2020

Middle-School Mathematics Teachers' Use of Formative Assessment Data

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This is to certify that the doctoral study by

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2020

Abstract

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MS, Walden University, 2012

BS, Florida Memorial College, 2001

Doctoral Study Submitted in Partial Fulfillment

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May 2020

Abstract

A school district located in the southeastern United States uses benchmark tests as formative assessment to provide teachers with data to differentiate their instruction to meet the individual needs of students in their classrooms. Despite this effort, student achievement in mathematics in this school district has not improved. The purpose of this study was to gain an understanding of how middle-grade mathematics teachers used the benchmark results as formative data to guide instruction and meet student needs. The conceptual framework that grounded this study was the model of formative assessment developed by Black and Wiliam. For this basic qualitative study, 9 middle-grade mathematics teachers were interviewed to learn how they use formative data to guide instruction, challenges they encountered, and supports needed for using formative data to guide classroom practice and meet student needs. Interview data were analyzed using a 2-step process of in vivo coding followed by axial coding to identify themes. Results from the study revealed that formative data are not being used effectively to plan for and guide classroom practices to meet the individual needs of students. Participants perceived that more professional development and planning time are needed. This basic qualitative research study may lead to positive social change when teachers improve their use of formative assessment to differentiate instruction that meets the needs of all students in the mathematics classroom.

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Dedication

This doctoral study is dedicated to me. At an early age, I knew that I wanted to obtain my doctoral degree. I have had many milestones in my life that could have easily deterred me from obtaining this degree. But, thank God, I stayed steadfast, kept my eye on the prize, and pushed for my destiny. I experienced difficult times when I wanted to give up, but I am not a quitter. I never stopped believing that I could one day reach my goal.

I dedicate this doctoral degree to my husband, Leon. The moment you stepped into my life, you always pushed me towards greatness. I thank you for never giving up on me. I thank you for sacrificing tireless hours and late nights of working toward my goal. I thank you for being my biggest fan. You always told me, "You can do anything you set your mind to do." You never left my side, and I truly thank you for that. I thank you for the encouraging words when I needed the boost to keep going. I may be your hero for reaching one of my lifelong goals, but in actuality, you are my hero! I thank God that you are my husband.

Lastly, I dedicate this doctoral degree to all my family and friends. I thank you for supporting me throughout my journey. I thank you for reminding me of my focus when I was unfocused. I thank you for your patience as I worked toward my goal. I really appreciate everyone for their love and support. I want to be that ray of hope to show that dreams do come true! Thank you and I love you all.

Acknowledgments

I would like to acknowledge and thank those who made it possible for me to obtain this degree. I acknowledge and thank my committee members: Dr. Shrofel, Dr. Seymour, and Dr. Underwood. Thank you for your continued support. It was not an easy journey, but I thank you for helping me with every step of this journey. I thank you for encouraging me and believing that I could reach my goal. This would not be possible without you.

I would like to acknowledge and thank the participants in my study. Without you, there would not be a study. I thank you for trusting me and giving your time. I cannot say thank you enough to show my gratitude. I really do appreciate all of you, and I thank you all from the bottom of my heart!

Table of Contents

List of Tables v

List of Figures vi

Section 1: Introduction to the Study 1

Introduction 1

Problem Statement 4

Nature of the Study 6

Purpose of the Study 7

Conceptual Framework 8

Teacher Clarifies and Shares with the Learner Learning Intentions and Criteria for Success 9

Teacher Engineers Effective Classroom Discussions and Other Learning Tasks That Elicit Evidence of Student Understanding 9

Teacher Provides Feedback That Moves Learners Forward................................ 10

Teacher Activates Learners as Instructional Resources for One Another 10

Teacher Activates Learners as the Owners of Their Own Learning.................... 11

Operational Definitions 11

Assumptions 12

Limitations 12

Scope and Delimitations 13

Significance of Study 13

Summary 14

Section 2: Literature Review 16

Introduction..16

Defining Formative Assessment 18

Formative Assessment and Student Achievement...20

Clarifying Learning Intentions and Criteria for Success 25

Engineering Effective Classroom Discussions and Other Learning Tasks That

Elicit Evidence of Student Understanding..28

Providing Feedback That Moves Learners Forward.......................................31

Activating Students to be Instructional Resources for One Another...............34

Activating Students as the Owners of Their Own Learning...........................37

Teacher Use of Formative Assessment in Mathematics Instruction................41

Conclusion 48

Section 3: Research Method 50

Introduction..50

Qualitative Research Design..51

Research Context 54

Selection of Participants 56

Ethical Protection of Participants...57

Role of the Researcher...59

Data Collection 61

Data Analysis...63

Validity and Reliability..65

Triangulation.. 65

Peer Review 66

Rich, Thick Description 66

Section 4: Results 68

Introduction 68

Demographic Information 68

Findings 69

Theme 1: Professional Development for Formative Data 70

Theme 2: Understanding Benchmark Data 72

Theme 3: Classroom Practices and Student Needs 74

Theme 4: Students' Understanding of Their Math Achievement 77

Theme 5: Students' Low Achievement in Math 79

Theme 6: Resources Needed 81

Discrepant Cases 84

Evidence of Quality 84

Section 5: Discussion, Conclusions, and Recommendations 86

Introduction 86

Interpretation of Findings 87

Research Question 1 89

Research Question 2 90

Research Question 3 91

Research Question 4 91

Implications for Social Change 92

Recommendations for Action 93

Recommendations for Further Study 94

Summary 94

References 97

Appendix A: Teacher Interview Questions 117

List of Tables

Table 1. Percentage of Students Not Meeting Standards on CRCT for Mathematics........ 5

Table 2. Percentage of Students Not Proficient on Milestones Test for Mathematics 6

Table 3. Middle-Grade Mathematics Teachers in the Study Site School District............ 55

Table 4. Codes and Themes Discovered From the Interview Data 64

Table 5. Demographic Data for Teacher Participants.. 69

List of Figures

Figure 1. Model of formative assessment. 9

Section 1: Introduction to the Study

Introduction

Formative assessment data can help teachers identify appropriate learning goals for students by providing descriptive feedback about student learning (Beckett, Volante, & Drake, 2010; Dirksen, 2011; Robert, 2011). Formative assessment provides teachers with feedback on their teaching strategies in the classroom and can help students recognize their strengths and weaknesses (Phelan, Choi, Vendlinski, Baker, & Herman, 2011). Evidence collected from students and used by teachers to guide teaching and learning defines formative assessment (Hattie & Timperley, 2007; Wiliam, 2008).

Quarterly benchmark tests are implemented as a form of formative assessment to "encourage teachers, principals, and district leaders to use data to inform their policies and practices" (Carlson, Borman, & Robinson, 2011, p. 379). The study site school district in this research began implementing quarterly benchmark tests during the 2008–2009 school year in Grades 3–8 in English/language arts, mathematics, social studies, and science. The benchmark tests were implemented to collect data from students that teachers could use to plan for differentiated instruction to meet the individual needs of students. Use of benchmark tests can increase the performance of low-achieving students on standardized tests by helping teachers develop instructional interventions, such as remediation and reteaching, and tutorial programs, and discuss benchmark results with students (Nelson, 2013). In the study site school district, benchmark tests are administered every 9 weeks. Typically, a benchmark test is given in September (Quarter 1), December (Quarter 2), and March (Quarter 3) of each school year (Principal, personal communication, September 20, 2016). Benchmark tests provide teachers an opportunity to detect learning deficiencies in each content area and design instruction to address these deficiencies. In the study site school district, the mathematics benchmark tests are designed so that each quarterly test covers the specific standards and units of the curriculum that students are learning as well as the standards and units that were covered by previous benchmark tests. For example, in sixth grade, the first benchmark covers Unit 1, number system fluency, and Unit 2, rate, ratio, and proportional reasoning. The second benchmark test, given in December, covers Unit 3, expressions, and Unit 4, one-Step equations and inequalities, along with standards from the first benchmark test. The third benchmark test, given in March, is a collection of standards from the first and the second benchmark along with standards from the remaining three units: Unit 5, area and volume; Unit 6, statistics; and Unit 7, rational explorations (Principal, personal communication, September 20, 2016).

The quarterly benchmark results provide teachers with immediate data about how well students understood the curriculum content and mastered the standards. SchoolNet, which provides various reports for teachers to view (Principal, personal communication, March 15, 2017) allows teachers access to the benchmark results the same day students take the tests. For example, teachers can view an item analysis report to determine the number of students who did not meet a particular standard, and teachers can view an error report to determine the number of students who chose a particular answer. Administrators at the study site school district encourage teachers to analyze the benchmark data reports to develop an instructional plan to differentiate instruction to help students master standards not mastered on the quarterly benchmark tests. Teachers can restructure their instruction to differentiate and meet the individual needs of their students using benchmark data.

Research has shown that benchmark assessment results tend not to be used by teachers for the following reasons: (a) teachers fail to review the benchmark tests, (b) teachers do not always have access to the test results, and (c) teachers do not perceive that they have time to use the benchmark results because of a demanding curriculum (Black & Wiliam, 2009). Black and Wiliam (1998a) stated that benchmark tests are not effectively used by teachers because teachers may not always review the results. Phelan et al. (2011) noted that benchmark tests cover standards that were previously learned rather than standards the students are currently learning. Teachers seldom have time to go back and review questions missed on the benchmark tests due to the amount of curriculum they need to cover throughout the year (Roskos & Neuman, 2012). Many teachers are not capable of using the information from benchmark tests because they lack the training to do so, lack adequate materials, or do not have enough curricular time available (Heritage & Yeagley, 2005; Herman & Gribbons, 2001; Stiggins, 2005).

This study addressed the concerns of how middle-grade mathematics teachers use the data from benchmark tests as a form of formative assessment to help guide instruction and meet the needs of individual students in the classroom. Benchmark tests should provide actionable information for teachers and students (Trumbull & Lash, 2013). The data from benchmark tests should help identify student progress, thought processes, and misconceptions (Trumbull & Lash, 2013).

Problem Statement

The study site school district has been using benchmark tests as a form of formative assessment and providing teachers with formative data for the past 12 years, since 2008, to help teachers differentiate their instruction to meet the individual needs of all students in their classrooms. Despite this, student achievement in mathematics has not improved (Table 1 and Table 2), raising questions about how mathematics teachers are using benchmark test data to guide their instruction. The gap in practice that my study addressed is that there is little understanding of how teachers are making use of the benchmark data to plan classroom practice to meet the individual needs of students in their mathematics classrooms. The school principal has stated that the district does not understand how teachers are using the benchmark data (Principal, personal communication, March 15, 2017). Administrators at the study site school district strongly recommend that teachers review benchmark tests with the students (Principal, personal communication, March 15, 2017), yet professional development has never been offered to help teachers interpret the benchmark data or use the benchmark data to guide instruction to and meet the individual learning needs of students. The study site school district has not conducted a study to determine how middle-grade mathematics teachers are using benchmark data to guide mathematics instruction in the classroom and meet the individual needs of students to improve achievement on the state mandated standardized tests administered near the conclusion of the school year.

