows that the teachers valued and had a positive belief toward the importance of formative assessment and used it as part of their classroom instructional practices. Their responses also revealed that they used formative assessment as part of their instructional practices at a medium level. The implications and limitations of the study are discussed.

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Acknowledgments

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CHAPTER ONE: INTRODUCTION

1.1. **Overview**

Understanding learners and responding to their needs plays a vital role in the success of the teaching and learning process. In recent decades, researchers have stressed the role of assessment in this process. Assessment is an important factor in the process of education. Assessment is essential for effective teaching and learning (Heritage, 2007). **Assessments become formative when the assessment outcomes are used to guide future teachings** (Black & Wiliam, 1998b). In recent decades, classroom assessment acquired significant attention in education as it helps teachers improve the quality of learning (Widiastuti et al., 2020). Formative assessment is an assessment for the purpose of instruction. If teachers regularly implement formative assessment following best practices, it is a strategy that has been shown to improve student achievement (Black & Wiliam, 2009). The success of formative assessment depends on teachers' beliefs and how they implement formative assessment activities in their classrooms.

In their meta-analysis, Black & Wiliam (1998b) examined over 250 studies during a nine-year period, which led them to conclude that formative assessment improves students' achievement. The theoretical ideal of formative assessment is to develop the capacity to collect evidence of students' own learning. Teachers then explicate and use it to plan the next learning process steps (Clark, 2011). Formative assessment assists teachers and students in knowing how far they have accomplished the set objectives and where they have to be by the end of the course, making the assessment a part of the curriculum (Black & Wiliam, 1998a). Hence, formative assessment aims to raise the standard of students' learning by helping learners know their progression and improve their learning where needed. However, some factors might obstruct learners' learning despite formative assessment practice in the curriculum.

The topic of teachers' beliefs has gained increasing interest in recent decades. Beliefs are considered vital because they are important factors that can predict teaching behavior (Pajares, 1992). In classrooms, teachers' beliefs play an essential role in teachers' behaviors, decisions, and judgment (Borg, 2001). Beliefs influence classroom activities and evaluation (Borg, 2001) and teachers' pedagogical decision-making (Borg, 2001; Pajares, 1992). Specifically, beliefs strongly affect teachers' assessment practices (Borg, 2001).

The implementation of formative assessment is interconnected to the teachers' knowledge and beliefs about the perception of formative assessment (Widiastuti et al., 2020). Teachers who use formative assessment techniques are better prepared to meet the needs of diverse students. Heritage (2007) revealed that teachers should understand the role of formative assessment in the instructional process and acknowledge it as a useful tool to improve learning achievement. Heritage (2007) and Shepard et al. (2005) asserted that formative assessment should be implemented as an element of ongoing classroom instruction. Therefore, when teachers discuss their experiences and beliefs about formative assessment, this information may indicate whether they recognize it as a primary teaching element.

1.2. **Background**

Reviewing the math department's data of the research site school, the data team of the school noticed that their students have been showing a consistent decline in mathematics achievement because their performance in mathematics classes has been plummeting, and the percentage of End of Course Testing (EOC) scores has also dropped over the last two years. The researcher believes that the mathematics department of the research site school is responsible for tracing the root cause behind these issues and subsequently developing a solution.

There could be several reasons for students' poor performance in mathematics as the research site school is in a rural area. Rural schools have high failure rates, limited parental support, limited teaching staff, and high learner absenteeism (Lowe, 2006). Some of these aspects affect the quality of education and have some serious implications. In addition, teachers' beliefs are powerful forces in teachers' decisions and actions that have been said to also influence learner achievement (Kaymakamoglu, 2017).

To find the reason for students' poor performance in mathematics, teachers' beliefs and assessment practices are likely two of the areas for investigation as teachers' beliefs are linked to student performance (Good, 1987). It is presumed that the students' academic failure in general, and mathematics skills in particular, is linked with teachers' assessment beliefs and their actual practice in the classroom. Abiy (2013) emphasized that assessment practices shape the instructional processes, and because of this, learning can be changed. This suggests that formative assessment is the motivation for the teaching and learning process.

As per the researcher's experience working as a mathematics teacher at the research site school, she noticed teachers give more importance to summative assessment and grades than students' ongoing learning process and formative assessment. Oftentimes, teachers focus on graded assignments, midterms, quizzes, and exams to determine students' learning progress rather than using formative assessment.

Being a senior teacher and mentor at the research site school, the researcher understands the need for a deeper understanding of teachers' perspectives about formative assessment and how they are implementing it in their classrooms to be effective teachers. Thus, the study of teachers' beliefs about formative assessment is important because research shows that teachers' conceptions (their beliefs, views, and preferences) about teaching influence how they teach and

what students achieve or learn (Thompson, 1992). In recent years, assessment design and its implementation has captured increased attention in the education field. Some research has been done on teachers' beliefs in English language and science classes. Although teachers understand the benefits of formative assessment, their beliefs about formative assessment are not always reflected by their use of it in the classroom (Yan & Cheng, 2015). Furthermore, teachers' beliefs about formative assessment in rural area mathematics classrooms, along with their assessment roles, have remained unexplored. Therefore, this study aims to explore mathematics teachers' beliefs on formative assessment and practices and its use to strengthen students' learning in secondary school classes.

1.3. **Problem Statement**

Assessment is a standard part of every classroom and teaching practice. Classroom assessments can galvanize students' learning and stimulate them to attain the mathematics classroom's maestro level. The benefits of formative assessment are significantly impressive. For improving students' learning achievement, formative assessment is recognized as a promising instructional practice. Formative assessment is "one of the most powerful ways of improving student achievement" (Wiliam, 2013, p.15). Because teachers' beliefs impact what they teach and students' learning, researchers (Black & Wilaim, 1998; Buyukkarchi, 2014; Karim, 2015; Widiastuti et al., 2020) focused on teachers' beliefs and practices of formative assessment as a significant area of study. However, those studies were conducted in English and science classes. Some of these studies reveal inconsistencies between teachers' beliefs and practices in other subjects (Büyükkarci, 2014; Karim, 2014).

Despite the depth of research on formative assessment and teachers' beliefs, there is a lack of empirical studies linking teachers' beliefs about formative assessment and its use in rural area

mathematics classrooms. Hence, a study of mathematic teachers' beliefs and practices of formative assessment is required to know how mathematics teachers implement and understand formative assessment. Therefore, this study's plan was to obtain mathematics teachers' beliefs about formative assessment in secondary school mathematics classrooms in a rural area to acquire information about how they implement formative assessment as part of their daily planning and preparation. In addition, it seeks to determine whether there is a connection between mathematics teachers' perceived understanding of formative assessment and their effective use of it in their classroom.

1.4. **Significance of the study:**

Many researchers have revealed that formative assessment has a significant influence on reducing gaps in achievement and improving learning (Black&Wiliam, 1998b; Stiggins, 2002). Black and Wiliam (2009) revealed that various factors influence formative assessment practices. However, some studies conducted on teachers of English as a Second Language (ESL) show that teachers' beliefs influence formative assessment practices (Büyükkarci, 2014; Karim, 2015). A significant amount of literature is available on formative assessment. Still, little literature is available on teachers' beliefs of formative assessment and how it affects their instructional practices in their classrooms. Understanding the teachers' beliefs with formative assessment relative to their instructional practices will shed light on the impact formative assessment has on their daily instructional practices. It is imperative to determine how mathematics teachers' beliefs can substantially influence their practice in their classroom. Furthermore, no such study has investigated the relationship between teachers' beliefs about the formative assessment conducted with secondary school mathematics students in rural areas. Hence, this study will provide a

group of secondary school mathematics teachers with the opportunity to share their beliefs and understanding of formative assessment and if their understanding is reflected in their classrooms.

This study's findings may provide helpful ideas and beneficial information for secondary school mathematics teachers since it is possible to identify the factors that impede or support teachers' formative assessment practices. Teachers may gain helpful information from this research that could help raise their students' achievement levels and influence mathematics teachers to reassess what they emphasize in the classroom and how it impacts students' perspectives towards learning. It may also inform the school administrator about teachers' positive experiences by using formative assessments and recognizing the weaknesses in practice.

1.5. **Purpose of the Study**

This study aims to investigate the significance of the influence of teachers' beliefs and understanding of formative assessment in a rural area high school mathematics class after recognizing the research on mathematics teachers' beliefs and understanding of formative assessment and its practices in the math classroom is insufficient. This study could provide important information about how beliefs about assessment impact teacher formative assessment practices, which ultimately impact student learning.

1.6. **Research Questions**

The research questions that will guide my dissertation are:

1. What are secondary school mathematics teachers' beliefs about the importance of formative assessment?

2. How are secondary school mathematics teachers' beliefs about formative assessment reflected in their classroom practices?

CHAPTER TWO: LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

The purpose of this study is to explore mathematics teachers' beliefs about formative assessment and their understanding of formative assessment in their instructional practice. In composing an analysis of high school mathematics teachers' beliefs about and effective use of formative assessment, it is vital to establish a detailed understanding of formative assessment and its components and teachers' beliefs. Therefore, this chapter reviews and synthesizes an overview of the definition and understanding of formative assessment, especially those related to teachers' beliefs and instructional practices used in secondary mathematics classrooms.

2.1. **Assessments:**

Assessment is the bridge between teaching and learning and is the central process in instruction (Wiliam, 2017). In the educational field, there are two main categories of assessment, formative assessment and summative assessment, used by the teachers.

Summative assessments are stated as the assessment of learning that aims to evaluate student learning at the end of an instructional unit or learning activity (Clark, 2012; Stiggins, 2002). Students get a score based on their knowledge, like end-of-course exams, ACTs, SATs, or national or state high stakes exams. Summative assessment provides information on students' level of proficiency to teachers (Bell & Cowie, 2001). Summative assessment is given at the end of the learning process, recognizes students' current capability, and requires the teacher to grade the students' competence or proficiency. Summative assessment data assists teachers with details about how effective their teaching strategies have been, how much they need for instruction, and how to improve their teaching for future students, not for present students. This assessment also gives opportunities to teachers, parents, students, and policymakers to monitor the educational progress a student makes (Bell & Cowie, 2001). Summative assessment has some limitations

because it is individualistic and isolated from the learning process; however, it is still relevant to the assessment process.

A conversation between student and peer, a conversation between teacher and students, or a collaborative activity can be a formative assessment. When the results of an assessment are used to guide or inform future teaching, it becomes a formative assessment (Wiliam & Black. 1998 a). Usually, assessment is thought of as a paper-pencil test or a computerized test, but formative assessment may exist in various forms. Formative assessments are performance opportunities or examinations to provide students and teachers feedback about students' learning (Black & Wiliam, 1998a, 1998b). Yearly tests produce results, but those are not suitable for informing learners' current instruction (Heritage, 2007). Learners can get formative assessment information while they are still in the process of learning (Burke & Depka, 2011) and can reflect on and monitor their own progress. However, formative assessment, unlike summative assessment, is an organized process of gathering evidence about student learning while it is happening (Wiliam and Black, 1996). There are still opportunities for students to improve (Black & Wiliam, 1998a, 1998b). Educators and researchers have acknowledged formative assessment as an important element in conducting learning activities to enhance student learning effectiveness (Bell & Cowie, 2001). Formative assessment data could be used by teachers to customize their instruction for students as needed to meet their learning needs (Ginsburg, 2009).

2.2. **Difference between Formative Assessment and Summative Assessment**

In brief, summative assessment intends at making a judgment about teaching and learning and concerns while summarizing the students' achievement status. In contrast, formative assessment aims at improving students' learning and has prospective functions. Formative assessment is constant, whereas summative assessment comes at the end of a semester

or a course (Sadler, 1989). As per Stiggins (2014), the assessment must yield appropriate evidence regarding student attainment of the set goal or objective regardless of which assessment type.

2.3. **Formative Assessment**

Formative assessments are the activities that are used to identify students' progress and modify instructional methods depending on learning needs (Burke & Depka, 2011) and the process used by both teachers and students to recognize and respond to students' learning needs to enhance that learning during the learning process (Cowie & Bell, 1999). Sadler (1998) revealed that formative assessment intends to produce feedback on performance to accelerate and enhance learning.

Formative assessment is also called an assessment for learning because this type of assessment is less consequential to student grade performance and instead provides opportunities for students to explore, discover, and ask questions, and activities are used as a practice to help students increase their competency with specific skills (Chappius & Chappius, 2007, 2008). Formative assessments are implemented during the process of learning; therefore, they are not used for grading purposes (Burke & Depka, 2011).

Research shows that effective use of formative assessment assists in improving students' learning (Bell & Cowie, 2005; Black & Wiliam, 1998a; Stiggins, 2005). Formative assessment helps the teacher to plan for and use effective individualized instruction (Black & Wiliam 1998b; Cauley & McMillan, 2009; Ginsberg, 2009; Heritage, 2007; Sadler 1989). Other researchers also emphasize the necessity for action during the instructive process and explain formative assessment as "assessment carried out during the instructional process for the purpose of improving teaching and learning" (Shepard et al., 2005, p. 275). Formative assessment is

generally stated as assessment for the purpose of instruction (Heritage, 2007). A major objective

of formative assessment is to evaluate and promote student learning throughout the entire

learning cycle. Formative assessment is recognized as the most powerful way to improve student

motivation and achievement (Cauley &. McMillan, 2010). Formative assessment is the

systematic process of continuously accumulating evidence about learning (Heritage, 2007).

Learning goals should be communicated during formative assessment (Chappius & Stiggins,

2002; Moss & Brookhart, 2009), and success criteria should be used to evaluate students'

performance (Moss & Brookhart, 2009). By using formative information, teachers can identify

individual learning needs to adjust instruction in formative assessment to better meet these needs

(Wiliam, 2011). When putting the formative assessment into practice, teachers gather evidence

of the students' learning and, based on their identified learning needs, adapt instruction or

feedback to meet these needs (Heritage, 2007). Teachers can change strategies during the

learning process and help students improve during formative assessments as formative

assessments are ongoing and give immediate feedback (Burke & Depka, 2011). Formative

assessment encompasses "all those activities undertaken by teachers, and/or by their students,

which provide information to be used as feedback to modify the teaching and learning activities

in which they are engaged" (Black & Wiliam, 1998a, p.7).