Tables 1 and 2 show the progress of student achievement in middle-grade mathematics classes from 2013 to 2019. Two tests are displayed to show student achievement in middle-grade mathematics. The state stopped administering the Criterion Referenced Competency Test (CRCT) at the end of the 2014 school year and began using the Milestones test. Table 1 displays the percentage of middle-grade mathematics students who did not meet the standards on CRCT from 2013 to 2014. Students in Grades 1–8 took the CRCT each spring, and scores fell into three categories: does not meet the standards (0–50%), meets the standards (51–84%), and exceeds the standards (85–100%). CRCT contained selected response (multiple-choice) items. Table 1 shows the percentage of middle-grade students who scored between 0% and 50% on the mathematics section of the CRCT in the study site school district.

Table 1

Percentage of Students Not Meeting Standards on CRCT for Mathematics

Year	6th grade	7th grade	8th grade
2013	14.2%	18.5%	12.5%
2014	13.7%	11.7%	16.8%

Table 2 displays the percentage of middle-grade mathematics students who did not achieve the proficient or distinguished categories on the Milestones test from 2015 to 2019. Students in Grades 3–8 take the Milestone Test each spring, and their scores fall within four categories: beginning learners (0–51%), developing learners (52–70%), proficient learners (71–90%), and distinguished learners (91–100%). The Milestones test is a combination of selected response (multiple-choice), technology-enhanced (multiple-select or two-part), constructed response, and extended constructed response items. Table

2 shows the percentage of middle-grade students who scored between 0% and 70% on the mathematics section of the Milestones test in the study site school district.

Table 2

Percentage of Students Not Proficient on Milestones Test for Mathematics

Year	6th grade	7th grade	8th grade
2015	71.1%	69.3%	72.3%
2016	68.1%	64.2%	75.5%
2017	67.9%	66.8%	74.7%
2018	72.1%	69.7%	71.4%
2019	71.2%	69.1%	65.4%

The results show large differences between percentages of students who did not score proficient on the Milestones test in mathematics (Table 2) and students who did not meet standards on the CRCT in mathematics (Table 1). One reason for the large differences is that the Milestones test is more rigorous. Another reason is due to the type of test items on both tests. The CRCT contained only selected response items, whereas the Milestones test contains selected response, technology-enhanced, constructed response, and extended constructed response. Students are no longer simply choosing a multiple-choice answer but are now choosing a multiple-choice answer along with choosing multiple answers and explaining their thinking.

Nature of the Study

I designed a basic qualitative study to gain an understanding of how middle-grade mathematics teachers use the benchmark results as formative data to guide instruction and meet the individual needs of students. Four research questions guided this study:

RQ1: How do middle-school mathematics teachers use formative benchmark data to plan for and guide their classroom practices to meet the individual needs of students?

RQ2: How do middle-school mathematics teachers inform their students about their strengths and weaknesses as measured by the benchmark test?

RQ3: What challenges have middle-school mathematics teachers encountered as they use the formative data to plan instruction?

RQ4: What supports and resources do middle-school mathematics teachers perceive they need to sustain and improve their use of formative data to plan instruction?

I selected a purposeful sample of middle-grade mathematics teachers who had at least 3 years of teaching experience and represent the three different grade levels (Grades 6, 7, and 8). I conducted semistructured interviews to provide meaningful and rich information to answer the research questions. A detailed discussion of the design and methodology is presented in Section 3.

Purpose of the Study

The purpose of this basic qualitative study was to gain an understanding of how middle-grade mathematics teachers use benchmark results as formative data to guide instruction and meet the individual needs of students. The results of my study informed the study site school district about areas where professional development or other interventions can be implemented to help teachers use formative data results to guide their instruction.

Conceptual Framework

The conceptual framework that grounded my study is the model of formative assessment developed by Black and Wiliam (2009) based on Ramaprasad's (1983) three key processes in learning and teaching: "Establishing where the learners are in their learning, establishing where the learners are going, and establishing what needs to be done to get the learners there" (p. 4). Black and William (1998b) explained that practice in the classroom is formative when evidence about student achievement is produced and when teachers and learners interpret and use the evidence to make decisions about instruction "that are likely to be better than the decisions they would have taken in the absence of the evidence that was produced" (p. 10). Black and Wiliam (2009) argued that formative assessment is "the creation of, and capitalization upon, 'moments of contingency' in instruction for the purpose of the regulation of learning processes" (p. 8). *Moments of contingency* refers to teachers' adjustments during one-on-one teaching or whole group instruction, teachers' feedback by means of grading practices, and a collection of evidence from students' homework (Black & Wiliam, 2009). The three key processes suggest that formative assessment can be theorized as being comprised of five key strategies as shown in Figure 1.

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

Figure 1. Model of formative assessment. Reprinted by permission from Springer Nature Customer Service Centre GmbH: Springer Nature. "Developing the theory of formative assessment," by P. Black and D. Wiliam, 2009, *Educational Assessment Evaluation and Accountability, 21*(1), p. 5. Copyright (2020).

In the following subsections, I describe each of the five key strategies in the conceptual framework model of formative assessment developed by Black and Wiliam (2009).

Teacher Clarifies and Shares With the Learner Learning Intentions and Criteria for Success

The National Council of Teachers of Mathematics (2007) suggested that teachers identify intended "learning goals for the students at the beginning of each lesson and differentiate between learning goals and the activities that will lead to learning" (p. 2). When a teacher clarifies and shares the learning intentions and criteria for success with students, the students receive a better understanding of what their classroom experience will be like and how their learning will be measured (Black & Wiliam, 2009).

Teacher Engineers Effective Classroom Discussions and Other Learning Tasks That Elicit Evidence of Student Understanding

Teachers who engineer effective classroom discussions and other activities that contribute to student learning develop instructional strategies that provide evidence of student learning (Black & Wiliam, 2009). Classroom questioning is an example of implementing classroom discussions that elicit student understanding (Black & Wiliam, 2009). Teachers must plan the types of discussions and other tasks that will be used with students so that the results are specific to the evidence of students' learning (National Council of Teachers of Mathematics, 2007).

Teacher Provides Feedback That Moves Learners Forward

Providing feedback to students should help students identify their misconceptions and correct their mistakes (Black & Wiliam, 2009). Black and Wiliam (2009) also stated that comment-only marking is a way that teachers can provide feedback that will help move learners forward. The key concept of feedback is that it should encourage students to think about their learning (National Council of Teachers of Mathematics, 2007). Students also have an opportunity to reflect on their work guided by teacher feedback (Hodgen & Wiliam, 2006). Feedback helps students gain a better understanding of their learning.

Teacher Activates Learners as Instructional Resources for One Another

Black and Wiliam (2009) explained that activating students as instructional resources for one another leads to collaborative learning and reciprocal teaching. Students often learn from one another because the information is coming from a peer rather than someone in authority over the students (National Council of Teachers of Mathematics, 2007). Goodrich (2012) stated that allowing students to be instructional resources for one another is beneficial for all students. Salvin, Hurley, and Chamberlain (2003) found that activating students as learning resources for one another is effective in that it,

> produces some of the largest gains seen in educational interventions, provided two conditions are met: (1) goals must be evident for students working in groups and (2) students must be held individually accountable for meeting the goals. (p. 183)

This encourages collaboration among the students while they are learning and gives the students opportunities to learn from each other (National Council of Teachers of Mathematics, 2007).

Teacher Activates Learners as the Owners of Their Own Learning

Black and Wiliam (2009) stated that activating students as owners of their own learning incorporates metacognition, motivation, interest, and attribution along with self-awareness. The rate of students' learning dramatically increases when students are involved in monitoring and regulating their own learning (National Council of Teachers of Mathematics, 2007). When students take ownership of their own learning, students become self-regulated learners (van Diggelen, Morgan, Funk, & Bruns, 2016).

The conceptual framework grounded the study and was carefully chosen. The research questions were developed to collect data on how middle-grade mathematics teachers use benchmark data in their teaching. The conceptual framework elements organized the literature review. In this study, I interpreted the analysis of the data using the conceptual framework as a guide.

Operational Definitions

In this study, I used the following terms that relate to benchmark tests and formative assessments. The defined terms give clarity to their meaning in the context of my study.

Pearson Benchmark Test: This is a standardized formative assessment. The study site school district uses this assessment to measure student growth toward passing the state mandated end-of-year test (Principal, personal communication, September 20, 2016).

Common Core State Standards: A set of high-quality academic standards in mathematics and English language arts; the standards define what students should know and should be able to do at the end of each grade level (Common Core State Standards Initiative, 2015).

Formative assessment: A process used by classroom teachers to provide information about what their students have learned (Emanuel, Robinson, & Korczak, 2013). Teachers are expected to use the results of formative assessment to plan their instruction.

Assumptions

I made the following assumptions when designing the study. I assumed that the teachers who participated in the study would answer the interview questions openly and honestly. I assumed that the teachers who participated in the study would describe their practices and needs based on their classroom experiences.

Limitations

The following are limitations of the study. Because the study will be conducted in one school district and with a small sample of middle-grade mathematics teachers, the results cannot be generalized to all school districts and all middle-grade mathematics teachers in the study state or elsewhere.

Scope and Delimitations

In the study site school district, there are four middle schools. Each middle school employs approximately 15 to 20 mathematics teachers. I recruited three experienced middle-grade mathematics teachers with a minimum of 3 years' experience, one each from sixth grade, seventh grade, and eighth grade.

Significance of Study

With the national focus on student mathematics achievement, it is important to gain an understanding of how middle-grade mathematics teachers use formative data to guide instruction and meet the individual needs of students. According to many researchers, formative assessment has significant influence on improving learning and reducing gaps in achievement (Black & William, 1998b; Chappuis & Stiggins, 2002; Fox-Turnbull, 2006; Fyfe & Rittle-Johnson, 2016; Martin, Polly, Wang, Lambert, & Pugalee, 2015; Marzano, Pickering, & McTighe, 1993; Meehan, Cowley, Schumacher, Hauser, & Croon, 2003; Nawaz & Rehman, 2017; Robinson, Myran, Strauss, & Reed, 2014).