Looking at the definitions given by the researchers, implicitly, some think of formative

assessment as a process, and others think of it4 as a tool. Stuart Kahl defines it as "a tool that

teachers use to measure student grasp of specific topics and skills they are teaching. It is a

midstream tool to identify specific student misconceptions and mistakes while the material is

being taught" (Stuart Kahl, 2005, 9.11). Dylan Wiliam (2011) thinks educators more frequently

use formative assessment to refer to a particular kind of assessment instrument, preferably a process to improve instruction.

Heritage (2007) identified four core elements of formative assessment: a) identify the "gap," (b) feedback, (c) student involvement, and (d) learning progressions. In his seminal paper, Sadler (1989) concluded the purpose of formative assessment is to identify the gap between the student's current learning and desired learning goal. He revealed that this gap would vary from student to student and clarified the consequences for pedagogy: if the gap is conceived as too large by students, their goal may be unattainable, resulting in discouragement and a sense of failure on the part of the student. Likewise, if the gap is conceived as too small, closing this gap might not be worth any individual effort. Hence, formative assessment is a process that requires identifying the "just right gap."

Heritage (2007) speaks on the validity of formative interactions to support learning. The purpose of formative assessment is to promote further learning, and its validity hinges on how effective learning takes place in subsequent instruction. This implies that it is the extent to which formative interactions are successful in supporting the synthesis and internalization of new meanings that determine the "consequential validity" (Heritage, 2007) of formative feedback strategies (Clark, 2011). Wiliam (2007) defines characteristics of formative assessment as "is that evidence about student learning is used to adjust instruction to better meet student needs" (p. 191).

Whether defining formative assessment in terms of instruction or individual learning, both teachers and students should use it to inform activities and the overall learning process. Multiple sources confirm that formative assessment significantly impacts student learning when delivered using feedback, questioning, and peer-to-peer assessment and when such formative

assessment is an embedded element of a teacher's everyday practice (Black & William, 1998; Shephard, 2000; Hattie, 2003; William & Leahy, 2015). Regular use of classroom formative assessment can substantially improve student achievement (Wiliam, 2011). Formative assessment can be organized. When the teacher uses an already prepared observational instrument to learn about her or his students' motivation, it can be informal when the teacher spontaneously questions students about their methods of solution (Ginsburg, 2009). Research shows that formative assessment and, in particular, feedback and instructional correctives can be a powerful technique to support student motivation and achievement (Cauley & McMillan, 2009).

Formative assessment could be done using both formal and informal methods. Formal methods allow for a more in-depth picture of student achievement and document learning. Daily checks are used by teachers to assess student understanding through informal methods. These daily checks could be in the form of discussion, questioning, and real-time checks during instruction. Wiliam and Leahy (2015) stressed that formative assessment provides evidence about your students' strengths and weaknesses and can provide various instructional techniques to improve questioning. Whether the assessment is formal or informal, it could be used to assess learning, but timely use of the data is important for improvement.

Formative assessment gives teachers tools to help them tailor teaching to specific learning needs. It is important to the teacher because it helps teachers meet students' needs, tracks student achievement, and provides opportunities for them to succeed. An assessment becomes formative when used to adapt or change teaching strategies, curriculum, or both to meet the students' needs (Brink & Bartz, 2017). Teachers need to use a variety of distinct strategies to

assess student readiness and plan their instruction around their students' needs. Strategies used to conduct formative assessment take place during regular class instruction.

2.4. **Formative Assessment Strategies/Activities**

Shavelson et al. (2008) recommended three types of formative assessment strategies that could be used during the instructional process. They are (i) On-the-fly assessment, which occurs spontaneously during the course of a lesson to assess the progress of students (ii) Planned- for interaction, when the teacher decides beforehand how she will elicit students' thinking during the course of instruction (iii) Curriculum-embedded assessment, which is placed in the curriculum to assess to see whether students have achieved certain learning goals. When teachers implement formative assessment, they interact with students and make on the spot judgments to provide support and encouragement.

Effective formative assessment involves using tasks that elicit evidence of students' learning then using that evidence to inform subsequent instruction. There are several formative assessment activities teachers can employ in their classrooms to monitor progress, collect evidence of student learning, and decide about current and future instruction. To effectively implement formative assessment in their classrooms, teachers should use several of the existing activities (Principles to actions, NCTM, 2014). Below some of those activities are described.

2.4.1. **Questioning**

Several studies have shown that to assess students' level of understanding, teachers could use questioning as a formative assessment method during a lesson (Shepard et al., 2005; Wiliam, 201). Questioning provides immediate feedback on students' understanding and the teacher with the opportunity to identify gaps in knowledge and correct misunderstandings. Questioning strategy can be used for small groups, a whole class, or an individual student. The teacher

provides prompts or questions, and students verbally reply or write their thoughts on a paper and show their work. This strategy assists the teacher in planning and selecting the teaching strategies in moving students from where they are to where they need to go.

2.4.2. **Small Grouping**

Small grouping allows teachers to extend content while allowing students to work with various students, for example, students of like interests and like readiness and students with different interests. Benders and Craft (2016), in their research study of the effect of small grouping on mathematics achievement, revealed that most mathematics teachers still use mathematics instruction in the traditional one-size-fits-all way. Small grouping in math classes allows teachers to manage instructional time productively and focus on the needs of students in smaller groups as it is difficult to meet the needs of those students at their level. Students should be provided with small group instruction (Tomlinson, 2008).

2.4.3. **Exit ticket**

Exit tickets are short response tasks given by the teacher to students after a task or lesson to get information about the next moves. This is an on-the-spot assessment (Marshall, 2018). After comprehending students' responses and deciding the next steps, teachers design and administer quality exit tickets. Exit tickets provide opportunities for teachers to elicit students' thinking without affecting their grades. It also provides individualized feedback and identifies modifications or learning needs to an instructional plan (Black & Wiliam,1998b). It provides the teacher with an understanding of the students' current levels of understanding on a given topic so that the teacher can adjust the instruction to better meet the students' learning needs (Wiliam, 2017). Students' responses from this task assist the teacher in planning the next stages of learning

by spotlighting whether a teacher should reteach the concept, clarify ideas, give practice, introduce new concepts, or restructure future instructional activities (Marshall, 2018).

2.4.4. **ABCD Cards**

ABCD cards are used for questions with multiple answers, one answer, wrong answer, or no right answer. Each student is given a set of cards. Students can signal the correct answer when the teacher poses a problem or question by holding up the correct card. Multiple correct answers allow the teacher to incorporate items that support differentiation, and they are useful for challenging the highest-achieving students (Wiliam, 2017). These cards require the teacher to plan questions ahead of time.

2.4.5. **Mini Whiteboards**

The mini-whiteboards technique can engage the entire class and provide helpful evidence of student learning. Every student should have a whiteboard; they can use it to write their answer and raise their board so that teacher can read it. The teacher can frame a question and get a response from the whole class quickly (Wiliam, 2017). The teacher can guage student understanding quickly to adjust how to move forward. Teachers could also use a tablet that Wiliam (2001) defined as a modern invention for learning.

2.4.6. **Observation**

Observing the students is one form of formative assessment as they work on a task or activity. The teacher walks around the classroom to monitor and offer guidance and encouragement as they work. This method works best when the teacher likes to know how students work individually or in groups. Based on the teacher's observation, she can decide whether or not modification needs to be made to that task or activity. Observation also assists teachers in understanding misconceptions, like the teacher asking students to talk about what

they find confusing or do not understand or maybe explain their thinking while working on a task. The teacher should be prepared with guiding questions. This strategy can be conducted in a think pair or individually.

2.4.7. **Bell Work**

Bell Work is used for assessing the initial understanding of the content the teacher is planning to teach that day. The teacher asks or writes down the questions on the board at the start of a lesson. Students write their responses on a piece of paper or index card. The teacher uses these responses to determine on students' understanding of the previous day's lesson, which will help her improve the teaching and learning in that lesson.

Even though formative assessment is effective in improving student learning, literature suggests that it is ingrained with some issues. Most teachers do not have the skill and knowledge for implementing formative assessment (Bennet, 2011), and it "is rarely consisted part of the classroom culture" (Brookhart, 2009 p.1). Teachers do not find time to develop as well as carry out the activities in implementing formative assessment (Cizek, 2010) and fail to have a clear understanding of the practice (Black & Wiliam. 1998a).

2.5. The Role of feedback in Formative Assessment

Feedback plays a critical role in teaching and learning (Brookhart, 2007; Burke & Depka, 2011) and is at the center of formative assessment (Hattie & Timperley, 2007). Feedback is one of the strongest factors influencing learning. (Black & Wiliam, 1998; Crooks, 1988; Hattie & Timperley, 2007; Hattie, 2009; Sadler, 1989). The main purpose of feedback is to enhance students' learning (Black &Wiliam, 1998b; Hattie & Timperley, 2007; Wiggins, 2012). Hattie and Timperley (2007), as stated in their frequently cited and important article "The Power of Feedback," developed a feedback model to assess learners by presenting the following questions

(i) Where am I going? (ii) How am I going to get there? (iii) And where to next? The first question is related to learning goals, the second question is on feedback about learner progress, and the third question focuses on specifying the challenges the learner may experience to be autonomous (p. 4-5). Hence, learning will not be successful without efficient feedback. The essential purpose of feedback is to improve the students' ability to perform the task (Wiliam, 2012).

Feedback exists in a wide range of ways; it can be written comments on assignments or given verbally (verbal comments on the activities, during a learning activity informal and rapid feedback) (Yorke, 2003). Feedback can be either a spontaneous process, or the teacher can plan the feedback for students. Although research has identified that feedback is a significant instructional tool to support student learning, the quality of feedback and how it is actually applied in a structured and sustained manner have been established as factors affecting success in classrooms (Black & Wiliam, 1998; Hattie, 2012; Hattie & Timperley, 2007). "Feedback is information about the gap between the actual level and the reference level of a system parameter which is used to alter the gap in some way" (Ramaprasad, 1983, p.4). Feedback should consider three essential elements about a task[:] 1) what was done well, 2) what needs improvement, and 3) how to improve it. This information can be communicated in writing, orally, or as a question that causes students to reflect. Effective feedback facilities should focus on learning goals and success criteria recognized for accomplishing the task (Heritage, 2008). Teachers' feedback strategies play an important role in the learning acquisition process, especially in the mathematics classroom. Black and Wiliam (1998a) revealed that teacher feedback was more effective when given in an unjudgmental way with specific suggestions for improvement.

For feedback to be effective, teachers should provide students feedback on their work based on success criteria for that learning experience (Wiliam, 2017). This feedback is most effective when it occurs in real time. The learners who get written feedback in the form of comments used it productively to improve their work (Wiliam, 2007). Giving comments by marking is the specific way of providing feedback that makes students' learning move forward by helping a student to identify weak and strong points of their work (Black & Wiliam, 2003, 2009). However, Hattie and Timperly (2007) stressed that teachers should give feedback with comments that are not ambiguous. Putting a check or cross next to the student's solutions leaves nothing for the student to do, except maybe correct those errors. An alternative to this would be to give them written comments on how to fix them (Wiliam, 2017).

Encouragement and praising strategic behaviors and learning through feedback leads to higher achievement than praising ability or intelligence (Nicol & Macfarlane-Dick, 2006). According to Hattie and Timperley (2007), negative feedback can deter student effort and achievement. Marzano et al. (2001) argued that feedback needs to be specific, corrective, and timely to have the greatest impact on student learning. A teacher needs to give students feedback that is at and just above their current level of learning (Hattie, 2012). Specific feedback enables them to perceive whether students have mastered a skill, somewhat mastered it, or have not mastered it (Marzano et al., 2001). Students hear little feedback about tasks and strategies (Hattie, 2012). Feedback to any student should be about the particular qualities of their work, with advice on what they can do to improve, and avoid comparisons with other students (Black & Wiliam, 1998 a). A numerical score or grades do not inform a student how to improve his/her work, so an opportunity to enhance his/her learning is lost (Black, Harrison, Lee, Marshall, & Wiliam, 2004). The feedback students receive from teachers helps them know where they are

with the learning goal and regulate their learning (Black & Wiliam, 2010). Students will successfully reach their learning goals when they feel confident and know where they are with the learning goal.

Feedback is a vital component of successful formative assessment (Bell & Cowie; Sadler, 1989; Williams, 2004). Nicol & Macfarlane-Dick (2006) further added that the feedback should be timely, which fulfills the requirement of formative use. Teachers should utilize formative assessment to provide students with opportunities to get feedback and revise their thinking (Bransford et al., 2000). Therefore, teachers need to provide students with "timely feedback" opportunities. A teachers's goal is to improve student learning and achievement; therefore, teachers need to know what feedback strategies or interventions work best for their students (Hattie & Timperley, 2007; Hattie, 2012; Nicol & Macfarlane-Dick, 2006). Teachers' feedback to learners is limited in traditional classroom teaching (Bransford et al. 2000, pp. 140–141).

In summary, research by Black and Wiliam (1998), Crook (1988), and Natriello (1997) revealed that all feedback is not considered effective and beneficial for learning (Wiliam, 2011). It should have detailed plans with activities to help students improve their learning and achieve the learning objectives. Sadler (1989) stresses that the role of teachers in formative assessment is more than just to provide feedback to promote learning. Feedback is not just for identifying errors but instead for assisting students in raising their academic performance (Wiliam, 2011).

2.6. **Teachers' Beliefs**

Over the last two decades, the term beliefs have been proposed in the literature by various descriptions and definitions, making it difficult to establish a clear definition of it (Barkatsas & Malone, 2005). Richardson (1996) revealed that beliefs are examined as psychologically held understanding or propositions about the world perceived as true. Beliefs cannot be measured or

observed directly, and hence they can only be inferred from what people say and do (Pajares, 1992). Belief act as a filter through which teachers interpret new information and experience (Phipps & Borg, 2009).

The term "teachers' beliefs" is typically used to refer to teachers' pedagogical beliefs or beliefs of individual teaching relevancy. Teachers' beliefs play a vital role in their teaching. Understanding teachers' beliefs is a significant step toward understanding their instructional practices (Thompson, 1992; Pajares, 1992). Thompson (1984) asserts teachers' beliefs "seemed to be beliefs operate as a filter through which teachers comprehend new information and experience and further added that "seemed to be manifestations of unconsciously held views of expressions of verbal commitments to abstract ideas that may be thought of as part of a general ideology of teaching" (p.112). Teachers' beliefs may play a vital role in mathematics education reform because their beliefs lead to action, and those actions affect students (Richardson, 1996). Richardson (1996) mentioned that teachers' beliefs are thought to have two functions in learning to teach. First, it is related to constructive learning theories, which suggest that learning is a dynamic and constructive process that is firmly influenced by individuals' existing understandings, perceptions, and beliefs. Second, teachers' beliefs are the focus of instruction. It is significantly acknowledged that teachers' beliefs influence their teaching (Beswick, 2006). Teachers' beliefs influence their perceptions and judgments, which, successively, affect their behavior in the classroom (Pajares, 1992) and influence their teaching practices (Polly et al., 2013). Handal & Herrington (2003) describe mathematics teachers' beliefs as an individual's perspective on engaging in mathematical tasks and pedagogical practices. Pajares (1992) stresses teachers' beliefs about mathematics are not likely to change, except if they are unsatisfied with their existing beliefs. And they are not likely to be unsatisfied except if they are challenged, and

one is capable of assimilating them into existing beliefs. Richardson (1996) describes three categories of experience that influence the development of beliefs about teaching. Those are personal experiences, schooling and instruction experiences, and formal knowledge experiences.

2.7. **Teachers' Beliefs about Assessment Practices**

Teachers' beliefs about formative assessment and evaluation can directly affect how they implement and use their student formative assessment and evaluations and how they interpret the results (Karim, 2015). A strong belief in formative assessment results from having a good understanding of the benefits of conducting a formative assessment (Widiastuti et al., 2020). The way teachers conduct a formative assessment is powerfully influenced by their beliefs (Leung & Scott, 2009, Widiastuti et al., 2020), and how they make decisions about students' academic performance is powerfully influenced by their beliefs in assessment practices (Büyükkarci, 2014). Teachers who have a firm belief in formative assessment benefits are more likely to carry out formative assessment properly (Karim, 2015). Teachers ' beliefs and values, their support for students' success, willingness to use various assessment strategies to meet students' needs, and their ability to engage students in the assessment process influence their formative assessment adoption (McMillan, 2003). Several researchers conducted studies on EFL teachers and concluded that teachers' belief in formative assessment influenced formative assessment practices' success and failure (Guadu & Boersma, 2018; Karim, 2015). Various factors influence formative assessment practices (Black & Wiliam, 2009), like teachers' beliefs, attitudes, and perceptions about teaching and learning (Karim, 2015). Therefore, teachers should have significant knowledge and skills to make formative assessment a pedagogical tool to enhance teaching and learning (Heritage, 2007).

Büyükkarci (2014) conducted his study on 69 primary language teachers in Turkey to outline the formative assessment perceptions. The findings of Büyükkarci's (2014) research show that primary language teachers had positive beliefs about formative assessment. They believed that feedback, sharing learning goals, peer assessment, and self-assessment are beneficial for learning. But their use of formative assessment in their classrooms was notably less because they could not use formative assessment very often and effectively because of the heavy workload of overcrowded classrooms.

Several studies indicated a notable relationship between teachers' beliefs and instructional practices (Barkatsas & Malone, 2005; Pajares, 1992; Polly et al., 2013; Thompson, 1992). Richardson (1996) affirms that teachers' beliefs are important considerations in understanding their classroom practices, and beliefs are the focus of instruction. Some researchers think understanding teachers' beliefs is an important move toward understanding teacher instructional practices (Thompson, 1992; Pajares, 1992). Teachers with instructional practices can influence students' learning experiences (Hughes, 2016). Pajares (1992) asserted that mathematics teachers' beliefs reflect personal theories regarding the nature of mathematics and mathematics teaching and learning that impact their decision-making and choice of instructional practices.

Boston (2002) reveals that formative assessment is linked with instructional practices. Mathematics teachers with knowledge and skills in formative assessment can better organize their instructional practices to promote student learning (Buck & Trauth-Nare, 2009). Assessment for learning (formative assessment) should be considered an essential part of an instructional process and an important element in teachers' efforts to help students learn (Bernard, 2020). Formative assessment is a process involving three essential elements (i) goal setting for instruction, (ii) assessment, and (iii) instructional feedback to promote adaptive

teaching (Black & Wiliam, 2009; Wiliam & Thompson, 2007). Formative assessment is a continuous recurring process that uses assessment-based evidence to make instruction decisions while learning happens (Black & Wiliam, 2009). Black (2013) reveals that formative assessments are vital to guide and enhance students' learning and teachers' instructional practice.

Barkatsas and Malone (2005) conducted a case study on a veteran mathematics teacher in Australia. Their analysis shows that the teacher's beliefs were inconsistent with her instructional practices. Whereas Stipek, Givvin, Salmon, and MacGyvers (2001) conducted a study on 24 elementary school teachers in California, they found a substantial, coherent set of beliefs that anticipated their instructional practices. Teachers with more traditional beliefs stressed students getting correct answers and good, instead of learning and understanding. They also provided them relatively less autonomy. Cohen and colleagues (2009) conducted their study on five high school mathematics teachers who teach Algebra I to find the relationship between mathematics teachers' beliefs and classroom practices. The study's finding was that there is no clear linear relationship between beliefs and practice, and other factors also influence how teachers perceive and constitute their roles in the mathematics classroom.

In summary, belief is defined by different researchers in different ways; some define it in a simple way and others in more complex ways. Pajares (1992) defines beliefs as "an individual's judgment of the truth or falsity of a proposition" (p. 316). At the same time, beliefs are not always reflected in what teachers do in the classroom (Phipps & Borg, 2009). According to White (1999), beliefs help individuals interpret and make them aware of the world and themselves; beliefs are instrumental in interpreting tasks and play an important role in interpreting behavior. For that reason, an investigation into teachers' beliefs is needed to achieve

a better understanding of their implementation of formative assessments in the classroom (Borg, 2001).

Literature shows that formative assessment practices increase student achievement when used as teaching strategies (Black & Wiliam, 1998a, 1998b). Black and Wiliam (2009) suggested formative assessment reduces performance gaps and helps students, especially low achievers. It was also highlighted that formative assessment can only be effectual if it is communicative and interactive by a dialogue between a teacher and a learner (Black & Wiliam, 2009). Teachers' beliefs can play an important role in mathematics education reform because their beliefs lead to action, and those actions affect students (Richardson, 1996). Handal & Herrington (2003) describe mathematics teachers' beliefs as an individual's perspective on engaging in mathematical tasks and pedagogical practices.

With this existing literature on teachers' beliefs, formative assessment, and formative assessment practices, it is essential to understand teachers' beliefs about formative assessment and teachers' formative assessment practices in the mathematics classroom. Since there is a lack of research explicitly devoted to formative assessment beliefs and practices in the rural area secondary school mathematics classroom, this study could fill this gap by investigating mathematics teachers' beliefs toward formative assessment and their actual practice in the mathematics class with particular reference to the research site high school. Therefore, the existing literature guided me to build my research questions on formative assessment teachers' beliefs.

2.8. **Research Questions**

The research questions that will guide my dissertation are:

1. What are secondary school mathematics teachers' beliefs about the importance of formative assessment?

2. How are secondary school mathematics teachers' beliefs about formative assessment reflected in their classroom practices?

2.9. **Conceptual Framework**

This section emphasizes the conceptual framework guiding this study and the analysis of the findings. The goal is to shed light on and clarify the theory that informs the development of conceptual work applied to guide this study. This section also describes the theoretical discussion of the parts of the conceptual framework and how these parts can be explored.

The research questions in this study were explored to examine mathematics teachers' beliefs on the importance of formative assessment and its practices. The work of Black and Wiliam (2009) was considered to be relevant for the study while developing a conceptual framework that could analyze teachers' beliefs and practices of formative assessment. The theory of Black and Wiliam (2009) is based on Ramaprasad's (1983) three key processes in learning and teaching: "Establishing where the learners are in their learning, establishing where they are going, and establishing what needs to be done to get them there" (p.4). While developing their theory of formative assessment, Black and Wiliam (2009) combined the three processes. This theory informed the way in which mathematics teachers' beliefs and practices of formative assessment were investigated and how they make sense of this concept as teachers apply it in the classroom. This framework describes the purposes for using formative assessment, and the framework was developed for K-12 students. The big idea for this framework is that evidence about learning is used to adjust instruction to better meet students' needs; in other words, teaching is adaptive to the learners' needs (Wiliam, 2017).

2.10. **Formative Assessment Theory**

Black and Wiliam (2009) provided a visual of the Formative Assessment model by intersecting the five key strategies of formative assessment with the role the teacher, learner, and peer have. Those strategies are:

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;

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

	Where the learner is going	Where the learner is right now	How to get there
Teacher	1. Clarifying, sharing, and understanding learning intentions and success criteria.	2. Facilitating evidence of learning by engineering effective classroom discussions and other learning tasks.	3. Provide feedback that moves learning forward.
Peer		4. Activating learners as instructional resources for each other.	
Learner		5. Activating learners as owners of their own learning	

Figure 1: Key aspects of Formative Assessment (Black and Wiliam, 2009).

According to this model, thinking and learning processes are supported when students are given information and feedback regarding the learning criteria and standards by which they are

assessed, and there is the subsequent use of that feedback by students and teachers as they plan the next steps of the learning process together. The key strategies of this theory are connected and sometimes dependent on each other's existence and performance. For instance, clear learning intentions allow the teacher to select tasks/questions that elicit relevant information about students' learning and assist the teacher in giving goal-directed feedback.

For this study, the researcher primarily focused on the first three aspects of the teacher's role out of five aspects. Because the researcher was considering high school mathematics teachers' beliefs of formative assessment and its practices in their classrooms, it mainly depended on the actions of the teacher represented by the first three aspects of the top row. Students' actions were not a part of this study.

The three aspects that primarily focused on teacher role are (i) clarifying, sharing, and understanding learning intentions and success criteria, (ii) facilitating evidence of learning by engineering effective classroom discussions, and other learning tasks, and (iii) providing feedback that moves learning forward. The three strategies mentioned above require teachers 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).

These aspects in formative assessment are connected and at times dependent on each other's existence and performance. Clear learning intentions help the teacher to choose tasks/ discussion questions that elicit related information about students' learning and assist the teacher in providing purposeful feedback. Below, the researcher described the first three key strategies of the formative assessment model developed by Black and Wiliam (2009).

2.10.1. **Clarifying, sharing, and understanding learning intentions and success criteria**

The first feature of the model is **clarifying and sharing learning intentions and criteria for success.** This feature notifies the learners of where they are going. Teachers state goals to students. Teachers should clarify learning intentions and success criteria during assessment (Black & Wiliam, 2009) and provide learners a clear direction of learners' expectations in learning. This means the teacher is responsible for providing appropriate learning targets and success criteria. Students may not have consistent success in learning if they don't know what they will be learning. This communication of learning intentions could be done by the teacher during the learning process at various times using a variety of methods depending on the subject matter and content to be learned (Chappius, 2015).

Teachers need to clarify the purpose and learning goals of the topic or unit they are teaching for themselves and the learners. They should provide explicit criteria on how students can be successful. Teachers should know the knowledge requirements and criteria for excellence and explain the learning intentions and success criteria to students. Clarity in teaching and learning significantly impacts students' learning growth (Almarode & Vandas, 2018). According to Hattie (2009), learning is most successful when teachers see learning through the eyes of their students and students see themselves as their own teachers: this is Visible Learning. Clarity is one of the essential features of Visible Learning (Almarode & Vandas, 2018).

2.10.2. **Facilitating evidence of learning by engineering effective classroom discussions and other learning tasks**

The second feature of the model emphasizes the significance of engineering effective classroom environments to see the students learning level because students do not always learn everything planned (Wiliam 2011). Engineering effective classroom discussion intends to

increase student-teacher interaction through questioning. The teacher should use reflective, stimulating, and probing questions. To activate this feature, it is the teachers' responsibility to provide students with suitable tasks and questions that could elicit evidence of student understanding. Asking high-quality questions is the characteristic of effectively engineering classroom discussions. Teachers need to establish learners' current comprehensive knowledge before providing them with a clear direction of where they are expected to be in their learning. This feature's purpose is also to use classroom discussions and activities to facilitate the acquisition of the knowledge and skills needed to meet the learning targets and elicit evidence of learning. According to Wiliam (2011), the teacher can make the classroom a much more engaging place for students by careful planning and thoughtful application of the different techniques like teacher-led classroom discussion, tasks, exit passes, and activities. All these techniques cause students to think and create student engagement while providing the teacher evidence about the extent of each student's learning and what to do next. Teachers plan activities that allow learners to express their thinking and provide feedback to guide their learning (Black & Wiliam, 1998 a).

Classroom discussion could be done on an ongoing basis by using various methods to know where students are in relation to the target and what should happen next. Classroom discussions will allow teachers to formatively assess students (through observation) to see how well students grasp new concepts and content. Teachers can involve as many students as possible in this discussion, requiring teachers to use good questioning routines and good knowledge-check routines. Questioning could be verbal or written. It is also important how the teacher is reacting to student responses. Simply telling students that their answer is right or wrong has an adverse effect on achievement (Marzano et al., 2001). It is usual for a teacher to assess student responses

for correct or incorrect answers, even though Black and Wiliam (2009) recommended that teachers listen interpretively to the student's response to elicit information about their level of learning and thinking.

2.10.3. **Provide feedback that moves learning forward:**

The third feature of the formative assessment theory is moving learners forward by providing feedback (Black & Wiliam, 2009). Teachers should comment on how to improve their learning and address misconceptions. Teachers should provide feedback to learners that helps them to improve in learning to reach the goals and intentions of learning. Feedback is a significant aspect of the formative assessment procedure as it provides the learners information that could help them enhance their current level of understanding and move toward purposeful learning intentions and goals (Black & Wiliam, 2009). Several studies on feedback have identified that feedback is a significant instructional tool to support student learning; the quality of feedback and how it is actually applied in a structured and sustained manner have been established as factors affecting success in classrooms (Black & Wiliam, 1998 a; Hattie, 2012; Hattie & Timperley, 2007). Therefore**, teachers need to know what feedback strategies or interventions work best for their students** (Hattie & Timperley, 2007; Hattie, 2012; Nicol & Macfarlane-Dick, 2006). Teachers need to provide consistent feedback. It could be individual feedback (verbal or written) or whole group feedback focused on what students are learning to help them achieve more. This also informs learners about where they are moving forward. According to Wiliam (2009), feedback will be only successful if students' learning improves. The goal is not just to improve students' work but also to change their capacity to produce better work. According to Wiliam (2011), feedback should cause thinking by creating desirable difficulties. Feedback should be focused and relate to the learning goals that have been shared

with the students. According to Black & Wiliam (1998b), "feedback to any pupil should be about the particular qualities of his or her work, with advice on what he or she can do to improve, and should avoid comparisons with other pupils" (p. 143).