The findings from this study provide the study site school district with information that could guide the school district in developing interventions to assist middle-grade mathematics teachers to better use formative assessment data to guide instruction and meet the individual needs of students. The results of this study will indirectly benefit middle-grade mathematics teachers who are the recipients of such interventions. The findings of this study may achieve positive social change in that when teachers improve their use of formative assessment in the classroom, student achievement in mathematics may be improved. Student achievement in mathematics may lead to student achievement in mathematics at the high school and college level. The achievements in mathematics could benefit students because mathematics is influential in our society. Amunga and Musasia (2011) endorsed the high demand of competency in mathematics due to continuous change in the global economy and workplace, use of mathematics for everyday living, the link between mathematics and other subjects, and the fundamental value of mathematical knowledge in every culture. Kwaku-Sarfo, Eshun, Elen, and Impraim-Adentwi (2014) added that mathematics presents itself in lives in various ways, such as practically, civically, professionally, recreationally, and culturally. Therefore, this study can affect students in the present and in the future.

Summary

In Section 1, I identified the local problem that there is little understanding of how middle-grade mathematics teachers are making use of benchmark data to plan classroom instruction and meet individual needs of students. The evidence for the problem was low mathematics achievement despite the use of benchmark tests for the past 10 years. The nature of the study is a basic qualitative design to gain an understanding of how middle-grade mathematics teachers use the benchmark results as formative data to guide instruction and meet the individual needs of students. I identified the conceptual framework using the model of formative assessment developed by Black and Wiliam (2009) based on Ramaprasad's (1983) three key processes in learning and teaching.

In Section 2, I review literature about the following topics: (a) research about the relationship of formative assessment and student achievement, (b) research about teachers' use of formative assessment to guide student learning, and (c) research about teachers' use of formative assessment in mathematics instruction. In Section 3, I describe the research design and methodology. I also describe the selection of participants, how the study addresses ethical issues, and data collection and analysis.

Section 2: Literature Review

Introduction

Researchers have expressed increased interest in the assessments teachers use in the classroom because they may serve as a powerful lever for improving student achievement (Wei, 2011). Teachers' use of formative assessment and formative assessment classroom practices have been analyzed from many different viewpoints, but it remains unclear how influential this model is on student achievement, particularly in the mathematics classroom.

In this literature review, I provide an overview of previous research on formative assessment, encompassing definitions of formative assessment, the effect of formative assessment on student achievement, five strategies used as part of this model, and its applications within mathematics education. I begin by examining various definitions of formative assessment from researchers in different fields, which led to the identification of common themes inherent in these definitions. I then reviewed literature suggesting that formative assessment can be an effective method to improve student achievement. While several studies show promising results (Black & Wiliam, 1998a; Dirksen, 2011; Heritage, 2010a; Heritage & Heritage, 2013; Robinson et al., 2014; Yalaki, 2010), not all research reveals significant benefits resulting from formative assessment. These latter studies are less numerous and some have methodological issues.

I then describe five key strategies that teachers and researchers seeking to use formative assessment to improve student learning and performance have identified. These strategies come from Black and Wiliam's (2009) model of formative assessment and include (a) clarifying learning intentions, (b) use of classroom discussion and question-based methods, (c) providing feedback that moves students forward, (d) use of peer-tutoring and other methods, and (e) developing students into owners of their own education and learning. Studies examining the effects of each of these strategies on student performance are presented in detail. I conclude this literature review by focusing on recent research regarding teachers' use of formative assessment specifically in mathematics instruction. Many of the same concepts and strategies previously described are revisited with special attention to mathematics instruction.

To locate literature for this review, I read peer-reviewed and scholarly journal articles that focused on the use of formative assessment in the classroom. I performed key term searches using the following databases: EBSCOHost, ProQuest Central, Google Scholar, ERIC, Education Research Complete, SAGE Premier, and Academic Search Complete. I used the following key search terms: *formative assessment, formative assessment in practice, feedback in mathematics, assessments in mathematics, high stakes testing and accountability, student performance in mathematics, teaching and learning in mathematics, benchmark tests in mathematics, classroom practices in mathematics, instructional practices in mathematics, standardized testing in mathematics*, and *theories of teaching and learning with assessment*. I focused my initial search on articles published between 2013 and 2019. In addition to the results obtained from the search, I used the bibliographies of relevant articles to identify additional literature on formative assessment, and I included earlier articles when relevant. The search process ended when the searches and bibliographies revealed no new articles relevant to my study.

Defining Formative Assessment

At its most basic level, formative assessment is a combination of frequent teacher assessments of student learning and the use of those assessments to develop an instructional plan to address student learning deficits (Hoover & Abrams, 2013; Hung, Hoang Ha, & Thanh Thu, 2019). Formative assessment can also be described as day-to-day classroom practices involving investigation and clarification of evidence about student learning (Santos & Semana, 2015).

Buyukkarci (2014) explained that formative assessment is an evaluation process for teachers because it gives them an opportunity to “reflect on how learning is best delivered, to collect evidence of how learning is best delivered and to use the information to improve students’ understanding” (p. 108). Teachers often assume that learning is taking place rather than investigating students’ retention of information and determining to what extent learning is taking place (van de Pol, 2012; van Diggelen, 2013). It is important to explore students’ thinking or look at examples of their work to verify they are on the right track and to gauge which misconceptions or gaps in learning still exist (van Diggelen et al., 2016). Formative assessment practices must be well supported in the instructional process so that the information learned from the assessment will help determine whether and how instruction should be altered (Trumbull & Lash, 2013).

Formative assessment practices allow teachers and students to generate and apply evidence from various sources to enhance learning (Black, Harrison, Lee, Marshall, &

Wiliam, 2003; Erickson, 2007; Sadler, 1989; Shepard, 2000). Teachers play a central role in this process by collecting data in the classroom that can inform their teaching (Heritage & Heritage, 2013).

> Without a deeper understanding of formative assessment teachers may fail to recognize that using assessment formatively represents a major change in the teacher's role" related to students' education, and constitutes "a fundamental reorientation of the teacher-student learning relationship on the part of both teachers and students. (Robinson et al., 2014, p. 144)

It is therefore important for teachers to be aware of their changing role and how it might affect the classroom environment.

When it is most effective, "formative assessment should (a) encourage and support, not undermine, the learning process for learners and teachers; (b) provide formative information whenever possible; and (c) be responsive to what is known about how people learn, generally and developmentally" (Shute & Kim, 2014, p. 1). When teachers know how students are developing and where they are struggling, they can use that information to adjust their teaching. For example, they can reteach, use other instructional approaches, modify tasks or assignments, or provide more opportunities for students to practice (Shute & Kim, 2014).

Regarding mathematics education, formative assessment has been described as similar to the practice of professional noticing, which is defined as "teachers attending to strategies, interpreting understanding, and the moment-by-moment decision making in the classroom based on students' verbal or written responses" (Martin, 2015, p. 303).

While there are differences in the approaches that different teachers use when implementing and applying formative assessment, there have been several commonalities documented:

> (a) determining achievement goals that students are expected to reach—the expected level; (b) collecting information about what students know and can do—the actual level; (c) identifying the gap between the actual level and expected level; and (d) taking action to close the gap. (Yin, Olson, Olson, Solvin, & Brandon, 2015, p. 42)

The inclusion of these commonalities provides the groundwork for teachers to ask questions, construct lessons, and reteach according to students' mathematical understanding (Martin, 2015). While this approach appears beneficial, it is important to examine extant research regarding whether formative assessment has an influence on student achievement. This issue is explored in the following section.

Formative Assessment and Student Achievement

Numerous researchers have explored the relationship between formative assessment and student achievement. While many researchers found that formative assessment positively influences student achievement, others found mixed results. Akpan, Notar, and Padgett (2012) claimed that "the power of formative assessment exists in the constant collection and modification of information gathered to inform instruction that will meet students' needs" (p. 95). Simply stated, formative assessment connects the results of an assessment to modifications in instruction with a goal of improvement in student achievement (Wiliam, 2011). A variety of actions can be taken with this information; for example, Bulunuz, Bulunuz, and Peker (2014) argued that the instructional plan should address student misconceptions about the educational content that are discovered by the assessments.

Hattie (2012) evaluated more than 800 meta-analyses containing over 50,000 studies and 146,000 effect sizes regarding the effects of formative assessment on student achievement. The *effect size* is a common measure that assesses the effect of an intervention relative to the variation present in the data. Effect size is calculated as the difference between the mean of two variables and divided by the standard deviation. An effect size of 0.5 or larger is usually considered statistically significant (Scruggs & Ritcher, 1988). Hattie found an effect size of 0.47, which is close to statistical significance. The high levels of variation in the student achievement measurements used in the studies Hattie included in the meta-analysis may obscure the true benefit of formative assessment; however, another quantitative approach (i.e., comparative ranking) may be warranted.

When Good (2015) analyzed Hattie's (2012) results, Good found that formative evaluation had the third largest effect on student achievement out of 138 other influences and was therefore a good candidate for interventions despite having an effect size below 0.5. The technique with the largest effect on student achievement out of 138 other influences was self-reported grades (Good, 2015). A self-reported grade is a strategy in which the teacher learns of students' expectations and pushes students to exceed those expectations; after students exceed their expectations, they gain confidence in their learning abilities. The technique with the second largest effect on student achievement involved Piagetian programs that are based on Piaget's theory of cognitive development and children's learning stages. Formative assessment came in third behind these two techniques. Good (2015) concluded that formative assessment may be more feasible for wide deployment due to its similarity to teachers' traditional assessment methods (i.e., giving tests).

Other researchers have focused more precisely on how formative assessment affects student achievement. In a mixed-methods study, Robinson et al. (2014) examined teachers' use of formative assessment practices in the classroom. The study took place over a 2-year period with a group of 21 teachers at one school in a district that provided professional development for teachers regarding formative assessment practices. The teachers used various formative assessment practices, such as peer questioning, classroom conversations, rubrics, goal setting, and feedback strategies, to modify instruction and meet student needs. The results of students' quarterly benchmark tests showed that teachers who used formative assessment strategies in the classroom scored 7.18% higher than the district's average. Students tested had 73% of items correct, and the district average was 66%. The effect size for teachers who employed formative assessment strategies was 0.41 compared to those teachers who did not use formative assessment strategies for similar learning targets. While the effect size was somewhat low, the difference in student achievement between the two groups was still notable, suggesting that formative assessment may affect student performance.

A subsequent pretest-posttest quasi-experimental study by van den Berg, Bosker, and Suhre (2018) also found some evidence of formative assessment influencing student achievement. The researchers investigated the effectiveness of the classroom formative assessment model and student performance in mathematics for fourth- and fifth-grade students. The design consisted of two groups made up of 34 fourth- and fifth-grade classes: 17 classes for the treatment group and 17 classes for the control group (van den Berg et al., 2018). During mathematics lessons, teachers in the treatment group made frequent use of daily and weekly goal-directed instruction, assessment, and immediate instructional feedback. Teachers in the control group used half-yearly standardized tests to monitor student progress. Students in both groups took a mathematics pretest covering learning goals at the beginning of the year and a posttest covering learning goals at the end of the year.