The researcher chose this model as a basis for the conceptual framework for this study as this research will advance the formative assessment theory in different ways. One of the reasons is Black & Wiliam's (2009) Formative Assessment Theory is used in many current studies and has widespread references. Second, this theory was used by Black & Wiliam (2009) on United Kingdom's primary and secondary school students; the researcher will use the framework of this theory to validate and expand it for the United States rural area secondary school mathematics students.

2.11. **Concluding Thoughts**

In this chapter, the researcher discussed the literature review and the conceptual framework of formative assessment. How the conceptual framework would guide the study and the analysis of the findings of the study were discussed. A detailed understanding of the first three key elements of the Black and Wiliam theory was discussed, and how teachers use it during the process of teaching and learning was also discussed, taking into consideration other researchers' work.

The next chapter presents the methodology and research design used to address the research questions.

CHAPTER THREE: METHODOLOGY

In the previous chapter, the researcher reviewed the literature on assessments, formative assessments, feedback strategies, teacher beliefs, instructional practice, and the influence of teachers' beliefs on their practices. Black & Wiliams's (2009) Theory of formative assessment was introduced as a fitting conceptual framework for this study.

This chapter discusses the study's method. It shows the study design and the participants' demographic information, describes the teacher participant's selection criteria descriptions of the school setting, and then describes the data collection procedure. The data collection procedure includes interviews, classroom observation, artifacts collection, and field notes. It then shows the data analysis procedure. Finally, it discusses the validity and ethical issues of this study. The researcher used pseudonyms for the school, city, and participants.

3.1. **Purpose**

The main purpose of this study is to outline the rural area mathematics teachers' beliefs and practices of formative assessment in mathematics teaching and determine how their beliefs affect their use of formative assessment in their classrooms. This chapter explains how qualitative data were obtained by case studies with the intention to provide insight into the factors that influence teachers' beliefs and practices. The researcher conducted teachers' semi-structured interviews and classroom observations to gather qualitative data to answer the research questions below.

1. What are the beliefs about the importance of formative assessment held by secondary school mathematics teachers of the research site high school?

2. How are secondary school mathematics teachers' beliefs about formative assessment reflected in their classroom practices?

3.2. **Philosophical Worldview**

The interpretive framework that best fits this study is social constructivism, which regards the beliefs about the nature of knowledge and learning. Social constructivists believe that individuals construct their own understanding of the world around them. Individuals are active participants in creating their knowledge, and learning is a social activity that doesn't occur only within an individual, but external factors also enhance it. When individuals are involved in social activities such as collaboration and interaction, meaningful learning occurs. People work together to construct artifacts that are created through the interaction of a group. Constructivist teaching and learning theory explains how people construct their knowledge through experiencing things and reflecting on their current and past experiences (Fernando & Marikar, 2017). From a constructivist perspective, formative assessments are more valuable to the learner. Formative assessment occurs during learning and provides feedback to the student (Board, 2013). The researcher's worldview aligns with social constructivism because the researcher's study focuses on the experiences of teachers who are engaged in implementing formative assessments. The researcher assumes that social constructivism strongly influences how each person learns. Social worlds grow out of individuals' interaction and knowledge sharing in understanding their society and culture. In addition, the researcher relied on the participating teachers' stories to understand their experiences and identified the factors that influenced the process of implementation.

3.3. **RESEARCH DESIGN**

This study was based on a qualitative research design. Based on the purpose of this research and chosen worldview thinking, the qualitative research design was most appropriate. The researcher employed a qualitative research design because this research is focused more on

the point of view, perception, and experiences of teachers. Interpretations are compiled based on "what they see, hear, and understand" (Creswell & Poth, 2016 p.39). Merriam (1998) laid out five features in a qualitative method. Those are " (i) the goal of eliciting understanding and meaning (ii) the researcher as the primary instrument of data collection and analysis (iii) the use of fieldwork (iv) an inductive orientation to analysis and (v) findings that are richly descriptive" (p.11). Creswell and Poth (2016) asserted that the qualitative method assists in examining learning strategies, hearing learners' voices, and understanding their experiences.

Qualitative research is "how things work in certain contexts, at certain times, and with certain people" (Stakes, 2010, p. 14). Pajares (1992) reveals that qualitative research methodology is relevant, appropriate, and promising in knowing teachers' beliefs. Creswell and Poth (2013) argue that qualitative research helps investigate the meaning humans give to a specific problem. Qualitative research draws on a combination of techniques to record and construct research data rather than on a single technique (Glesne, 2016).

3.4. **RESEARCH TRADITION**

Case study research methodology was used for this dissertation because it suits the nature of this research in examining a specific case of a group of people (Yin, 2013) within a real-life setting or context (Yin, 2009). Creswell (2013) thinks that the goal of research should be to rely as much as possible on the participant's view of the situation. Because the overall design uses a case study approach, the study itself is qualitative. A case study that is qualitative in nature, like this present study, provides a unique example for real people in real situations. The case study technique is a comprehensive research inquiry (Yin, 2009), a bounded system by time and place (Creswell & Poth, 2013), and "not a methodological choice but a choice of what is to be studied (Stake, 2005, p. 438). A case study is studying the complexity and particularity of a single case,

coming to understand its activity within important circumstances (Stake, 2010). A qualitative

case study comprises the intensive study of an incident (Glesne, 2016). Since no one data source

is sufficient on its own, this method requires the use of multiple data collection (Stakes, 2010). In

this context, the researcher collected qualitative data through semi-structured interviews with

teachers and their classroom observations. The qualitative case study method assisted the

researcher in elaborating on the teacher's actions and thoughts of formative assessment. This

method gave an in-depth look at the interviewed participant's perspectives and the researcher's

analysis while conducting the investigation.

The researcher analyzed data of all three teachers separately to understand their

assessment beliefs and practices, then the researcher compared and contrasted the three cases to

completely understand the external factors and phenomena of classroom assessment in this

specific context that affects teachers' formative assessment beliefs and practices.

The below table shows the data collection methods used for each question of the study.

Table 1

Data Collection Methods used for this Study

Research Question	Method used and Duration
1. What are the beliefs about the importance of formative assessment held by secondary school mathematics teachers of research site school?	Observations Interview August 2021- December 2021(observations) November 2021 – December 2021 (Interviews)
2. How well are mathematics teachers' understanding of formative assessment aligned and reflected in their classroom?	Observations Interview Field Notes Documents Analysis

	(lesson plan, teaching material, handouts used by teacher during observation) August 2021- December 2021(observations) November 2021 – December 2021 (Interviews)

3.5. **CONTEXT & PARTICIPANTS**

This section gives details about the research site and participants.

3.5.1. **RESEARCH SITE**

The research site was a rural high school located in eastern Georgia, where the majority of the students are from low-income families. This school is a part of a rural school district with three elementary schools, one middle school, and one high school. The total population of the students in the county is 2,354 (K-12). The high school population is approximately 764, with 60 faculty and employees. The ethnic composition is African American, Caucasian, and a few Hispanic and Asian students. The percentage of students receiving a free and reduced meal is 100%. The population breakdown of the high school is African American 519, White (Non-Hispanic) 194, Hispanics 28, and Asians 6. The female population is 379; African- American females are 267, and white females are 90. The school consists of almost 68% of minorities. All the students are on free lunch. Students usually have to attend four 90-minute class periods every day, five days a week. The research site school offers math courses in Algebra 1, Geometry, Algebra 2, College Readiness, Pre-Calculus, and Calculus. Most students use a school bus for transportation, and only a few drive to school. Many of them do not have access to a computer or the internet at home.

3.5.2. **Participant Selection**

After acquiring approval from the administration of the research site school to conduct this study in the math department, an open invitation was sent to all mathematics teachers, asking for volunteers to participate in the study. This study was open for all mathematics teachers to ensure everyone had a chance to participate in the research. The researcher selected three participating teachers from the research site's math department. The reason to select three participants was the number of mathematics teachers in the participating school. There were six mathematics teachers in the mathematics department. The researcher was trying to involve 50% of the participants to involve a fair number of participants in the study. There were more than three interested participants; names of the willing participants were drawn out of a basket to provide equal opportunity for all willing participants. Participants' willingness to share their views and practices in data collection was considered while selecting the participants.

3.5.3. **Description of Participants**

Three teachers from a rural high school volunteered to participate in this research and shared their beliefs about and practice of formative assessments. Participants for this study were from different ethnical backgrounds and ages to assure more cultural and diversity richness in the sample. After the participants signed the consent form, the researcher discussed the time and date and conducted the interview with them. The researcher answered their questions about the study prior to their interviews.

3.6. **DATA GATHERING METHODS**

Even though beliefs cannot be measured or observed directly, they can be inferred from intentions to behavior, belief statement, and actions relative to the belief (Pajares, 1992). Hence, data was collected by multiple instruments like semi-structured interviews, classroom

observations, field notes, and the collection of artifacts (teachers' lesson plans and teaching materials). Using these multiple data sources helped in bringing internal validity to the study by providing the opportunity for triangulation of the data. According to Glesne (2016), triangulation is a way to validate claims by using more than one method for obtaining data**.** The researcher's goal for data gathering instruments was to focus on the relationship between mathematics teachers' beliefs and the effective use of formative assessment in a secondary school mathematics classroom. This study was conducted during the fall semester of 2021.

Participating teachers chose a date and class for the researcher to observe. The researcher and teachers selected two dates for classroom observation. A semi-structured interview was conducted after agreeing upon a date and time. The researcher also collected participating teachers' documents (like lesson plans and teaching materials) related to the courses that the researcher observed. Observation was used for this study to strengthen the data collection through other means. Observation was done in participating mathematics teachers' classrooms, and the interview was scheduled during the semester. Interviews were the leading source of information about the teachers' practice, and the classroom observations and data collection also assisted in validating the conclusion drawn from the interviews.

3.6.1. **Classrooms Observations**

The researcher did two mathematics lesson observations per teacher in their classroom, believing it would provide a first-hand account of how the teachers use formative assessment. Observation leads to a richer understanding of the participants and the social context and permits researchers to check the definition of terms that participants use in interviews (Kanwulich, 2005). Observations are not just on a specific aspect of the lessons. They help the researcher focus on what is happening in the classroom, which will give deeper insight into how

mathematics teachers' interpretation of formative assessment plays out in class. Prior to observation, the researcher consulted the participating teachers to identify a day that would be a typical class day for observation and made sure they were using formative assessment on observation day. Participating teachers chose the class to be observed. At the research site high school, each class is 90 minutes long. The researcher observed at least 60 minutes of the class for each observation. The researcher used the observational form (see appendix II) to record ongoing activities and descriptions of the classroom environment. The observation form has details about the observation date and time, information about the subject and unit, and the classroom's physical structure in terms of seating arrangements, size, technology, ventilation, cleanliness, heat, and safety.

Notes taken during each observation were reviewed after every observation to support clarification. Notes included activities and events occurring in the class and conversations between the teacher and students. Participants' use of formative assessment framework activities with their students, frequency of its use, and feedback provided by the teacher noted during observation. The researcher used the notes from the classroom observations to describe teaching practices and context for the discussion with all three participating teachers in both interviews regarding their beliefs. The researcher participated in a follow-up debriefing with the participating teacher of each observation to discuss any questions. This follow-up session was conducted during the planning period of the participating teacher. The time of this debriefing depended on the needs.

3.6.2. **Field Notes**

Field notes from this study described the location and atmosphere of classroom observation. Field notes included actions or quotes by the teacher during the observation. The

researcher intended to capture everything that happened during observation. Therefore, the researcher noted the details and descriptions of the active-board work, any materials handed over to students, a conversations between students and teacher, teacher observations of students, and any important actions by the teacher and students that were felt essential for analysis.

3.6.3. **Interviews**

Interviews are an essential source of data (Yin, 2011). For this study, interviews were the vital tool for teachers' views because the researcher's purpose was to obtain access to all participant teachers' own voice and understanding. The researcher conducted an interview with each participating math teacher. The researcher used semi-structured interview questions (Appendix D) with follow-up questions to get clear responses and depth about the expressed beliefs of teachers. Participants were capable of expressing their perspectives in detail. Stakes (1995) stresses that interviews are the "main road to multiple realities" (p. 64), a design that influenced this research. The interview was focused on teacher participants' beliefs about formative assessment and instruction practices they use in their classroom. The researcher used scholarly articles to discover what types of questions other researchers have asked in similar research topics. The researcher prepared a set of questions to guide the interview. The interview questions were of three categories. The first category was on gathering information about the participant teachers' educational background experience, the second set of questions was on their beliefs, and the last one was on their classroom practice. Both teacher and the researcher mutually agreed on the date and time of the interviews.

One semi-structured interview was performed with each of the three participants. It was left to teachers to decide the venue. They decided to use their classroom for the interview as the

participants were comfortable and felt safe there. The semi-structured interviews were conducted after the teachers' classroom observations. Each interview lasted for about 30-40 minutes.

Interviews were audio-recorded on two devices; on a digital audio recorder and voice memo on an apple phone. Recording the interview on both devices made it easier for the researcher to focus on the interview and created a verbatim transcript. The researcher transferred and stored the interviews and made sure that the quality of sound of the interview was maintained. The researcher used "Otter" software to transfer and transcribe the interviews.

For the interview, the researcher used the protocol included in Appendix I during the interview. The researcher avoided asking biased questions and questions that could be answered with yes or no but asked unplanned questions so that additional information could be gathered. The interview lasted for about thirty to forty minutes. Open-ended questions allowed participants to give free-form answers.

Through the interviews, the researcher investigated participants' underlying thoughts regarding the purpose of formative assessment and views on implementing formative assessment in their classroom.

3.6.4. **Documents:**

The researcher collected the participating teachers' instructional and assessment documents (Ex: teachers' lesson plans, teaching material including learning tasks, and blank worksheets provided to classes by teachers to which teachers referred in their teaching. All three participants provided lesson plans that outlined the date/course/standards, learning intentions, success criteria, and teaching-learning activities for the lessons. These provided documents can corroborate other data that could triangulate the data during data analysis (Merriam, 1998), even though these documents were not shaped in response to the research questions. The purpose of

collecting blank worksheets was to look for whether teachers utilize formative assessment. The data collection supported analysis with information or clarification and provided a perception of the meaning and sense in the data. Documents were also validated by the researcher's observations and interviews and made the researcher's findings more trustworthy.

3.7. **Data Storage and Management**

To maintain confidentiality and protect the participant's identity, the researcher made sure that no other individuals had access to data and used several safeguards to protect the identity and maintain confidentiality. All electronic or hard copy documents provided by a participant were coded with a unique number. No individually identifiable information was associated with any of the documents or files. Pseudonyms were used on documents and hard copies of transcripts. After transcribing the interviews, data was stored on the researcher's personal computer. A secured password protected this personal computer. All the data were saved in an electronic form on a USB drive for three years, at which time the files will be wiped clean or purged. Consent forms signed by the participants will be shredded after three years.

3.8. **DATA ANALYSIS**

Data for this study were gathered from individual teacher participant interviews, which were transcribed, classroom observations, and document analysis. The researcher reviewed the collected data and organized and analyzed the data into categories to make sense of it. Data procedures were followed by those outlined by Yin (2011) and Stake (2010) for analyzing observations and interviews. The three sets of data to analyze were observation, document, and interview data. The interviews were the prime source of information regarding teachers' beliefs, and the observations assisted in validating the conclusions resulting from the interviews.

After completing the observations and interviews, the researcher transcribed the audio recording of interviews using Otter software and copied it on a Word document to understand the data thoroughly and prepare for the analysis. To identify each participant's teachers' interviews, pseudonyms (participant 1, participant 2, and participant 3) were used during transcribing. The researcher composed field notes from observations and transcribed them verbatim in a Word document. During analysis, the researcher listened to all recorded interviews several times to check the collected data for accuracy and to make sure that they were the true responses of the participant teachers. The researcher also referred to field notes that she took during observations. Reading observation notes and field notes of the classroom observation while transcribing helped the researcher to gain a deeper understanding of what participant teachers were doing in their mathematics classes. The researcher read transcriptions twice, line by line, to begin coding. The researcher did manual coding. Then the researcher generated codes from the data. The interview transcriptions were coded by identifying similar ideas and patterns to generate a complete picture (Saldana, 2013). Coding was done based on the researchers' identification of similar ideas and personal judgment.

The researcher did a descriptive analysis of each document while analyzing document. Documents analysis was done to determine what formative strategies, when, and how were given to students. Data from documents were transformed into Word documents and analyzed. Teachers' lesson plans and the teaching material they used on the day of observation were used. These documents also revealed how teachers' beliefs influenced their formative assessment practices.

Coding was done to assign meaning to descriptive data. According to Saldana (2013), a code in qualitative inquiry is most often a word or short phrase that symbolically assigns a

summative, salient, and essence capturing for a portion of language-based or visual data. Merriam (2009) stresses that coding is about reading carefully transcribed data line by line and dividing it into a meaningful component. This process involved going back and forth on the transcripts of the interview. The researcher read the transcripts several times to make sense of them. The researcher used open coding to examine the data and then label the code that emerged from the transcripts.

The researcher did coding manually while attempting to identify phrases or keywords in mathematics teachers' beliefs and practices of formative assessment. Hence, while reading the interview and observation transcripts, coding was done by hand. Same idea codes were pulled together to make themes. The researcher used different colors for coding. During the coding process, the data were classified into categories and themes based on formative assessment theory.

The researcher then used axial coding. Axial coding is suitable for describing a pattern of action or a theme. The researcher gathered all the codes on a word document and grouped the codes into themes. Six themes were developed during the coding process. Some of the other themes emerged by thoroughly reading the transcripts. Themes emerged from the data (Creswell, 2014). The coding process also involved reading the participants' transcripts line by line, selecting phrases and sentences, and coding pieces related to the research questions. After compiling, they were copied and pasted on the Word document and arranged alphabetically so that the researcher could categorize the codes that she would develop. The frequency of codes (how many times they appeared) was tallied for each code, and the researcher made sure categories of codes were related to research questions. The codes helped to analyze the teacher's

beliefs of formative assessment and their use of effective instructional practices. The resulting themes were presented in the next two chapters as key research findings.

The conceptual framework of Black and Wiliam (2009) discussed in chapter three was used to get an idea of three mathematics teachers' beliefs and practices of formative assessment. Meaningful components were determined from long responses. Meaningful units were confined in relation to the research questions and conceptual framework. Concepts that were determined to be related to themes were put under the themes. This resulted in the appearance of existing and new themes. The conceptual framework of Black and Williams' model of formative assessment and data guided in identifying and naming the themes.

3.9. **ETHICAL PROTECTION OF PARTICIPANTS**

To secure the protection of the participants' rights, the researcher followed ethical guidelines before implementing the study. The researcher requested permission to conduct the study at the research site school district. After getting approval from the school district, the researcher applied for ethics approval from the Kennesaw State University Institutional Review Board to conduct the study. The researcher received an approval letter to conduct this research on August 16, 2021 (see Appendix A for approval form). After receiving the approval from the Kennesaw IRB, the researcher shared the information with the secondary-grade math department of the research site school about this study at a Professional Learning Team (PLT) meeting, and the invitation was given to all mathematics teachers. PLT is held at the researcher site's math department every week on Tuesday or Wednesday during their planning period as the math department had a common planning period. The researcher described the purpose of the study and who was conducting the study, and explained why they were asked to participate in the research. Also, an email was sent with the same information by the researcher about the study.

The researcher emailed a consent form to all mathematics teachers at the research site school; it described the study in greater detail, identified the study's purpose, discussed the study's privacy rights, and provided background information for the research. The consent form described the risks involved in the study and explained that participation is voluntary for this study. Participants were asked to return the consent form if they were willing to participate in the study; they were given one week to do this. The researcher conducted informal meetings with interested participants to inform them of the study design. An initial meeting with the participants was held to explain the study, and the consent form was collected from the participants before they participated in the study. A pseudonym was used to identify participating teachers for the presentation of results.

CHAPTER FOUR – ANALYSIS OF FINDINGS

This chapter first describes the information obtained from each data analysis process. The results presentation contains themes common to the observations, documents, and interviews, which provide answers to the research questions. This chapter will also summarize the theme and codes about literature and the conceptual framework, and this study's significant findings. A qualitative case study method was employed to answer the research questions. Three mathematics teachers from an eastern Georgia secondary school participated in the study. Data were collected by conducting interviews and classroom observations. Each teacher's class was observed two times. This study aimed to examine mathematics teachers' beliefs and practices of formative assessment in mathematics teaching and how their beliefs affect their use of formative assessment practices. The research questions for this study were:

1. What are secondary school mathematics teachers' beliefs about the importance of formative assessment?

2. How are secondary school mathematics teachers' beliefs about formative assessment reflected in their classroom practices?

The first pieces of data were gathered through classroom observations. Observations allowed the researcher to see the relationship between the teachers use of formative assessment and beliefs. As each class period at the research site school is 90 minutes, the could not cover the whole period observation. That is why the researcher reviewed the documents (lesson plan, activities used by the teacher) to look for formative assessment activities the participant teachers considered valuable and used often. During classroom observations, the researcher looked for the formative assessment strategies/activities teachers were using and how they were generating feedback, how they utilized the feedback they received, and how frequently they generated

feedback. The researcher was able to ask questions to understand participant teachers' beliefs about formative assessment strategies and feedback during the interviews.

Before discussing the findings and themes of this study, participants' biographies were discussed. This chapter will also discuss some of the issues teachers face in implementing the formative assessment.

4.1. **Participant Biographies**

The researcher asked the participants demographic questions. Participants' biographies are presented in detail below. The researcher assigned each participant a number from 1 to 3 to protect their identity. Merriam and Tisdell (2016) recommended that the researcher accommodate demographic questions about the participants and the nature of the study in the interview.

4.1.1. **Participant 1**

Participant 1 is in her forties and is an African American. She lives in northeastern Georgia. She teaches grades 9-12 Algebra I, College-readiness, and Foundations of Algebra. She likes reading. She has an associate degree in criminal justice, a bachelor's in sociology with a minor in psychology, and a master's in teaching through the MAT program. She is also a specialist in leadership and is currently working on her doctorate. She is certified in Special Education, Early Childhood Education, and Mathematics Education. She worked for ten years with the Department of Corrections before teaching. She is married with three grown-up children, a girl and two boys. She is enthusiastic about education. When the researcher asked her why she chose the teaching profession, the participant replied, "Well, before I started teaching, I worked ten years with the Department of Corrections. And so, I saw a lot of youth come in. And I just felt that I could help out more on this side versus on the other side."

4.1.2. **Participant 2**

Participant 2 is an Asian in her forties. She lives in eastern Georgia. She teaches grades 9-12. She teaches Algebra II and Geometry. She loves teaching Geometry because this is her strength and most enjoyable class. She has 15 years of teaching experience and three years at the research site school. She has a Bachelor's in Science and Education and a Master's in Education. She has a son who graduated from college. She loves cooking and reading books. When the researcher asked her why she chose the teaching profession, her reply was, "I have been fascinated with this profession. Like, as I was in high school, I wanted to become a teacher. And I think it's one of the noble professions. And I also feel that I could make some impact on the younger generation when I'm teaching kids, and I want to be a part of it. In the process of shaping the future generation".

4.1.3. **Participant 3**

Participant 3 is a Caucasian born and raised in Pennsylvania. She has a Bachelor's in Economics and Master of Science in Mineral Economics from Pennsylvania State University. She worked for the coal division in a company for 15 years and then moved to the teaching field. She taught middle school for seven years and eight years at high school. She teaches Algebra 1, Algebra 2, and Geometry. She has a daughter who graduated from college. When the researcher asked her why she chose the teaching profession, her reply was, "I liked the teaching and interacting with the students."

Table 2

Demographic and Description of Participants

Participant	Grade Level Taught	Content Taught	Teaching Experience	Leadership experience

Participant 1	9-11	Algebra 1 /College Readiness	14	Department Chair
Participant 2	9-12	Algebra 1 /College Readiness	15	------------
Participant 3	9-12	Algebra 1 / Geometry	15	------------

The researcher requested the participants to highlight any training or coursework they received in their teaching career to develop an understanding of their prior knowledge relative to formative assessment. All participants expressed that they received professional development for formative assessment, but it was a long time ago, not in recent years.

Participant 1 said, "I think throughout the 14 years we have seen several pieces of training on formative assessment, I think, if I'm not mistaken, one is called the FIP, formative instructional practices. We did that. And it's just about feedback to students on their performance".

Participant 2 stated: "It has been a long time like in my previous school, I did receive a formative assessment training, and it's called FIP program from Georgia Department of Education, and has been very, very wonderful".

Participant 3 answer was, "I received some training at the middle school, and then more training on formative assessment, through professional learning at the high school, as far as taking college class, in education where, you know, form assessment, formative assessment was specifically addressed. No, it was all through professional learning; it was all through RESA. It was through interaction with other mathematic instructors on a personal and professional basis."

4.2. **Data Analysis**

The data used for this analysis are observation of teachers' classrooms, interviews, field notes, and document analysis. According to Saldana (2016), coding is an essential feature of qualitative data analysis. The researcher used in vivo and axial coding to analyze the data for this study. First, in vivo coding was used for coding this study. Saldana (2016) revealed that in vivo coding could be used with all qualitative studies, but it is very useful for beginner researchers and studies that focus on the participants' voices. Using in vivo coding is useful for this study as the researcher was trying to gain insight into teachers' beliefs on formative assessment and how their beliefs align in their classrooms.

The researcher created some of the themes and codes before analyzing the data, which were based on the research questions. Subthemes were also based on themes that emerged during transcription and questions that the researcher developed from the interviews. Some other subthemes emerged by thoroughly reading the transcripts. The researcher generated a list of codes by selecting approaches Saldana (2013) suggested, like line-by-line coding. Line-by-line coding helps to immerse researchers in the data and discover the concept they have to offer (Glense, 2016). Codes were taken from phrases and single words representing a line or sentence extract. After compiling, they were copied and pasted on a Word document and arranged alphabetically so that the researcher could categorize the codes that she would develop. The frequency of codes (how many times they appear) was tallied for each code, and the researcher ensured codes were related to research questions. The codes helped analyze the teacher's beliefs about formative assessment and their use of effective instructional practices. The resulting themes will be presented in this chapter as key research findings.

4.2.1. **Observation, Interviews, and Documents Data**

All three teachers were observed twice. With the participants, consent observation time and location were decided. The researcher used field notes to record what she saw connected to formative assessment and feedback during the observation. After completing the observation, the field notes were reviewed and transferred to a Word document.

The participant teachers and the researcher mutually agreed upon a date and time for the interview. The researcher communicated through email about the date and time before the interview. Interview questions were not shared with participants before the interview. Interview recordings were transcribed on "Otter" software after the interview. The researcher listened to the interview recording several times, read the transcriptions, and reviewed, summarized, and analyzed interviews. Interview questions were focused on teachers' beliefs about formative assessment, their understanding of using formative assessment, formative assessment strategies, and feedback strategies. This section addresses themes that emerged from the teacher observations, interviews, and documents in-depth. These themes are based on some of the teachers' quotes during observations and interviews, word frequency used, assessment practices teachers used in their classroom, and their perspectives and experiences.

Five themes appeared from the analysis of interviews. The five themes are (i) *Formative Assessment Beliefs* (ii) *Purpose and Benefit of Formative Assessment*, (iii) *Formative Assessment Activities/Strategies*, (iv) *Feedback* (v) *Factor Affecting Formative Assessment Practices.*

4.2.2. **Theme 1: Formative Assessment Beliefs**

The first theme, "Formative Assessment Beliefs" was derived from teacher interview transcripts. All three participants had positive beliefs about formative assessment. Some of the responses of the participants about formative assessment beliefs are given below.

Participant 1 defined it as

I think formative assessment is very valuable, because it provides you with feedback, it gives you an idea. What it gives you not just you, but the students idea of where they stand, whether they're grasping a concept, whether they are on track to master a standard, so I think formative assessment is very important.

Participant 2's answer was

Formative assessment is very, very important for us to understand because, as I said, summative assessments are like the end products, whereas formative is the is the part of the process of teaching and learning. So, it is very important for teachers to use formative assessments in their classroom.

Participant 3's view on formative assessment was

Formative assessment is an integral part of teaching mathematics. If you're not doing it, then you're not teaching mathematics, you're just teaching an algorithm and you're, you're not going to get the most out of your students and the students aren't going to get the most out of you. Because they don't, they don't know what to ask how to ask it. That part is your responsibility, you really need to address them. Because that's your job as a teacher.