The results from van den Berg et al.'s (2018) study show that employing daily and weekly goal-directed instruction, assessment, and immediate instructional feedback was effective in enhancing student performance in mathematics. During the study, teachers in the treatment group and the control group did not differ in their use of goal-directed instruction ($U = 94.00$, $p = 0.07$). However, there were significant differences as it related to their use of assessment ($U = 22.00$, $p < 0.001$) and immediate instructional feedback ($U = 32.00$, $p < 0.001$). The mean score for the treatment group was 10.44 with a standard deviation of 4.76, and the mean score for the control group was 9.91 with a standard deviation of 4.75. These results indicate that, compared to teachers in the control group, teachers in the treatment group assessed their students' mastery of the learning goal and provided immediate instructional feedback during the lessons more frequently.

Several other researchers have found that formative assessment practices positively affect student achievement (Black & Wiliam, 1998a; Box, 2019; Dirksen, 2011; Heritage, 2010b; Heritage & Heritage, 2013). Evidence suggests that progress can be made in student achievement when teachers incorporate formative assessment practices into their daily instruction (Black & William, 1998b; Martin et al., 2015; Wiliam, 2011). Not all studies of formative assessment have found that the technique positively affects student achievement, however.

In a meta-analysis of 13 studies about the effect of formative assessment on student achievement, Kingston and Nash (2011) found that the median effect size was approximately 0.2, far below the threshold of 0.5. Additionally, even the results they did claim to find may have been spurious, according to McMillian, Venable, and Varier (2013). These authors criticized Kingston and Nash's meta-analysis, identifying many flaws in their research. McMillian et al. argued that "several weaknesses in their methodology, along with limitations in the quality of the studies, mitigate their conclusions" (p. 1). The primary criticisms were that (a) Kingston and Nash did not pay enough attention to the methodological qualities of the studies that they reviewed, and (b) Kingston and Nash did not give enough consideration to the type of formative assessment under investigation in the study that they reviewed. Overall, McMillian et al. concluded that Kingston and Nash did not establish that there was a positive relationship between formative assessment and student achievement. While there are numerous possible explanations for these more negative results, one possibility is that teachers attempting to implement formative assessment are unsure of effective practices, when to use the practices, and the outcomes of combining the practices for certain students in the classroom (Duckor, 2014).

The aforementioned studies suggest that there are potential challenges to implementing effective formative assessment approaches in education. However, the larger volume of positive results indicates that the overall technique is likely to be effective. What may be useful to replicate those positive results, however, is a comprehensive strategy to help teachers implement formative assessment effectively. To accomplish this goal, Black and Wiliam (2009) devised three questions to help teachers and researchers design an effective formative assessment plan, and Witte (2012) rephrased them as: "(1) Where are my students? (2) Where do my students need to be? and (3) How do my students get there?" (p. 9). These three questions led Black and Wiliam (2009) to identify five key strategies to answer these questions and guide formative assessment activities. They state these as:

> (1) clarify learning intentions and criteria for success, (2) engineer effective classroom discussions and other learning tasks that elicit evidence of student understanding, (3) provide feedback that moves the learner forward, (4) activate students as instruction resources for one another and (5) activate students as the owners of their own learning. (Black & Wiliam, 2009, p. 5)

These strategies provide the organizing structure for the next five sections in this review.

Clarifying Learning Intentions and Criteria for Success

The first strategy to improve student achievement with formative assessment consists of the teacher making it very clear to their students what the intentions of lessons are and what the criteria for success will be. Teachers set expectations for students and explain how their work will be evaluated, therefore enabling their students to set goals (Leirhaug & MacPhail, 2015). According to van Diggelen et al. (2016), one of the main focuses of learning is to help students understand where they are going in the learning process. Students need to understand what the teacher intends for them to learn and be able to identify whether they are on the right path to achieve their learning goals (van Diggelen et al., 2016). According to Forster and Souvignier (2014), goal setting is a critical component in promoting achievement and motivation in students. Schneider and Andrade (2013) identified best practice as teachers sharing learning targets and expectations with their students in a variety of ways.

Studies that focus on the effectiveness of this specific approach have shown mixed results. Leirhaug and MacPhail (2015) conducted a qualitative case study of three Norwegian physical education teachers to learn how physical education teachers incorporated formative assessment practices and shared learning goals with their students. All three teachers incorporated various formative assessment practices to share learning goals with their students related to assessment in physical education. One teacher used self-assessments; the second teacher used self-assessments and peer-assessments; and the third teacher used feedback. All the teachers focused their formative assessment practices on allowing the students to play a more active role in their learning. All three teacher participants stressed the importance of involving students in their learning to help students understand where they are in the learning process and pursue goals they want to achieve. The findings of this study indicated that physical education teachers should individualize their instruction and provide appropriate learning experiences for individual students. For students to assume responsibility for their own learning, detailed teacher planning is required along with support for students (Leirhaug & MacPhail, 2015).

Not all efforts at goal setting show positive results, however. Forster and Souvignier (2014) conducted a pretest-posttest quasi-experimental study to investigate "the effects of learning progress assessment (LPA) and goal setting on reading achievement, reading motivation, and reading self-concept" with fourth-grade students (p. 93). The design consisted of three groups that met three conditions: 13 classes that received LPA with goal setting, 15 classes that received LPA but no instruction in goal setting, and 13 classes that received neither LPA or instruction in goal setting. The study took place over a 6-month period with the pretest given at the beginning of the 6 months and a posttest given at the conclusion of the 6 months. During the study period, both LPA groups completed eight LPA tests. Students in the LPA with goal setting group identified goals before each LPA test and reflected on their goal achievement after each test. The results showed that the growth in reading for students in the LPA without goal setting group was the highest with an average growth of 0.38 in 6 months versus students in the LPA with goal setting group with an average growth of 0.09.

The researchers were surprised by their results. They had predicted that the use of goal setting would enhance student achievement, but their findings suggested otherwise. Forster and Souvignier (2014) explained their unexpected results as follows: Teachers in the LPA without goal setting group were able to focus on the students' reading results and their progress while teachers in the LPA with goal setting group also had to focus on helping the students with goal setting. The study showed that instruction in goal setting alone is not enough to positively influence student achievement. Forster and Souvignier argued that teachers need to give students feedback on the progress of their learning, help students set goals, and encourage students to reflect on how they are meeting their goals. Whether goal setting is positive and sometimes poorly implemented or not a sufficient strategy on its own is unclear. More research on this aspect of formative assessment is therefore warranted.

Engineering Effective Classroom Discussions and Other Learning Tasks That Elicit Evidence of Student Understanding

When teachers assess student learning they become aware of where the learner currently stands in the learning process. This can be accomplished using formal assessments, but it can also come from a teacher listening carefully to classroom discussions and even guiding the conversation themselves. Questioning can therefore be considered a type of formative assessment. Early studies conducted about teacher questioning practices adopted a process-product model that focused on the relationship between teacher questioning and student achievement (Carlsen, 1991). Wolfe and Alexander (2008) reviewed a body of longitudinal research and found that "exploratory talk, argumentation, and dialog promote high-level thinking and intellectual development through their capacity to involve teachers and… learners in joint acts of meaning-making and knowledge construction" (p. 1). Chin (2007) found that studies of the benefits of questioning with regard to using formative assessment to improve student achievement have shown mixed results.

Through a qualitative case study, Heritage and Heritage (2013) focused on a teacher's use of questioning and instructional practice to further student learning. Observations and video recordings were conducted in a fifth-grade writing class where the teacher used one-on-one questioning as a formative assessment practice. The teacher specifically targeted two students to hold a one-on-one conference during the writing lesson. During the conference, the teacher conversed with each student to gather evidence of the student's current status in relation to the learning goal(s) and to engage in instructional responses to perceived needs. The teacher kept a record of the conferences and used the notes to decide what the plan of action would be to move the learner forward. The results of this study showed that open and respectful questioning between the teacher and the student contributed to the teacher's understanding of the student's current learning status and guided the teacher to make decisions regarding instruction (Heritage & Heritage, 2013). These findings corroborated Wolfe and Alexander's earlier study.

Chen, Crockett, Namikawa, Zilimu, and Lee (2012) conducted a qualitative case study of three eighth-grade mathematics teachers to learn how the mathematics teachers used teacher talk and classroom discussions as a formative assessment practice. The researchers observed how the mathematics teachers asked students about their understanding and provided feedback to the students.

The first teacher in Chen et al.'s (2012) study posed questions and elicited student responses based on an exam the students were going to take. Most of this teacher's questions were low-level questions that only required one-word responses. The feedback only verified whether students had answered the questions correctly. The second teacher was similar to the first and pressed the students with low-level questioning. However, this teacher's next steps depended on whether the students answered the questions correctly. When the students did not answer correctly, the teacher probed the students with a series of low-level questions to derive the correct answer and incorporated some "why" questions that required students to explain their thinking. The third teacher employed different methods and began by creating teacher-made examples of important concepts within the lesson. When students provided incorrect answers to the teacher's questions, the teacher modified the instruction to address the students' misconceptions. This teacher incorporated high-level questioning techniques which, according to Chen et al. (2012), force students to explain or justify their answers. The researchers observed that this teacher concentrated on students' thinking by using questioning and providing feedback. This teacher therefore used more formative assessment practices than the other two teachers.

The findings from Chen et al. (2012) suggest that the teachers needed more clarity regarding the types of questions that extend beyond highlighting factual knowledge. The findings also suggest that the teachers could benefit from learning how to construct probing questions, guide student thinking, and give constructive feedback that promotes mathematical understanding. This study showed that the use of questioning and feedback may be relevant for teachers to gauge students' thinking and misconceptions when gathering evidence of student understanding. Despite the potential drawback of the non-quantitative nature of class discussions (i.e., it is difficult for a teacher to objectively assess understanding), the lack of additional grading work or logistical planning may make this approach realistic if best practices can be identified to make it effective.

Providing Feedback That Moves Learners Forward

Teacher feedback to students is essential if formative assessment is to positively influence student understanding and assessment scores. According to Einig (2013), feedback has been consistently found to have a strong positive effect on learning and achievement. However, for this to occur, feedback should be specific to a certain task, contain learning-related information, and be timely and informative. Effective feedback provides students with suggestions, hints, or cues that improve their learning (Heritage, 2010b). Low (2015) found that feedback is more effective if it is "specific, simple, descriptive, and focused on the task so as to help students set clear expectations and facilitate successful decision-making" (p. 44). Feedback benefits learning by supporting correct responses, minimizing perseveration on incorrect responses, and facilitating alternative solutions (Fyfe & Rittle-Johnson, 2016).

In a meta-analysis, Hattie and Timperley (2007) gathered data from 12 meta-analyses on feedback that included 196 studies and 6,972 effect sizes. The average effect size was 0.79. The effect sizes reported in these meta-analyses varied depending on the type of feedback, implying that some types of feedback are more effective than others. For example, higher effect sizes were associated with formative feedback, and lower effect sizes were associated with feedback that consisted of praise, rewards, or punishment. Hattie (2012) reported results consistent with findings in Hattie and Timperley's (2007) study. Hattie (2012) reviewed over 900 studies about instructional techniques that are most effective in the classroom. This later meta-analysis focused on finding a specific result, student achievement, and interpreting what caused the result. Hattie found that formative feedback was the most influential practice that improves student learning.

Van der Kleij, Feskens, and Eggen (2015) conducted a subsequent meta-analysis to examine the success of using different methods for providing detailed feedback regarding students' learning outcomes within a computer-based environment. The researchers explored 40 studies that produced 70 effect sizes ranging from -0.78 to 2.29, with the feedback type as the independent variable in this meta-analysis. Four types of feedback were commonly found throughout the 40 studies: elaborated feedback (EF); knowledge of correct responses (KCR); knowledge of results (KR); or no feedback at all. The mean weighted overall effect size for EF was 0.61, for KCR was 0.32, and KR had the smallest effect size of 0.05. The findings of this meta-analysis consistently showed that detailed feedback results in better learning outcomes than simple feedback, especially as it relates to higher order learning outcomes (Van der Kleij et al., 2015); these findings are in line with the earlier results of Hattie and Timperley (2007).

Corroborating the findings of Hattie and Timperley (2007), Hattie (2012), and Van der Kleij et al. (2015), several other studies have also shown that detailed feedback is effective and can contribute to effective formative assessment (Black & Wiliam, 2009;

Gipps, 2012; Wiliam, 2007). However, some researchers have found less positive results. In an experimental research study, Fyfe, DeCaro, and Rittle-Johnson (2015) examined the effects of feedback type as it relates to children's mathematics problem solving and whether their working memory capacity affected the effectiveness of feedback. A total of 64 elementary students from nine different elementary schools participated in the study. The students randomly received strategy-feedback or outcome-feedback. Students receiving strategy-feedback explained how they solved their problems and received feedback regarding whether their strategies were correct or incorrect. Students receiving outcome-feedback stated their numerical answer and received feedback on whether their numerical answer was correct or incorrect. The researchers' experimental hypothesis was that the strategy-feedback would be more effective than the outcome-feedback.

The results of Fyfe et al.'s (2015) study showed that "children with lower working memory capacity benefitted less from strategy-feedback than outcome-feedback, whereas children with higher working memory capacity benefitted similarly from the two types of feedback" (p. 73). In contrast to their initial hypothesis, the findings showed no evidence that feedback regarding strategies is more beneficial than feedback on outcomes. This result was the opposite of that predicted based on the studies of Hattie and Timperley (2007) and Van der Kleij et al. (2015). It also contradicted the conclusion of Lipnevich, McCallen, Miles, and Smith (2014) who found that student performance does not improve if feedback does not provide helpful strategies to get students where they need to be in the learning process. Fyfe et al.'s (2015) findings therefore suggest that, in some cases, more detailed strategy-based feedback can be more harmful than good. This indicates that students' cognitive demands must be considered when determining the various types of feedback to use with children.

One factor that may explain these discrepancies was identified by Schneider and Andrade (2013), who found that teachers have difficulty interpreting evidence of student learning from formative assessment and that they also struggle with providing students with feedback that enhances student learning. Because of these mixed results, the proper training of teachers in using formative assessment strategies is critical for their success.

Activating Students to be Instructional Resources for One Another

Given that classrooms are interactive learning spaces, interactions between students may be useful for learning. Allowing students to function as instructional resources for one another can be classified as a formative assessment practice (van Diggelen et al., 2016). The benefits of using students as resources for one another include: (a) students will discuss and explain concepts to each other using different vocabulary than the teacher, (b) students will be more open to ask questions of their peers, and (c) the process can increase students' own knowledge and understanding (van Diggelen et al., 2016). This approach is often referred to as peer tutoring. *Peer tutoring* is a formalized intervention that teachers use to help students who are struggling to learn academic content (Bowman-Perrott, deMarin, Mahadevan, & Etchells, 2016). Teachers and students can easily incorporate peer tutoring because it is flexible and can be implemented using the curriculum teachers already have in place (Bowman-Perrott et al., 2013). Research has shown that peer tutoring is an effective strategy for student learning

(Bowman-Perrott et al., 2016; Hudson, Browder, & Jimenez, 2014; Jameson, McDonnell, Polychronis, & Riesen, 2008; Reinholz, 2016).

In a meta-analysis examining the effects of peer tutoring, Bowman-Perrott et al. (2016) analyzed 26 single-case research experiments of about 900 students in Grades 1-12. The five variables examined in this meta-analysis included use of peer tutoring, grade level, reward, disability status, and content area. The effect size found for peer tutoring was 0.75. The findings indicated that students who were involved in peer tutoring achieved higher academic gains than those students who were not engaged in peer tutoring interventions. The research also showed that teachers found it easy to incorporate peer tutoring into their classrooms.

A later quasi-experimental study by Nawaz and Rehman (2017) also demonstrated the effectiveness of peer tutoring as an instructional strategy. The study was conducted in secondary level mathematics classes and included 200 tenth-grade mathematics students from two different schools who were randomly assigned to a control group and an experimental group. At the beginning of the study, all students were given a pretest in their mathematics class. Students in the experimental group received 8 weeks of peer tutoring as an instructional strategy and those in the control group did not. A posttest was given to all students at the conclusion of the 8 weeks to determine the effects of peer tutoring as an instructional strategy. On the posttest, the experimental group had a mean score of 24.46 with a standard deviation of 5.23 and the control group had a mean score of 16.53 with a standard deviation of 4.35. Nawaz and Rehman's findings indicate that the use of peer tutoring as an instructional strategy had positive effects on students' academic performance at the secondary level in the mathematics classroom. They specifically found peer tutoring to be successful in "improving students' grades, increasing knowledge of subject matter, increasing students' engagement and improving students' behavior in the classroom" (p. 17). The technique enabled students to learn through teaching their peers and self-correcting their own errors. The researchers argued that their study provided strong evidence that peer tutoring should be implemented on a consistent basis in the mathematics classroom and for instruction in other subjects as well.

While various meta-analyses have shown that peer tutoring has a positive effect on academic achievement, Leung (2015) claimed that results had been misrepresented due to theoretical and methodological flaws. Leung therefore conducted a meta-analysis that was structured to compensate for the limitations of previous meta-analyses. According to Leung, those previous studies,

> have not adopted both fixed and mixed effects models for analyzing the effect size; they have not evaluated the moderating effect of some commonly used parameters, such as comparing same-age reciprocal peer tutoring, same-age nonreciprocal, or cross-age peer tutoring; considered the educational level of tutee or tutor; or properly addressed publication bias. (p. 558)

Leung (2015) included 72 articles in a meta-analysis of peer tutoring and its effect on academic achievement that yielded an effect size of 0.59. Despite skepticism, Leung's meta-analysis confirmed the findings of previous meta-analyses (e.g., Bowman-Perrott et al., 2013, 2016) regarding the overall effectiveness of peer tutoring on academic achievement. Leung's meta-analysis addressed the limitations of previous meta-analytic research by including studies that examined a greater range of subject content and participants and by adopting current methodological advances in meta-analysis research. The results of this meta-analysis generated stronger evidence that peer tutoring has a positive effect on academic achievement.

In contrast to some of the previously described strategies for formative assessment, peer tutoring seems to have considerable support in the literature. The ease of implementation is also a benefit to using this technique.

Activating Students as the Owners of Their Own Learning

One of the main objectives of formative assessment is for students to own their personal learning experience and require less external imposition and instruction. Black and Wiliam's (2009) final formative learning strategy therefore involves fostering such self-direction in students. van Diggelen et al. (2016) described this process as *self-regulated learning*, which "can be considered as a process whereby a student sets goals for learning and then attempts to monitor, regulate, and control their cognition, motivation and behavior to achieve the goals" (p. 19). Self-regulated learners are more effective learners because students have continuous and immediate access to feedback based on their own thoughts, actions, and work. According to Reinholz (2016), self-assessment is closely related to self-regulation.

There has been considerable research on the effectiveness of various approaches to achieve this goal of self-regulation. Baas, Castelijns, Vermeulen, Martens, and Segers (2014) conducted a qualitative study on the relationship of formative assessment and students' use of cognitive and metacognitive strategies. The study was designed to examine the connection between formative assessment practices and self-regulated learning. The self-regulated learning strategy used in this study was portfolio assessment, which enabled students to monitor their own work and development. The study included 528 students in Grades 4-6 from seven different schools. Students' self-regulatory skills were evaluated using six scales of the *Children's Perceived Use of Self-Regulated Learning Inventory* (Vandevelde, Van Keer, & Rosseel, 2013). The students completed the questionnaires that measured their perceptions of monitoring their work 6 weeks after the study began.

The findings for this study showed that giving "students a clear understanding of where they are in their learning (monitoring) predicts students' task orientation and planning activities" (Baas et al., 2014, p. 41). The researchers also found that "supporting student learning by discussing with students what the next step in their learning (scaffolding) is positively related to students' use of surface learning strategies, deep-level learning strategies, and process evaluation" (p. 41). The results of this study show that it is important for teachers to relinquish responsibility to students so that students take control of their own learning. Formative assessment can be influential in enhancing students' use of cognitive and metacognitive strategies. However, its level of effectiveness depends on how well teachers use formative assessment data.

A later study by Cleary and Kitsantas (2017) employed a quantitative approach to examine the relationships between background variables (prior mathematics achievement, socioeconomic status), motivational beliefs (self-efficacy, task interest, school connectedness), self-regulated learning (SRL) behaviors, and performance in mathematics courses at the middle school level. One of the primary goals of this study was to examine "the mediation roles of both self-efficacy and SRL behaviors" (p. 88). A total of 331 middle-school students from one middle school were selected for this study because this particular school was diverse and fairly represented the state's demographics. Data about three types of motivation beliefs (self-efficacy, task interest, connectedness) were collected by way of self-report questionnaires and students' numerical grades in mathematics were used to gauge the students' success in mathematics. The data were collected over a 3-week period while students were in their social studies classes.