4.2.3**. Theme 2: Purpose and Benefit of Formative Assessment**

The second theme is *the Purpose and Benefits of Formative Assessment.* This theme was developed by looking at the data from all three resources, teachers' interviews, classroom observations, and document analysis. The participant teachers used formative assessment for a variety of purposes. They believed assessment should be used to identify students' learning needs, evaluate student performance, guide instruction, see what students already know, and gather insight into what they can teach in a group setting. The majority of their responses were almost the same. They believed formative assessment is important for tracking their understanding of their students.

Participant 1's response was

I feel like there's room for improvement with anything, but I do see the value of formative assessment. So, I do try to incorporate it throughout the lesson because I don't want to wait till the end of the lesson. Know that a student doesn't know how to do something. The benefits of formative assessment are considerable. The students focus on learning extensively during formative assessment practices, which helps in increasing their success.

Participant 2's response was

It helps me to gain students' understanding and assists me in modifying my teaching practices. Formative assessment makes students focus on learning instead of focusing on grades, which significantly improves success. Formative assessments help you to teach in a better way, in a different way. So that you can, you know, change your strategy of instruction. And you can implement differentiated instruction based on formative assessment. You can regroup students, and that way, you know, it's more effective.

Participant 3's view was

> I don't know how you can teach without doing formative assessment. Formative
>
> assessment has many benefits. I think that good math teachers do it almost intuitively. As
>
> you're, as you're teaching, a particular concept in a math class, you might be, you know,
>
> demonstrating a problem that's on the board. And you have to literally turn around and
>
> look at your students and, you know, assess to see, is this making sense to them? Who out
>
> there is learning is looking lost? Are they working the problems that you have put up
>
> there for the I do one, we do one, you do one if we're not, if you're not looking at and
>
> interacting with your students on a coaching level, because formative assessment really is
>
> a coaching thing, if you're not doing that, then you don't know where your students are,
>
> you don't know whether they understand it, you don't know, who understands part of it,
>
> who understands which part of it, and what you as a teacher need to do in order to go
>
> back and pick up the ones that are totally lost, pick up the ones that have most of it, but
>
> not all of it, and then accelerate the ones that who really do get it.

4.2.4. **Theme 3: Formative Assessment Practices**

The third theme, *Formative Assessment Practices*, was derived from teachers' interview

transcripts and research questions. The theme *Formative Assessment Practices* is further divided

into sub-themes F*ormative Assessment Strategies/Activities* and L*earning Intentions and Success*

Criteria.

4.2.4.1. **Subtheme: Formative Assessment Strategies/Activities**

Formative Assessment Strategies/Activities subtheme was discovered from all three data

sources.

The teacher should use questioning to determine what students know and discover where students' ideas come from. With careful planning and thoughtful application of some good techniques, the teacher can make the classroom engaging. The teacher should be able to make effective instructional adjustments to respond to their students' learning needs (Wiliam, 2011). Teachers used the below-mentioned activities to elicit evidence of students' learning, which is the second component of Black and Wiliam's (2009) formative assessment theory.

The researcher noticed that participant 1 gave students a two-step equation to explain the steps during observation. Students used their mini whiteboards to work out the problem. After completing their problem, they raised the board and showed their work. After looking at their responses, she decided whether students knew how to solve the problem or not. She gave them another problem[:] " Solve $3x + 5x + 3 - 2x + 8 = 25$". Most of the students struggled with this problem and could not do it. They did not raise their boards, and she concluded that they struggled with this problem. She used her active board to explain this problem, asking some questions while showing them how to do it. Teachers used a different strategy to ask questions. They used Exit Tickets, Bell-work, mini whiteboards, observation, and whole-class discussion to determine what students knew. When questions require a longer response, the teacher could use the exit passes (Wiliam, 2011). During observation, the researcher noticed the teachers used some of the strategies mentioned in the literature review to elicit students' understanding.

During the interview, all three participants discussed using some form of warm-up. They used questions from those standards on which students had some misconceptions or did not score at a proficient level. They also justified their purpose of using warm-up. Participant 1's reply was:

I get an idea of their understanding. I also use bell-work to know what they are thinking

about new information, or I use it to check their understanding of a concept or skill.

Participant 2 said

I use entry slips to activate their prior knowledge or to know how well my students have

understood the topic or lesson the previous day.

Candidate 3 replied

I also use bell-work most of them to know what they are thinking about new information,

or I use it for checking their understanding of a concept or skill.

The exit ticket was the most common practice expressed by the participants during the

interview and also noticed on the lesson plans provided by the teacher. For the exit ticket,

students used a piece of paper to write their responses to the questions provided by the teachers.

They handed it to teachers before leaving the classroom or at the end of the lesson. Responses of

participants were the following:

Participant 1 replied that

I may use Ticket out the doors (which is also called exit ticket) to see did they actually or

what pieces they were missing from the lesson that day? Or do have they actually

mastered it?

Participant 2 said

I use exit slips to check for students' understanding of the concept they learn that day. I

take from students before they leave the classroom. I try to use it at least once a week.

Exit slip provides more comprehensive information.

Participant 1 talked about using questioning as one of the strategies.

I may ask questions throughout the lesson to check for understanding.

Participant 3 mentioned

> I do tickets out the door. I do bell work. I do. Yeah. Those are the things that I do in order to see where they are and where we need to go I do tickets out the door.

Participant 1 also mentioned about using mini white board for her classes. She said,

> I also use a mini whiteboard for some of my classes. When I ask or write down the problem on the active board, they have to write their answer on their board with a marker. After they complete it, they raise their board and check to see who got correct and who got wrong. I get an idea of their understanding.

Two of the participants mentioned that they use questioning as a formative assessment strategy.

Participant 1's response was

> I use questioning throughout the lesson to check for understanding.

Participant 3 stated

> I do a lot of questioning. I use guided questioning to gather information about student learning. I use this activity when students work in pairs or group.

Two of the teachers mentioned using observation as a formative assessment strategy. Participant 2 reply was

> I use observation when students are working on an activity or learning task.

Participant 3's response was

> I use observation, and I walk around the classroom; I walk to see who's doing what, where they're making mistakes, whether it's simple calculation error, whether they do not understand how to use a calculator, whether it is a true misunderstanding of the process if it's a whole from other things if you're not walking through that classroom and looking to

see what your students are doing, then you are not taking advantage of a way to

formatively assess your students.

Other classroom practices mentioned were concept mapping, Kahoot, graphic organizer,

and station teaching. They use station teaching after teaching a concept to know whether students

have a good understanding of the concepts they learned. Participant 1 mentioned that she uses it

when she has a co-teacher in her classroom. The teachers' use of some of the activities mentioned

above was considered as formative assessment activities, showing that the information gathered

from those activities was used to adjust teachers' teaching.

4.2.4.2. **Subtheme: Learning Intention and Success Criteria**

The subtheme *Learning Target and Success Criteria* was discovered from all three data

sources. The teachers should make it clear to students what the students will learn. Students need

to know where they are going in their learning and what counts as quality work (Wiliam, 2011).

The research site school district requires all teachers to explain learning targets and success

criteria to the students as part of their SIP. The researcher noticed in the observations that the

teachers were using learning targets and success criteria at the beginning of the class. It was

written on the active board before teachers started the lesson, and they also shared it verbally.

Teacher should "state, write, and restate objective(s) throughout the lesson. Students write down

the learning target" (Eddy, Harwell, & Heitz, 2017, p. 146). All the participants explained

learning targets at the beginning of the lesson. Teachers should make a professional judgment in

communicating students' learning intentions and success criteria (Wiliam. 2011). But teachers

did not communicate learning intention and success criteria during the lesson. Chappius (2015)

stressed that this communication of learning intentions could be done by the teacher during the

learning process at various times using a variety of methods depending on the subject matter and content to be learned.

Participant teachers' responses on learning intention and success criteria during the interview was positive. They found it helpful to inform students about learning intentions and success criteria for classroom activities and learning tasks. They all agreed that they verbally say the information to their students, write it on the board, and repeat it during the learning activity. Participant 1's response was

I believe that it is important for students to know what they are learning and it's purpose. Knowing the purpose of what they are doing can generate understanding.

Participant 2's answer was

Learning Intentions gives the teacher and the students a clear picture of the aim of the lesson. Success Criteria is linked to the learning intentions. These are usually made by the teacher and help the teacher measure the various levels of student achievement and determine whether the students have met the desired learning intention. I discuss learning intention and success criteria with students before starting the lesson so that students know what is expected from them.

Participant 3's reply was:

I think it helps a student to understand what it is that we're going to talk about. I think that if you said it was student, well, this is what we're going to do today, then it's not a mystery to them. Learning intentions and success criteria have kind of been around a long time. You know, we, like I said, I've been doing this for many years. I have watched how the state of Georgia has changed things from back in the early 2000s, to where we are right now in 2021- 22. And what they want you to do really hasn't changed. What

they call it has. So, where we used to have Enduring Understandings, now we have

learning intentions, and where we used to have what we called concepts and particular

items, we now call those success criteria. It would only help a student understand that this

is where we are and where we're going. And here's the map of how we are going to get

there. And you will know that you have arrived, because when you've arrived, you will

be able to do this thing, this thing, this thing, and you will understand this thing. So, it's

just it's, however, whatever you want to call it. However, you want to describe it, it's just

a roadmap to get us from point A to point B.

4.2.5**. Theme Four: Feedback**

The theme *Feedback* was derived from classroom observation and interviews.

Feedback is an essential component of formative assessment. It provides information to learners

about their learning. It is not just simply telling the correct answer to the learner. Feedback is

effective if it is constructive and gives meaningful information to students about their learning in

various forms (Wiliam, 2017).

For formative assessment to positively influence students' understanding, teacher

feedback to students is important. During the observations, all three participants provided varied

levels of feedback during the task and discussed a way they assisted their students in

understanding math achievement. Due to time constraints, the participants stated that they did

not thoroughly review the formative assessment provided to the students. Participants mentioned

addressing only misconceptions. Research shows that for feedback to be effective, teachers

should provide students feedback on their work based on success criteria for that learning

experience (Wiliam, 2017). Participant 3 mentioned not providing feedback because students do

not read the feedback. Participant 1 and participant 3 mentioned that they do not review every formative assessment with their students.

During observation, the researcher noticed some feedback activity from the participants. Participant 3 was teaching characteristics of polynomials. Students were given a task where they had to identify the characteristics of polynomials by looking at the graph. The teacher was guiding and observing the class while moving around the classroom. She provided feedback about the task while students were working on it and the processes that could assist students in completing the task. The feedback she provided could be useful in building the self-confidence of learners about their work. During this task, students were confused about finding the multiplicity of the given polynomials; she provided feedback to the whole class regarding their work on multiplicity. The researcher also noticed that Participant 3 was giving "good," "excellent" type of feedback during her teaching. Hattie and Timperley (2007) concluded this type of feedback to be least effective. During observations of Participant 2's classes, the researcher noticed that she was informing them what to do instead of giving feedback on some part of the task on which students were working. She was also using phrases like "good job" or "nice work ."During observation, the researcher noticed Participant 3 involving her students in interpreting the learning goals and success criteria by organizing the instruction. This was the first strategy of Formative Assessment Theory in which the teachers should clarify and share the learning intention and criteria for success. All three participants emphasized the role of feedback during the interview.

Participant 1 mentioned that

Feedback to me is like constructive criticism, something that helped you, something that helped you master the standards. I think feedback is important because how will you grow, how will you learn if you're not getting corrective feedback.

Participant 2 answer that

Feedback is very important. Unless you give feedback. Even for me, like unless I get feedback, I don't think I am ready to move on. So, feedback is important for the students to see that they're ready to move on. I give them feedback while they work on answering questions during class; this helps them to know whether they are right or wrong and to make relevant corrections.

Participant 3 expressed her view on feedback as

Feedback happens in a lot of different ways. There's verbal feedback, there is written feedback," and she thinks just writing a good job, excellent job, or a grade is not feedback. "Just grading a ticket out the door and handing it back. So that they just see a number on there. That's not feedback. Rather, teachers should provide students with detailed feedback instead of just judging them, as detailed feedback informs students of how their performance or learning can be improved.

The teachers were asked how do they provide feedback? Teachers had mixed responses. They mostly focused on verbal feedback. Participants did not discuss in detail how they provided written feedback. They all agreed on providing verbal feedback.

Participant 1's answer was

After each example they do in their notes, I provide feedback on when they do it up, do the work on the board, I provide feedback after each lesson. Ticket out the doors, ticket into doors. And like I said, when we're working on a group, we provide feedback as a

group, not just that, not just me, as a teacher, when I have them practice problems from

the board, I go around to check the circle, what any issues that I see and ask them to go

back and check it and I'll come back and check it again. So say use verbal feedback,

verbal feedback as well.

Participant 2's reply was

Usually, like, unlike again, as I said, summative assessments provide you feedback at

intervals of time, whereas formative assessments provide you like continuous feedback.

So continuous feedback is very much needed for the whole group improvement of the

class. And I do that often, like, as I said, it's a it's a process of my teaching students.

Participant 3's response was

Feedback is for two things. One, it's from me to understand where they are, because I

can't provide written feedback if I haven't analyzed their work. And the other part is for

them to understand that a they either get it and they're ready to move on. Be they're

almost there, they just made a few simple either math mistakes, or just a just an error. Or

be there maybe halfway there. And then finally, they're totally clueless. And they really

need to come into a tutorial where they can get a one on one lesson. You know, because

usually, when you sit down with a student, if you do one on one, or one of one of two or

three, then there are a lot more aha moments going on. It's like oh, now I get this, I

understand what I did wrong.

Teachers were asked what the strategies are that they use for providing feedback. Below are their

responses:

Participant 1's response was

Because kids, kids want to know what they're doing right? What are they doing wrong? adults want to know what they're doing right what they're doing wrong. So you know, the sit in class and just work problem not knowing what are you getting right or wrong? This kind of, I wouldn't be lost as a teacher and a student. So I may feedback is important. You want to know, what are you doing? And I think that's conversation that has to be had so kids can understand what they're doing. They can understand this. And they can interpret it.

Participant 2 stated

Like I take up, when I do when I collect the ticket to the door, I can quickly see like these other mistakes, and these I need to go back and reteach in the class next day. So that question, I take it as my bell ringer. So that saves my time. At the same time, it's like, you know, quick, instant feedback for the students. Sometimes, I give gesture feedback like when they are doing quizzes, I would just lie, let's say, I mean, I just go silently, place a sticky note and tell them like, check this question back. And the strategy needed for that to rethink. That's one kind of like, you know, giving my feedback. Sometimes it just might signal like, that's not the right one to do. feedback strategies, okay. Because unless as I said, unless they get their feedback, then I'm going to improve on that. So that then the feedback is needed is very, very important step in the formative assessments, and it is needed just like summative assessments, feedback is needed. So there's no point unless you've given them feedback? Yeah,

Participant 3 stated

Verbal feedback because it's more immediate and Like I said before, all students don't read and sometimes don't understand written feedback. verbal tends to work the best.