The study's following hypotheses were confirmed:

> (a) Socioeconomic status would relate to mathematics performance through student self-regulated learning, (b) school connectedness would be positively related to self-efficacy through task interest and positively related to student self-regulated learning through self-efficacy, (c) task interest would be positively related to student self-regulated learning through self-efficacy and positively related to mathematics performance through self-efficacy, and (d) self-efficacy would be predictive of mathematics performance through its relations with student self-regulated learning. (p. 94)

Based on Cleary and Kitsantas' results, self-efficacy beliefs and self-regulated learning behaviors were significant factors in the structural model. However, the researchers did acknowledge that simply because self-efficacy was the dominant motivational belief does not mean that task interest and connectedness are not relevant. It is important to recognize that middle school students' academic performance is impacted by various factors such as students' prior knowledge, students' own capabilities to succeed, and the students' level of engagement in the classroom.

In a meta-analysis examining the same relationship between self-regulated learning and academic achievement, Ergen and Kanadli (2017) analyzed 21 quantitative studies published between 2005 and 2014. The researchers investigated whether the effect size showed a significant difference as it related to course type, self-regulated learning strategy type, school level, and study design. The findings of this study revealed that the use of self-regulated learning on academic achievement had a large effect size of 0.859. There was no significant difference as it related to course type, self-regulated strategy type, school level, or study design. Based on their results, Ergen and Kanadli (2017) suggested that teachers employ self-regulated learning strategies in their classrooms to increase student performance. The fact that self-regulated learning had a significant effect on academic achievement confirmed the findings from the meta-analyses by Hattie, Biggs, and Purdie (1996), Chiu (1998), and Dignath and Buttner (2008).

Not only are teachers responsible for improving student achievement, they also need to adjust the curriculum, instruction, and classroom assessments as part of their role as instructors (Chan, Graham-Day, Ressa, Peters, & Konrad, 2014). Consequently, their time is very limited. It is therefore crucial that teachers promote student ownership of learning. Chan et al. (2014) argued that when teachers show students how to be actively involved in their learning and provide them with chances to do so, student achievement is enhanced. Students who are self-regulated have the necessary skills required "to monitor and control their learning and to accommodate the changing demands in their learning environment" (DiFrancesca, Nietfeld, & Cao, 2014, p. 6). Research has demonstrated that students who are encouraged to participate in self-assessment and keep track of their own progress can thus make significant improvements in their academics (Black & Wiliam, 1998a; Ma & Winke, 2019; Stiggins & Chappius, 2017).

Based on the research reviewed above, the literature overwhelmingly supports the conclusion that helping students take control of their own education is beneficial. This strategy complements the peer-tutoring strategy previously discussed; both are key elements for effective formative assessment (Black & William, 1998b).

Teacher Use of Formative Assessment in Mathematics Instruction

The studies listed above encompass a wide range of academic subjects, but whether their findings regarding formative assessment also apply to mathematics education is one of the main queries of this research study. The continuous use of formative assessment has been proposed as a method to help teachers make concrete decisions about teaching and learning in mathematics specifically (Santos & Semana, 2015; Veldhuis & van den Heuvel-Panhuizen, 2019). Adabor (2013) argued that teachers should allow formative assessment of mathematical understanding to be the focal point of instruction employing questioning, feedback, self- and peer-assessment, and formative use of summative assessment. Several studies specifically investigating formative assessment in mathematics courses have been conducted using various research designs, including quantitative, quasi-experimental, qualitative, and mixed methods.

In a quantitative study examining the types of formative assessment practices that affect eighth-grade students' mathematical achievement in five high-performing Asian school systems, Cheng (2014) found that student performance varied depending on the school system. The researcher analyzed 2011 data from the Trends in International Mathematics and Science Study (TIMSS) dataset in Korean, Singapore, Taipei, Hong Kong, and Japanese school systems because they were the five highest-ranked schools in mathematics performance according to the TIMSS (National Center for Education Statistics, 2011). Cheng (2014) discovered that five different formative assessment practices employed at the schools contributed to the five high-performing school systems. These included: (a) having students work out their problems by themselves or with a peer, (b) having students explain their answers, (c) having students decide their own procedures for solving complex problems, (d) having students listen to teachers explain how to solve problems, and (e) having students memorize rules, procedures, and facts. Although the formative assessment practices were correlated to students' mathematical performance in all school systems, they affected each school system in a different manner. To be more specific, Korean teachers asked students to explain their answers. Teachers in Singapore asked students to decide their own procedures for solving problems. And, Japanese teachers asked students to work out their problems by themselves or with a peer. Given the varied results of this study, it is critical for researchers to better understand why formative assessment practices are effective for some students and not others as it relates to students' mathematical achievement.

Two different quasi-experimental studies have provided further insight into the potential effectiveness of formative assessment on mathematics performance (see Abbas, 2016; Andersson & Palm, 2017). Abbas's (2016) study aimed to determine the effectiveness of a developmental mathematics program that used formative assessment strategies to enhance primary students' higher order mathematical thinking and mathematics appreciation. *Higher order mathematical thinking* is a way of thinking in mathematics that relates to "quantitative reasoning, pattern recognition, inductive reasoning, and deductive reasoning" (Abbas, 2016, p. 382). The formative assessment strategies used in the developmental mathematics program included problem solving, mathematical communication, and realistic mathematics education. This program was designed to:

> (a) understand and simplify the bases of mathematics and the algebraic concepts and relate them to the concepts of numeracy and geometry and to students' prior knowledge and experiences, (b) organize new knowledge and add it to the student's cognitive structure to form his/her own concepts, and (c) use this knowledge to comprehend and solve mathematical problems. (p. 378)

The program was designed in stages that allow students to move from lower levels to higher levels.

Abbas's study included 25 students as the control group and 28 students as the experimental group. Both groups were given pretests containing a problem-solving test, a creative thinking test, and a mathematics appreciation scale. After the administration of the pretests, the experimental group participated in the program for approximately 8 weeks, after which both the control and experimental groups were given posttests containing the same content as the pretest. Abbas (2016) found a significant positive difference in posttest scores between the experimental group and the control group, including a mean score of 75.32 for the experimental group and 55.68 for the control group for problem solving; a mean score of 72.29 for the experimental group and 32.60 for the control group on the creative thinking test; and a mean score of 123.18 for the experimental group and 74.00 for the control group on the mathematics appreciation scale. These findings demonstrate that developmental mathematics programs enhance student achievement in mathematics, suggesting that the specific formative assessment practices used were also effective.

Another quasi-experimental study examined formative assessment more directly. Andersson and Palm (2017) studied teachers' formative classroom practices and their effect on student achievement using a sample of Year 4 mathematics teachers during the 2011-2012 school year. Participants either formed part of the professional development program in formative assessment during spring 2011 (the intervention group) or the control group. The professional development program was designed to emphasize that formative assessment is a unity of integrated strategies. In the intervention group, 22 teachers participated in the program in anticipation of implementing the formative assessment practices in the upcoming school year. A pretest and posttest were administered to all students in the Year 4 mathematics classes for those teachers in both the intervention and control groups to determine the effect of formative assessment on student learning. The researchers found that students taught by the teachers in the intervention group ($M = 27.16$, $SD = 3.68$) outperformed students taught by those in the control group ($M = 26.19$, $SD = 3.69$), although by a small degree. Given its findings, this study indicates that formative assessment practice in the classroom may positively affect student performance in mathematics.

Several qualitative and mixed methods studies also lend evidence to the potential effectiveness of formative assessment in mathematics education. In a qualitative study, Polly (2015) explored how students' mathematical understanding was influenced by teachers using formative assessment practices that they learned during a year-long professional development program. Two elementary-school teachers with little experience were selected from the year-long professional development group to participate in the study. Two other elementary teachers with similar characteristics who did not participate in the professional development group were chosen to provide a comparison. All four participants taught the same grade level in mathematics, used the same mathematics curriculum, and had students with similar abilities. The researcher gathered data from all the participants using video recordings, field notes, and student work samples collected from classroom observations.

Polly (2015) found that the teachers who participated in the year-long professional development group engaged their students in more high-level tasks and the comparison teachers used more teacher-directed tasks. Moreover, those teachers who participated in the professional development group provided their students with more tasks than the comparison teachers. In terms of student learning, the students of the participating teachers demonstrated their understanding of their learning in two ways: (a) through working with different mathematical representation, and (b) in conversation with their teachers. This study demonstrates that teachers could connect the formative assessment techniques they learned from the professional development program to their classroom practices (Polly, 2015), and confirms Robinson et al.'s (2014) similar findings, discussed above.

Another study, Martin (2015), explored the use of formative assessment strategies within a writer's workshop model in mathematics using a case study design. The research was conducted in a fourth-grade mathematics classroom with one teacher over a 6-week period and included 18 applications of a modified version of the Adapted Writer's Workshop (AWW) model. Lessons consisted of "prior-knowledge prompts, mathematical problems related to the mini-lesson, and prompts geared toward reflection" (p. 305). The purpose of the workshop was to create an outlet "for students to write about their mathematical thinking and problem solving" (p. 304). Through the study, Martin explored how students' writing affected their achievement in mathematics, considering the fact that students were in the beginning phases of mathematical writing since their use of journals to document their learning process had recently been introduced to the class.

The data collection process occurred in three stages. During Stage 1, the planning process took place with the classroom teacher. During Stage 2, classroom visits took place three times a week during the implementation of the AWW. During Stage 3, a follow-up interview took place with the teacher to discuss the experience and future plans. According to Martin, this case study revealed three findings about the implementation of AWW in a mathematics classroom:

> First, students used writing to demonstrate their mathematical understandings and, in some cases, their misunderstandings; second, students' writing provided insight into their readiness for more challenging problems; and third, students' writing showed their connections and understanding between prior knowledge and the mathematical concepts presented in class. (p. 307)

Martin found that the AWW model, which incorporated formative assessment techniques, was an effective instructional strategy for teaching mathematics. These qualitative findings complement the empirical data from Andersson and Palm (2017) and Abbas (2016).

A mixed methods study by Polly, Martin, Wang, Lambert, and Pugalee (2016) provided valuable insight into certain challenges associated with formative assessment. They explored the effects of a year-long professional development program about formative assessment on teachers' instructional decisions in their mathematics classrooms. The primary grade teachers in this study participated in 40 hours of face-to-face training along with 40 hours of classroom-embedded activities that were facilitated online. Polly et al. (2016) collected data from 138 primary teachers within four school districts in the southeastern United States by way of discussion board posts and reflection questions. The results of this study showed that the teachers who participated in the year-long professional development program learned how to successfully use formative assessment, analyze student data, and implement instructional activities to address the data.

Polly et al. (2016) also found differences among teachers regarding their ability "to clearly articulate references to specific outcomes in the data, their rationale for selecting activities, or specific activities that were associated with available resources" (p. 285). For example, some teachers used formative assessment consistently and adjusted their instruction based on the collected data. However, other teachers demonstrated difficulty determining the alignment between the assessment and specific mathematical standards and how the assessment should inform their teaching. Some teachers also stated that they have difficulty establishing a routine that allows them time to collect formative data and plan instruction based on the data. Some teachers also felt that instructional time should be devoted to covering standards and that they had no time for formative assessment during instruction (Martin et al., 2015).

Conclusion

Research studies investigating mathematics and formative assessment have shown a strong relationship between student achievement in mathematics and teachers' use of formative assessment evidence (Andersson & Palm, 2017; Burns, Darling-Hammond, & Scott, 2019). Indeed, the National Council of Teachers of Mathematics (2014) and the National Mathematics Advisory Panel (2008) concluded that the positive effect of formative assessment teaching practices on student achievement in mathematics was empirically supported by the research. To be able to use the power of formative assessments in the mathematics classroom, however, teachers must find simple ways to integrate it into their daily mathematics teaching (Mitten, Jacobbe, & Jacobbe, 2017). Polly et al. (2016) claimed that the use of formative assessment in mathematics instruction can be problematic for teachers and argued that more research is needed into how teachers connect formative assessment, instructional resources, and instruction.

Given that teachers' instructional practices are the most powerful indicator for raising student achievement in mathematics (McKinney, Robinsom, & Berube, 2013; Veldhuis & van den Heuvel-Panhuizen, 2019), it is imperative to better understand how teachers engage in these practices. This is the main objective of the proposed study. In the following chapter, I present the proposed methodology and design for this research study.

Section 3: Research Method

Introduction

The purpose of this basic qualitative study was to gain an understanding of how middle-grade mathematics teachers in the study site school district use formative data to guide instruction and meet the individual needs of students in their classrooms. This study was conducted because little is known about how middle-grade mathematics teachers in this district use formative data to guide instruction and meet the individual needs of students. Research (Martin & Polly, 2015) has indicated that teachers sometimes do not know how to use formative data and plan instruction. To answer the research questions, I conducted teacher interviews to gather qualitative data about how middle-grade mathematics teachers use the results from benchmark data to guide instruction and meet the individual needs of students in the classroom. The research questions that guided this study are as follows:

RQ1: How do middle-school mathematics teachers use formative benchmark data to plan for and guide their classroom practices to meet the individual needs of students?

RQ2: How do middle-school mathematics teachers inform their students about their strengths and weaknesses as measured by the benchmark test?

RQ3: What challenges have middle-school mathematics teachers encountered as they use the formative data to plan instruction?

RQ4: What supports and resources do middle-school mathematics teachers perceive they need to sustain and improve their use of formative data to plan instruction?

The study was designed as a basic qualitative study. A basic qualitative study is used to focus on how others interpret their experiences, how people construct their worlds, and what meaning they gather from their experiences (Merriam & Tisdell, 2016). Use of a basic qualitative study approach allowed for understanding teachers' experiences and meaning of how middle-grade mathematics teachers use formative data to guide instruction and meet the individual needs of students in their classroom.

Qualitative Research Design

The main purpose of this study was to gain an understanding of teachers' experiences and how middle-grade mathematics teachers make use of benchmark data to plan classroom instruction and meet the individual needs of students. I designed the study as a basic qualitative study. Merriam and Tisdell (2016) stated that "qualitative research is based on the belief that knowledge is constructed by people in an ongoing fashion as they engage in and make meaning of an activity, experience, or phenomenon" (p. 23). Qualitative researchers are determined to understand how people see their experiences, how they shape their worlds, and how they interpret their experiences (Merriam & Tisdell, 2016). I considered a quantitative methodology, but did not choose it because I wanted to construct meaning of how middle-grade mathematics teachers use benchmark results as formative data to guide instruction and meet the individual needs of students in their classrooms. I did not select a quantitative methodology for my study because such a study would not provide teachers' rich descriptions of how they make use of formative data to guide their instruction and meet the individual needs of students. Consequently, I selected a qualitative design instead of a quantitative design.

Qualitative research is grounded on constructivism because the researcher is searching for meanings constructed by people as they encounter the world they are interpreting (Merriam & Tisdell, 2016). The purpose of a basic qualitative research approach "is to understand how people make sense of their lives and their experiences" (Merriam & Tisdell, 2016, p. 24). I selected the qualitative approach because I wanted to gain an understanding of teachers' experiences and how middle-grade mathematics teachers use benchmark results as formative data to guide instruction and meet the individual needs of students in the classroom.

Creswell (2013) identified five other qualitative approaches—(a) narrative research, (b) phenomenology, (c) grounded theory, (d) ethnography, and (e)case study—but none was the best fit for this study. Researchers portray the lives of individuals, gather and articulate stories about people's lives, and write narratives concerning the individuals' experiences with narrative research designs (Connelly & Clandinin, 1990). The key to narrative designs is the use of stories as data. Specifically, narrative designs use first-person accounts of experience and the stories contain a beginning, middle, and end (Merriam, 2009). Narrative designs normally emphasize studying a small group of individuals, gathering their stories, reporting their experiences, and interpreting those experiences. The study I proposed was not intended to collect stories of mathematics teachers' experiences. Rather, I asked participants to describe their experiences about using benchmark results as formative data to guide instruction and meet the individual needs of students in the classroom. I asked semistructured interview questions rather than seeking stories. For this reason, I did not choose a narrative approach.

Phenomenology research is the study of people's conscious experience of their lives that involves their everyday living and social actions (Schram, 2003). Phenomenologists try to understand the meaning of an experience from the participant's point of view (Lodico, Spaulding, & Voegtle, 2010). The phenomenologist's focus is more on the essence of the human experience. Phenomenological studies are conducted to comprehend human experience and how experiences are understood differently by different people (Lodico et al., 2010). The difference between case studies and phenomenological studies is that phenomenological studies collect extensive data over time (Lodico et al., 2010) and case studies collect data over a shorter period because the focus of case studies is usually just one event or phenomenon. This study was not intended to collect extensive data over time. Rather, it was focused on collecting data through face-to-face interviews to gain an understanding of teachers' experiences and meaning on how middle-grade mathematics teachers use benchmark results as formative data to guide instruction and meet the individual needs of students. For this reason, I did not select a phenomenological approach.

Lodico et al. (2010) explained grounded theory as an approach where the collected data become the foundation of a theory. Grounded theory provides a better explanation than a theory already developed "because it fits the situation, works in practice, is sensitive to individuals in a setting," and may signify all the difficulties found in the process because it is grounded in the data (Creswell, 2012, p. 423). Grounded theories are different from other qualitative research designs because theorists aim to generalize their research to other settings (Lodico et al., 2010). Merriam (2009) summarized grounded theory as useful for answering questions about how something changes over time. A grounded theory approach was not appropriate because the purpose of my study was neither to develop a theory nor to try to understand a phenomenon as it changed over time.

The purpose of “ethnographic research is to understand the essence of a culture and its unique complexities in order to paint a picture of the group, its interactions, and its setting” (Lodico et al., 2010, p. 267). Ethnography was not an appropriate design for this study because ethnographers search for rich descriptions of communities or cultures (Lodico et al., 2010), and that was not the purpose of my study.

Yin (2018) defined a case study as “an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context may not be clearly evident” (p. 16). Merriam and Tisdell (2016) described a case study as “an in-depth description and analysis of a bounded system” (p. 39). The purpose of a case study approach is to deliver a rich detailed description of the situation (the case; Lodico et al., 2010). However, a case study approach was not the best fit for this study because a case study approach focuses on a unit of analysis and not a topic of investigation (Merriam & Tisdell, 2016). For this reason, I did not select a case study approach.

Research Context

This basic qualitative study took place in a small school district in a southeastern state. The school district is comprised of 11 elementary schools, four middle schools, and three high schools. The school district services over 16,000 students and employs over

1,000 teachers (Public School Review, 2019). All the schools in this school district are Title 1 schools with approximately 70% of the students in each school on free or reduced lunch (Superintendent, personal communication, July 18, 2019). The school district employed approximately 38 middle-school mathematics teachers (County Public Schools, 2019).

Table 3

Middle-Grade Mathematics Teachers in the Study Site School District

School	6th grade	7th grade	8th grade
A	3 teachers	3 teachers	3 teachers
B	4 teachers	4 teachers	4 teachers
C	3 teachers	3 teachers	3 teachers

The school district's mission is:

> to ensure that each student performs at his/her highest academic level and is a successful, participatory member of our global society through a system distinguished by fearless advocates for students; community alliance for students' success; empowering students to shape their own future; infinite learning opportunities for all; and customized measures of individual success. (County Public Schools, 2019, para. 2)

The school district offers various career pathways beginning with the elementary level throughout high school. The decision to offer various career pathways aligns with the district's vision of expanding learning options for students and families, providing specialized programs of study based on student interests and talents, and finding new ways of learning through virtual opportunities (County Public Schools, 2019).

The school district developed a 5-year strategic plan that serves as the plan for improvement. Each school is required to create a strategic plan showing how they will meet six goals specific to the needs at the individual schools. The six goals are as follows:

> (a) create a rigorous system of teaching and learning that empowers students to define and achieve their educational success, (b) create safe and supportive learning environments that inspire and activate the love of learning, (c) create a culture that nurtures individual uniqueness and embraces the diversity of our school community, (d) provide optimum resources to support a world-class educational system, (e) maximize the district's capacity through the individual growth of each person, and (f) build a community alliance through the meaningful inclusion and activation of all stakeholders. (County Public Schools, 2019, p. 1).

The action plans are created to assist the district in meeting the goals outlined in the strategic plan.

Selection of Participants

I selected a purposeful convenience sample for this study. The participants were middle-grade mathematics teachers selected from the study site school district except for the school where I teach. The sample represented all the middle school grade levels.