4.2.6. **Theme Five: Factors affecting teachers' formative assessment beliefs and practices**

This theme was discovered from teachers' interviews. Based on the participant's responses, one of the issues in implementing formative assessments was the lack of time to use some of the formative activities. Accordingly, this creates a challenge for the teachers to complete classes as planned and assess students after class. Two of the participants expressed that they were not able to implement the assessments effectively because of a lack of time.

Participant 2 mentioned that after she acquired the formative assessment data, she did not have enough time to organize groups to address skills her students needed.

> Sometimes, I had to go back and reteach a concept to a group of students because several students didn't get the concept. If my day is already full, it's hard to find a time to reteach the concept to that group the next day to clarify their misunderstanding and it's hard to stay on pacing.

Participant 3's reply to whether she has any hurdle in implementing the formative assessment was

> Lack of time sometimes a problem. I have a tendency to get so wrapped up in doing the instruction and watching the practice that if I had to say anything was an issue for me, it would be that closing part of the daily instruction, because it seemed like we would just run out of time.

Another issue in implementing formative assessments was their class size. To my question to Participant 1 about what she does when she has a large group of students who need additional instruction she answered,

> You can end up with kids all over the place. It's kind of hard to make groups, which means a little bit more one on one assessments. Yeah, that will be the hurdle because you

know, if you have a group of mixture, and kids are at different levels, is kind of okay. Do

I need a formative assess this person this way is formative assess that person that way?

So, I thought that can be a hurdle for me, because sometimes I run into those type of

classes, with different level of performance.

4.3. **FINDINGS**

The themes and subthemes that were produced in this research were associated with the

conceptual framework and contributed to understanding the teachers' beliefs and practices of

formative assessment in mathematics classrooms.

The themes to research questions 1 and 2 were *Formative Assessment Beliefs and*

Teacher Formative Assessment Practices. The subcode for Formative Assessment Beliefs were

purpose of formative assessment and *value of formative assessment.* The subcode under

formative assessment practices were *formative assessment strategies/activities*, *feedback*,

learning intentions and success criteria, and *factors affective formative assessment practices*.

A detailed discussion of all the themes and codes regarding the theory is included below.

The first theme, *Formative Assessment Beliefs*, describes teachers' beliefs about

formative assessment and the importance of formative assessment. All the participants agreed

that formative assessment informs them how well they have taught their students. Participating

teachers stated that formative assessment results are vital in the teaching and learning process.

Formative assessment improves mathematics learning.

The second theme, *purpose and benefits of formative assessment*, describes teachers'

understanding and benefits of using formative assessment. The teachers mentioned that they use

formative assessment to evaluate students' performance and acquire information to adjust or

improve instruction.

The third theme, *formative assessment practices*, describes the large range of formative assessment strategies and learning intention used by all three participants in their classrooms. The subthemes for this theme were *formative assessment activities* and *learning intention and success criteria*. The participants mentioned using formative assessment strategies/activities like bell work, exit ticket, observations, mini whiteboard, graphic organizers, and questioning. They also shared how they do these activities in their classroom.

The data from three sources, observation, interviews, and documents, shows that teachers used questioning as an important strategy in teaching. They also used it for establishing prior knowledge and engaging students in discussion. Participants mentioned receiving formative assessment professional development at this school or a previous school, which helped them perform these activities in their classroom.

The subtheme, *learning intention and success criteria*, describes how the teachers explained the achievement standards to students and what their students needed to do to achieve them. Teachers communicate learning intention to learners to understand the standards on which their work will be assessed. Teachers should clarify learning intentions and success criteria during assessment (Black & Wiliam, 2009).

The fourth theme, *feedback,* describes the feedback strategies teachers used in their classroom. All the participants believed that feedback is an essential part of the assessment and learning process because feedback comments inform students if they are on the right track. They think that feedback should be used to promote students' learning.

The fifth theme, *factors affecting formative assessment practices,* describes the factors affecting implementing formative assessment practices in their classrooms. Participants expressed their concern about not having enough time to implement formative assessment

frequently. They stated that it is hard to make groups in class or listen to every students' response and give them feedback individually. They have to complete all the standards because of state testing, and performing formative assessment activities is difficult every day. Large class size was another difficulty in implementing the formative assessment.

All of the themes and subthemes mentioned here are based on descriptions involving three participants who were asked about their beliefs about formative assessment and their practices of formative assessment in their classrooms. After analyzing the data, the themes that were identified represent the participants' experiences of formative assessment practices in their classrooms.

CHAPTER FIVE: RESULTS AND DISCUSSION

In the previous chapter, the researcher gave detailed information obtained from data analysis and a summary of the theme and codes. This chapter relates previous studies on mathematics classroom formative assessment and assessment beliefs and practice to study findings to gain insights and draw conclusions. The researcher will give a detailed discussion of findings from the existing literature, this study's significant findings, a discussion, and the limitations of the research. The primary purpose of this qualitative case study was to understand classroom teachers' beliefs about formative assessment and how it impacts their classroom instruction in a rural secondary school. This study was designed to gain information about how mathematics teachers view formative assessment as part of their planning and preparation and find whether teachers implement their perceived understanding of formative assessment in their classrooms. The researcher wanted to learn through the eyes and journeys of three teachers' experience with high school education to achieve this. This study used the Formative Assessment Model of Black and Wiliam (2009) as the conceptual framework. Starting with the themes developed through the classroom observations, interviews transcripts, and document analysis assisted the researcher in understanding participants' experiences and stories about their beliefs and practices of formative assessment and how these beliefs translate into actual instruction in their classrooms. The coding of data assisted the researcher in understanding and interpreting the teacher's view. This chapter will also discuss on the limitations and future research recommendations of this study.

The researcher conducted this study to respond to two research questions. The data collected from the classroom observations, documents, and interviews revealed five themes

during the analysis of this qualitative research study. All themes and subthemes were described in detail in the last chapter.

5.1. **Research Question 1**:

What are secondary school mathematics teachers' beliefs about the importance of formative assessment? The first question explores the general conceptions of participants' formative assessment beliefs as well as their beliefs about the assessment practices in context to their teaching. Research question 1 was answered by theme 1, *Formative Assessment Beliefs*, and theme 2, *Purpose and Benefit of Formative Assessment*. Theme 1 showed that the participants had a positive belief about formative assessment, and they tried to use formative assessment to enhance their students' learning. Teachers valued formative assessment, and their positive responses were revealed by classroom observations, documents, and interviews. All three participants recognize that formative assessment improves mathematics learning, and the results from the formative assessments are vital for instruction. Participants agreed that formative assessment improves students' learning and is essential for improving their instruction. The responses given by the three participants showed that they have a positive belief regarding the importance of formative assessment in their classrooms.

The theme, *Purpose and Benefit of Formative Assessment,* showed that participants clearly understood the formative assessment purpose. Teachers shared their beliefs and understanding of formative assessment during the interview.

The answer to this question is that the participant teachers strongly believe in formative assessment. They understand the importance of formative assessment and perceive it to be valuable. Their beliefs align with the three questions[:] (i) Where are the learners in their learning? (ii) Where are they going? (iii) What needs to be done to get there?

5.2. **Research Question 2**:

The classroom observations revealed how all three participants implemented formative assessments with their students. The interviews also illuminated teachers' beliefs about formative assessment and its practices. The document showed how teachers value formative assessment strategies and utilize them in their classrooms. Research question 2 was answered by theme two, *Purpose and Benefit of Formative Assessment*, theme three, *Formative Assessment Practices*, theme four, *feedback*, and theme five, *Factors Affecting Formative Assessment Practices*. Theme two exhibited that the participating teachers used classroom practices to enhance student learning. It showed that the participating teachers implemented classroom practices to fulfill the students' individual needs to some extent. Participating teachers revealed that they use formative assessment strategies like exit tickets, bell work, questioning, and observations to assess their students.

Participant three mentioned that "I read the exit slips and like to see what the students have written. Depending on their responses, I review the content next day". This shows that review was a regular feature of her instruction, and she used formative assessment strategies regularly. Some participants mentioned using small group instruction, but they did not use it consistently. Classroom observations revealed that the teachers used questioning to determine students' understanding of material and feedback to understand where the students are in their learning. Questioning by teachers during the learning task or guided assignment generated feedback that helped them address misunderstandings, redirect students, and lead them towards achieving a learning goal. Questioning by teachers and the feedback they received from the students addressed two of the strategies of the formative assessment framework (see figure 1).

During the interview, teachers revealed using questioning as a formative assessment activity and the feedback they get during questioning from their students. Participant three stated,

I do a lot of questioning. Guided questioning. I do tickets out the door. I do bell work.

Those are the things that I do to see where they are and where we need to go.

Participant 1's response to formative assessment was

formative assessment provides you with feedback; it gives you an idea. What it gives you

is not just you, but the students get an idea of where they stand, whether they're grasping

a concept, whether they are on track to master a standard.

Teachers' definition of formative assessment during interviews aligned with three questions proposed by Ramaprasad (1983) and Black and Wiliam (2009)[:] establishing where the learners are in their learning, establishing where they are going, and establishing what needs to be done to get them there.

Teachers employ some strategies of formative assessment more than others. All the teachers comfortably used questioning to determine students' understanding and where they are in their learning. Teachers mentioned utilizing and making use of feedback they get from their students to guide instruction. But they also said that they did it when time permitted. However, some other formative assessment strategies are used occasionally. Participant 2, during the interview, stated that "I like to put my students in groups, but it takes a lot of time for them to settle down in groups, get started, and stay on task. When we get closer to EOC (End of course) testing, I prefer to use questioning to know what they know and what needs to be remediated or need to reteach". Interviews and classroom observations revealed that participant teachers believe in the feedback they receive from students when they ask questions, and they could use it to move their learning forward.

As part of the school improvement plan (SIP), teachers are expected to have learning targets and success criteria visible to students.

Theme three showed that participants implemented classroom practices at a medium level. They mostly used ticket out the door, bell work, and questioning. Two of the participants mentioned small group instruction, but they did not use small group instruction consistently. The participants stated that they could not make groups because of time constraints, and because they were in a rush to complete standards before the end of the course. They made groups when time permitted.

Theme four, *feedback*. showed that the teacher provided students with some kind of feedback during the learning process. They give them mostly verbal feedback. The participants stated that they didn't consistently provide written feedback to their students regarding misconceptions about their work because of time constraints in the classroom. Research shows that feedback should correct misunderstandings (Wiliam, 2017). The participants explained they reviewed the misconceptions in a whole group setting instead of giving individual written feedback. This may not inform students about the weaknesses and strengths of their work. Research shows that for feedback to be effective, teachers should provide students feedback on their work based on success criteria for that learning experience (Wiliam, 2017).

Theme five, *factors affecting formative assessment practices*, revealed that due to time constraints in the classroom, participating teachers did not consistently provide written feedback to the students about their work. This theme also discussed the participating teachers' reasons for not implementing some formative assessment strategies because of the lack of time. Two of the study participants stated that they needed more time to implement the grouping strategy. The participants discussed that they could not consistently use it because of lack of time; they use it

when time permits. They expressed their fear of failing to complete the mathematics curriculum as they try to use formative assessment strategies in their classroom. The participants agree on reteaching or remediating standards when students do not grasp the concept. The problem is implementing formative assessment strategies to remediate those standards and teaching the standards that the teacher planned to complete to stay aligned with the mathematics curriculum. The classroom observations, documents, and interviews revealed that participant teachers understand formative assessment's importance. They understand formative assessment practices in their classrooms and know their use shows them where students are in their learning and where they are regarding attaining the learning target although their formative assessment practices do not always reflect their use of it.

This research question leads to the conclusion that participants have a strong belief in formative assessment and its practices in the classroom. Their beliefs align with instructional practices and moving their students forward toward their learning goals. The data sources revealed that they use formative assessment strategies like questioning, ticket out the door, and bell work frequently because these strategies give them the information they need quickly. They mostly utilized verbal feedback and did not use written feedback about students' work. The participants stated that they do not get enough time to provide feedback. If teachers provide feedback, students do not read it.

5.3. Formative Assessment Model of Black and Wiliam

Black and Wiliam's (2009) formative assessment model was used to conceptualize this research. The theory of Black and Wiliam (2009) is based on Ramaprasad's (1983) three key processes in learning and teaching: "Establishing where the learners are in their learning, establishing where they are going, and establishing what needs to be done to get them there"

(p.4). This study aimed to examine mathematics teachers' beliefs and practices of formative assessment in mathematics teaching and determine how their beliefs affect their use of formative assessment practices in a mathematics classroom. To understand teachers' beliefs and their formative assessment practices in mathematics classrooms, the first three strategies of Black and Wiliam (2011) ((i) Clarifying, sharing, and understanding learning intentions and success criteria, (ii) Facilitating evidence of learning by engineering effective classroom discussions and other learning tasks, and (iii) Provide feedback that moves learning forward.) represent the key processes in teaching and learning. Formative assessment practices in the classroom assist the teachers in determining where the learners are in their learning (what their students have learned), where they are going (what they need to learn), and what needs to be done to get them there (what they need to know about their learning). The conceptual framework was obvious through the themes that were developed from the researcher's analysis. Formative assessment is vital for increasing student achievement.

5.4. **Relation between Literature Review and Themes**

The literature review of this research is comprised of literature on formative assessment, formative assessment strategies/practices, teachers' beliefs about formative assessment, and the relationship between teachers' beliefs and teachers' formative assessment practices. Many of the themes established in this study are related to the literature review. Therefore, there is corroboration of alignment between the literature review and the identified themes.

Most of the studies discussed in the literature review align with the theme *of Formative Assessment Activities/Strategies.* The participants' formative assessment strategies included bell work, questioning, exit tickets, and observations. The literature noted that to effectively implement formative assessment in their classrooms, teachers should use several of the many

existing activities (Heritage, 2007). Teachers effectively used questions to guide conversation and instruction about learning. Findings concerning the participants' formative assessment strategies in this study are consistent with the studies of Wiliam (2010) and Shepard et al.(2005) discussed in chapter 2 of the literature review. Literature shows that to assess students' level of understanding, a teacher could use questioning as a formative assessment method during a lesson (Shepard et al., 2005; Wiliam, 2011), and the teacher can frame a question and get a response from the whole class quickly using a mini white-board (Wiliam, 2011). The teacher can quickly determine students' understanding to adjust how to move forward. Furthermore, the literature recognized several formative assessment activities like questioning, bell work, observation, exit tickets, and ABCD cards, which were also in the theme *formative assessment practices.* All three teachers mentioned using exit tickets. The literature also discussed exit tickets as one of the teaching strategies. According to Marshall (2018), an exit ticket is an on-the-spot assessment. One of the participants mentioned using a mini-white board in her class to assess students. The literature also shows that the teacher can frame a question and get a response from the whole class quickly (Wiliam, 2011).

The researcher observed that all the participants implemented formative assessment; however, their formative assessment mostly involved bell work, questioning, and exit tickets. During the observation, the researcher noticed that participant two did not use small group instruction while teaching the concept of finding a missing angle and missing sides, even though she mentioned it in her lesson plan. Participant 2, during the instruction part, used the lecture method, and interactions with the students were limited. Participant 3 effectively used pacing to guide student learning, and her feedback to students was responsive and targeted. Participant 1 also mentioned using small group instructions during the interview, but the researcher did not see

it during observation. Research shows that small grouping allows time for students to get needed instruction on content that seemed difficult in the whole-group setting (Benders & Craft, 2016).

The sub-theme *learning intention and success criteria* shows a connection to the literature review. This describes how the teachers stated the achievement standards to students and what their students need to do to achieve them. As per the review, teachers should clarify learning intentions and success criteria during assessment (Black & Wiliam, 2009). The literature review also shows that learning goals should be communicated during formative assessment (Chappius & Stiggins, 2002; Moss & Brookhart, 2009), and success criteria should be used to evaluate students' performance (Moss & Brookhart, 2009).

For theme 4, *feedback*, all of the candidates spotlighted the importance of feedback in formative assessment. This is in line with Sadler's and Hattie & Timperley's perspectives that "feedback is the key element in formative assessment" (Sadler, p. 1989), and feedback addresses a "gap" between students' current level of understanding and their desired level (Hattie & Timperley, Sadler, 1989). The participants explained they review the misconception as a whole group instead of giving individual written feedback, which aligns with feedback should correct misunderstandings (Wiliam, 2017).

Summary

Analyzing interview transcripts revealed that all the participants valued formative assessment and agreed that it has a central role in the teaching and learning process. Participants expressed their beliefs that formative assessment improves the quality of instruction and enhances students' learning. They described that formative assessment helps teachers and students to identify the gaps in learning and help in remediation. Hence, it can be concluded that participating teachers have a positive belief regarding the importance of formative assessment.

Data analysis shows that teachers were using oral feedback in the form of wrong or right answers. Their feedback was not compromised, specific to what their students understood and guidance on the next steps in learning.

The findings from the data showed that at a theoretical level, the research site school mathematics teachers have a positive belief about the importance of formative assessment in enhancing their instruction and students' learning. Significantly, the data about their practices showed a mid-level difficulty in implementing their beliefs.

CHAPTER SIX: CONCLUSION

This study's first aim was to examine teachers' beliefs about formative assessment. The study found that all three mathematics teachers of the research site high school have positive beliefs on the importance of formative assessment. That is, they believe that formative assessment is essential for student learning and maximizing instruction. They use formative assessment practices for enhancing the students' learning. They believe that feedback, sharing learning goals, and success criteria should be communicated in their classrooms as they are beneficial for students' learning.

This study's second aim was to examine how teachers' beliefs affect their use of formative assessment practices in a mathematics classroom. The finding shows that practices of formative assessment in their classroom were moderate after looking at the interview, observation, and documents data. Teachers were making use of some of the formative assessment strategies with ease in the lessons that were observed. They could not use some of the other formative assessment practices very often and effectively in their classrooms. In other words, the relationship between the teachers' beliefs and their formative assessment practices was moderate. Some difficulties impede the practice, which include large size classes, not enough time to give written feedback, and time constraints to complete the course standards. Even though the teachers try to use formative assessment practices to enhance their students' learning in their classrooms, such difficulties make it harder for mathematics teachers to implement formative assessment effectively.

The classroom practices of the three teachers were investigated using formative assessment strategies proposed by the Black and Wiliam Formative Assessment Model. This model proved useful for this study as it is associated with good teaching and assessment

components. The findings proposed a possible relationship between teachers' beliefs and practices. The relationship is based on three case studies and limited classroom observations. Therefore, it is not intended as generalizable.

6.1. LIMITATIONS OF THE STUDY

This study has the following limitation:

1. The sample is used on only one high school in a school district.
2. The sample is limited to a rural area high school located in eastern Georgia.
3. The study sample is limited to experienced teachers.
4. This study has a small number of participants.

Therefore, results from this study should not be generalized to all Georgia high schools or any school districts. The data from this study adds to the body of research on formative assessment in the high school mathematics classroom. As there is a lack of research on teachers' beliefs and practices of formative assessment in secondary school mathematics classrooms, this study may help other researchers in this area.

6.2. IMPLICATIONS

The findings of this study could inform other mathematics teachers, instructional coaches, and school administrators about the positive experiences teachers have using formative assessments and recognizing their weaknesses in practice. Findings from this study could be used by school officials in designing required training or professional development that could increase teachers' capability to implement formative assessments in their classrooms.

6.3. RECOMMENDATIONS

On the basis of the findings discussed in the last chapter, the following recommendations are offered:

1. Mathematics teachers can be given professional development training that will help them develop a thorough understanding of formative assessment practices and how they can implement them, considering some of the difficulties rural schools face.

2. Studies can be conducted to acquire knowledge about results on student achievement after effectively using formative assessment in a mathematics classroom.

3. To expand the field beyond high school mathematics teachers, a study can be conducted on elementary and middle school mathematics teachers.

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Appendix A: **Information to Be Shared for Recruitment**

Study Title: Teachers' Beliefs and Effective Use of Formative Assessment in Secondary School Mathematics Classroom

Researcher information: Abeda Banu; Secondary and Middle Grades Program, Bagwell College of Education, Kennesaw State University; abanu@students.kennesaw.edu

My name is Abeda Banu. I would like to invite you to participate in a research study about teachers' beliefs and effective use of formative assessment in secondary school mathematics classrooms. This study aims to explore high school mathematics' teachers' understanding and application of formative assessment in their classrooms. By doing this research, I hope to learn if teachers' value of formative assessment relates to their use of formative assessment in the secondary school mathematics classroom. This form will give you information about the study that I will be conducting at Jefferson County High School to help you decide whether you want to participate in it or not.

You are being asked to participate in this study because you are a high school mathematics teacher. This study will be conducted for a duration of one complete semester in participating mathematics teacher's classrooms. If you decide to participate in the study, observations of your classroom will be conducted once during each nine-week period of the semester, and two interviews will be scheduled during the semester. This would allow me to determine your understanding of formative assessment practice. Please be reminded that you may ask to be withdrawn from this study at any time.

Participating teachers will not receive money or any form of compensation for taking part in this research. There will be no cost to participants for taking part in this research. This research cannot guarantee potential direct benefits to participating teachers. However, the

research findings may provide helpful ideas and beneficial information for secondary school mathematics teachers since it is possible to identify the factors that impede or support teachers' formative assessment practices. To the best of my knowledge, this study does not pose a risk to participants that is greater than ordinarily encountered in everyday life.

The results of this participation will be kept anonymous. The researcher will keep all the records private, and they will be stored in encrypted files on a computer that is password protected. Only the researcher will have access to the information you provide. Files of coded documents (all names redacted) will be saved electronically on a USB drive stored in the researcher's office along with any hard copy documents (names redacted) in a locked drawer to which only the researcher has access. When I present this study or publish its results, all identifying information regarding your name or school will not appear. Your identity will not be revealed at any stage in the study. All the data of the study will be kept for three years. Any hard copy documents (such as consent forms) will be shredded after three years.

Participant participation is completely voluntary in this study. Participants do not have to be a part of the study if they do not want to. If participants choose not to take part in the study, there will be no penalty for them. Participants can change their minds and not be in the study at any time.

Participants can ask the researcher if they have questions at any time. Participants will be given a copy of this form to keep. They can ask questions about the study, email, or call the researcher. If you are willing to participate in this study, you can reply by email at banu@students.kennesaw.edu or banuab@jefferson.k12.ga.us, by voice at 912-492-4146, or you can talk to me directly.

Appendix B: IRB Approval Document

Date: 8-16-2021

IRB #: IRB-FY21-676
Title: Teachers' Beliefs and Effective Use of Formative Assessment in Secondary School Mathematics Classroom
Creation Date: 6-23-2021
End Date:
Status: Approved
Principal Investigator: Abeda Banu
Review Board: KSU IRB
Sponsor:

Study History

Submission Type	Initial	Review Type	Exempt	Decision	Exempt

Key Study Contacts

Member	Camille Sutton-Brown-Fox	Role	Co-Principal Investigator	Contact	csuttonb@kennesaw.edu
Member	Abeda Banu	Role	Principal Investigator	Contact	abanu@students.kennesaw.edu
Member	Abeda Banu	Role	Primary Contact	Contact	abanu@students.kennesaw.edu

Appendix C: Letter of Consent

Study Title: Teachers' Beliefs and Effective Use of Formative Assessment in Secondary School Mathematics Classroom

Researcher information: Abeda Banu; Secondary and Middle Grades Program, Bagwell College of Education, Kennesaw State University; abanu@students.kennesaw.edu

Description of the Project: The purpose of this study is to examine the teachers' beliefs and effective use of formative assessment in secondary school mathematics classrooms. Despite the depth of research on formative assessment and teachers' beliefs, there is a lack of empirical studies that link both teachers' beliefs about formative assessment and their use in mathematics classrooms. Therefore, this study plan to obtain mathematics teachers beliefs about formative assessment in secondary school mathematics classrooms in rural areas, acquire information about how they view formative assessment as part of their daily planning and preparation, and determine whether there is a connection between mathematics teachers' perceived understanding of formative assessment and their effective use of it in their classroom.

The research questions for this study are

(1) What are secondary school mathematics teachers' beliefs about the importance of formative assessment?

(2) How are secondary school mathematics teachers' beliefs about formative assessment reflected in their classroom practices?

Explanation of Procedures: You are being asked to take part in a research study that will be conducted during the fall semester of 2021. The information in this form will help you decide if you want to be in the study.

By granting consent to participate in this study, you agree to participate in two semi-structured interviews and two classroom observations voluntarily. Data will be collected by multiple methods like semi-structured interviews, classroom observations, field notes, and the collection of artifacts (Ex: teachers' lesson plans, teaching materials including learning tasks, and blank worksheets provided to the class by the teacher). The researcher's goal for data gathering instruments is to focus on the relationship between mathematics teachers' beliefs and effective use of formative assessment in the secondary school mathematics classroom.

Risks and Discomforts:

To the best of my knowledge, this study does not pose a risk to participants that is greater than ordinarily encountered in everyday life.

Benefits:

This research cannot guarantee potential direct benefits to participants for participating in the study. However, the research findings may provide helpful ideas and beneficial information for secondary school mathematics teachers since it is possible to identify the factors that impede or support teachers' formative assessment practices.

Compensation:

Participating teachers will not receive money or any form of compensation for taking part in this research. There will be no cost to participants for taking part in this research.

Confidentiality: The privacy of the participants will be protected. The results of this participation will be kept anonymous. Any information obtained during the course of

participation will remain confidential and will be used for research only. The researcher will keep all the records private, and they will be stored in encrypted files on a computer that is password protected. Only the researcher will have access to the information you provide. When I present this study or publish its results, all identifying information regarding your name or school will not appear. Your identity will not be revealed at any stage in the study. All the data of the study will be kept for three years. Any hard copy documents (such as consent forms) will be shredded after three years.

Rights of participants: Participant participation is completely voluntary in this study. Participants do not have to be a part of the study if they do not want to. If participants choose not to take part in the study, there will be no penalty for them. Participants can change their minds and not be in the study at any time or decline to answer any interview questions without penalty. A copy of this consent form is for you to keep.

Contact information: If you have any concerns or questions about this research or your rights as a participant, please contact

Abeda Banu call: 912-492-4146; email: abanu@students.kennesaw.edu; or

Faculty Advisor Camille Sutton-Brown-Fox at csuttonb@kennesaw.edu

 The Institutional Review Board (IRB) of Kennesaw State University has reviewed the study to ensure that the participant's rights are protected. If you have any questions about the rights in the study or you are not satisfied with something that happens to you during the study, you can contact the IRB of Kennesaw at irb@kennesaw.edu or 470-578-7721.

By SIGNING below, you are agreeing to participate in this study, and that you have read and understand all of the information provided on this form.

_____   _____   _____

Participant's Name (PRINT)   Signature

Appendix D: Observation Protocol

Observer: **Abeda Banu**
Observed Teacher:
Location: **Mathematics Classroom at Research Site High School**
Date :
Observation Start Time: Observation End Time:
Subject: Name of the course: Unit:

Standards:
Physical structure of the classroom:
Comments:

Appendix E: Interview Form and Questions

Research Question: (1) What are secondary school mathematics teachers' beliefs about the importance of formative assessment?

(2) How are secondary school mathematics teachers' beliefs about formative assessment reflected in their classroom practices?

Participant (Pseudonym): _____   Interview Date: _____

Interview Time: _____   Location: _____

- Please tell me about yourself (like education/certification)?

- How long have you been teaching mathematics?

- How many years of teaching experience do you have in the current school?

- What grades do you teach?

- Why did you choose teaching profession? What attracted you to the teaching profession?

- What do you like or dislike about teaching?

- Did you receive any professional training on formative assessment? If so, do you remember when?

- What are your beliefs about the value of formative assessments?

- What types of formative assessments do you use in your classroom?

- How often are formative assessments scheduled in your classroom?

- How would you describe your expertise level with formative assessment?

- What you do when you have a large group of students who need additional instruction?

- What is your view about clarifying learning intention and success criteria for students in classroom activities?

- What are the hurdles, if any, you face implementing formative assessment?

- Do you think formative assessment practices affect the motivation of students? If so, in which ways? Could you please provide examples to illustrate your response?

- What is your understanding of feedback?

- Why and when do you provide feedback to students?

- "What are the strategies you use for giving feedback?" Could you please provide examples to illustrate your response?

- What is your explanation for using feedback strategies?