After I received permission to conduct the study, the middle-grade mathematics teachers (approximately 30) in the school district were invited to participate in the study except for the mathematics teachers at my school. I sent an invitation letter to all the eligible middle-grade mathematics teachers in the school district. The invitation letter explained who was conducting the research, the purpose of study and why the participant was being asked to participate in the study. Once the invitation letters were emailed to the teachers' school email addresses, I gave the potential participants 10 days to respond. Because I had not received enough responses after the 10-day period had elapsed, I sent a reminder email. I waited another 5 days, but after 5 days this reminder email did not result in a representative sample; I sent another email. I received nine responses, three from sixth grade, three from seventh grade, and three from eighth grade. The consent form was then emailed and it asked interested participants to email me indicating their willingness to participate in the study by replying "I consent." The consent form described the research study in greater detail, restated the purpose of the study and provided background information for the study. The consent form outlined the procedures for the study, explained that the participation in the study was voluntary, described the risks involved in the study, explained that a gift card in the amount of $10.00 would be provided as a token of appreciation for participating in the study, discussed the privacy rights of the study, provided a contact number for questions or concerns regarding the study, and asked the participant to sign consenting to participate in the study. Once the consent forms were received by email, I contacted the participants via email to schedule one face-to-face interview. I sent a thank you letter via email to those participants who volunteered to participate in the study whether they were selected or not.

Ethical Protection of Participants

As the researcher, I followed ethical guidelines to ensure the protection of participants' rights. First, I requested permission from the study site school district and approval from Walden University's Institutional Review Board (IRB) to conduct the study; second, I obtained consent forms from the participants; third, I informed the participants that they could remove themselves from the study at any time with no consequences; fourth, I ensured the participants that they would be protected from any physical and/or mental harm or danger that could result from their participation in the study; and last, I ensured the confidentiality of the participants and the data collected from the study. The participants' names were replaced with pseudonyms. Data were kept secured on a password-protected computer and in a locked filing cabinet, both in a locked office. Data will be kept for a period of 5 years and then destroyed, as required by the university. Lodico et al. (2010) stated that gaining informed consent from participants, protecting participants from harm, and ensuring confidentiality are the leading ethical issues. I conducted this basic qualitative study in such a manner so that privacy and safety risks were identified and minimized.

I established trusting relationships with the participants by: (a) explaining the purpose of the study, (b) explaining to the participants how I would conduct the research, (c) discussing with them their obligations as participants, and (d) conveying information about all the components of the study (see Creswell, 2007; Hatch, 2010; Patton, 2014; Stake, 2010). I provided the participants with my email address and my personal phone number so that they could contact me if they had any questions about the process.

I obtained conditional Walden IRB approval (IRB #10-15-18-0132131). After I received conditional IRB approval, I submitted a research application to the study site school district requesting permission to conduct my research study. The research application was submitted to the study site school district via email.

Once I received final approval from the Walden IRB, I emailed an invitation letter using the publicly available email addresses to all middle-grade mathematics teachers in the study site school district. The invitation letter explained who was conducting the research, it described the purpose of study and it explained why the participant was being asked to participate in the study. The letter asked that interested participants email me indicating their willingness to participate in the study. I emailed a consent form to all middle-grade mathematics teachers who were sent the invitation letter and who consented to participate in the study. The consent form described the research study in greater detail, restated the purpose of the study, and provided background information for the study. The consent form outlined the procedures for the study, explained that the participation of the study was voluntary, described the risks involved in the study, explained that a gift card in the amount of $10.00 would be provided as a token of appreciation for participating in the study, discussed the privacy rights of the study, provided a contact number for questions or concerns regarding the study, and asked the participants to reply to the email with the words, “I consent” to indicate they were consenting to participate in the study. Two reminder emails were sent 5 days apart to recruit nine or more participants.

Role of the Researcher

In this basic qualitative research study, I was the only data collector and the only one analyzing the data. I have been involved in the education profession for 18 years.

Since 2011, I served as an accelerated math teacher at one of the middle schools in the study site school district. My educational experience has allowed me the opportunity to work with low-achieving and high-achieving students in mathematics. I am a certified middle-grade mathematics teacher who is also certified to teach middle-grade language arts and elementary education, P-5. I have a minor degree in English to Speakers of Other Languages, the Teacher Leader Endorsement, and the Gifted In-Field certification. This is my third year serving as the mathematics department chairperson at my school. As the mathematics department chairperson, I have discussed with mathematics teachers at my school the results of benchmark tests and what they revealed about students' responses. One of my beliefs is that formative assessment is a crucial component of teaching and learning of mathematics.

As an accelerated mathematics teacher, I collaborated through professional learning communities on instructional and student-related matters with teachers and administration at my school. I have participated in discussions with teachers to address students' academic problems including how to help teachers meet the individual needs of students by way of remediation or acceleration. My professional relationship with the mathematics teacher participants did not affect data collection because I did not recruit or select teachers from my school as participants. The mathematics teachers in the study site school district viewed me as a colleague of equal status because I had no authority over them.

My biases arise from the fact that I am a middle-grade mathematics teacher who administers quarterly benchmarks to my students. This affects what I believe about formative assessment and how it should be used in the classroom. I managed these biases by continually monitoring my personal views and opinions so that they would not affect how I analyzed and interpreted the data. I applied reflexivity, a systematic way of attending to the content of knowledge construction in every step of a research process (Cohen & Crabtree, 2006). Lincoln and Guba (2000) described reflexivity as the "the process of reflecting critically on the self as the researcher, the 'human as instrument'" (p. 183). I self-monitored and attempted to control my biases by developing a journal to record and describe all my methodological decisions, logistics of the study, and reflections about what was happening during the research process (see Cohen & Crabtree, 2006). The journal assisted throughout the data analysis process to ensure my personal and professional biases were identified and managed.

Data Collection

Qualitative data contain "direct quotations from people about their experiences, opinions, feelings, and knowledge" gathered by way of interviews (Merriam & Tisdell, 2016). I collected, recorded, and transcribed data from the nine participants who volunteered to participate in my research study. First, I sent out an invitation email to all the 30 middle-grade mathematics teachers eligible to participate in the study. Within the invitation email, I asked participants to respond if they wanted more information about participating in the research study. As the participants responded to the invitation email, I sent a consent form via email outlining the details about the research study. Once the participants were sure that they wanted to volunteer to participate in the research study, I asked the participants to respond with "I consent." After receiving the consent email, I contacted the participants via email and scheduled a mutually convenient time and location for the interview to be conducted.

I conducted each participants' interview at a mutually agreed upon location and time where the participant felt comfortable to conduct the interview and where their confidentiality remained protected. Each interview lasted approximately one hour. The interview process involved asking the participants in-depth open-ended questions to gain a better understanding of how middle-grade mathematics teachers use the benchmark results as formative data to guide instruction and meet the individual needs of students in their classrooms. I used an audio tape recorder with a microphone attached that recorded each participants' responses on an individual audio cassette tape. The interview questions used for the interviews are in Appendix A. After completing each interview, I transcribed the responses from the audio cassette tape into a Microsoft Word document that is password protected on my desktop computer at my residence. After each transcription, the audio cassette tape was labeled with the participants' number and locked inside of my desk file cabinet at my residence.

I saved each transcribed interview in a data collection folder on my password protected desktop computer at my home. Each transcribed file is saved by the participants' number, date, and time of the interview. I listened to each audio cassette tape multiple times and read over the transcript for each participant to make sure that I transcribed everything that was recorded on the audio cassette tape. I matched the participant's number, date, and time of the interview with the participant's number, date, and time written on the audio cassette tape to ensure that I was recording the right participant's responses.

Data Analysis

Merriam and Tisdell (2016) advised researchers to conduct data collection and data analysis simultaneously. They also noted that the data analysis process becomes more intense as the research study progresses and all the data has been collected. Coding is an important feature of qualitative data analysis that allows the data to be broken into manageable sections (Baskarada, 2014). I analyzed the data for this research study using a two-cycle process of in vivo coding and axial coding.

In vivo coding was used as the first round of coding for this research study. In vivo coding can be used with all qualitative studies but, it is especially useful for beginning researchers and studies that focus on the participants' voice (Saldana, 2016). In vivo coding was useful for this research study because I was seeking to gain a better understanding of how middle-grade mathematics teachers used benchmark results as formative data to guide instruction and meet the individual needs of students in their classrooms. During the first round of data analysis, I coded all nine of the transcripts.

For the second round of coding, I used axial coding. Saldana (2016) explained that axial coding is appropriate for describing a theme or a pattern of action. I transferred all the codes onto a spreadsheet and grouped the codes into categories. Then, I examined all the categories and the related themes again. I then developed six themes that became the findings of this research study (see Table 4). All the data were accounted for except for discrepant cases.

Table 4

Codes and Themes Discovered From the Interview Data

Codes	Themes
Data conversations; information presented in professional development; questions on formative assessments; professional learning communities; alignment of standards and questions; district-wide professional development; professional development on making formative assessment questions; professional development on providing feedback to students	Professional development for formative data
Pretests; posttests; mid-chapter checks; data analysis; detect deficiencies; growth on assessments; remediate; error analysis; grouping students based on results; analyze the questions; accelerate; teacher-made assessments; achievement gaps; intervention; remediate into lessons; remediate in whole group	Understanding benchmark data
Co-teacher setting, small group instruction; parallel teaching; gallery walk; scavenger hunt; differentiated instruction; anchor charts; use of vocabulary; classroom discussions; use of manipulatives; hands on activities; learning games; online programs; use of OneNote; peer teaching; note-taking; ticket out the door; teacher observations; discourse; pop quizzes; temperature checks; warm ups; feedback	Classroom practices and student needs
Partial review of test; review test scores; class discussions; data tracking sheet; ownership of learning; discuss frequently missed questions; teacher-created weekly assessments; clarify misconceptions; teacher self-reflection; compare class data to data for the entire grade level; feedback	Students' understanding of their math achievement
Deficiencies in math from previous years; RTI process; individualized education programs; growth on formative assessments; parent conferences; behavior issues; develop a relationship with student; bargain with the student; encourage the student; capable student; confidence levels; unmotivated; no participation in class; attendance issues; no homework	Students' low achievement in math
time constraints; use of various strategies; common planning with all math teachers in the building; student readiness component for online programs; more professional development; more planning time; supporting students with accommodations; reading data from SchoolNet; toolbox of effective strategies; modeling how to use the strategies; use of manipulatives; data tracking tools	Resources Needed

Validity and Reliability

Merriam (2009) stated that "validity and reliability are concerns that can be managed by way of careful attention to a study's conceptualization and the way in which the data are collected, analyzed, and interpreted, and the way in which the findings are presented" (p. 210). Qualitative researchers collect multiple sources of data to ensure that they have a broad representation of the people being studied. I validated the findings by using triangulation, peer review, and rich-thick descriptions of the study. I triangulated the data collected from three different schools. I also validated the findings of my study by using peer review. Lastly, I used rich-thick description as a validation strategy.

Triangulation

Triangulation was used in this research study to ensure reliability and validity. The process of triangulation is most often used in qualitative research and allows the researcher to corroborate evidence from various individuals, types of data, or methods of data collection to validate the study (Creswell, 2012). Merriam and Tisdell (2016) explained triangulation as using multiple sources of data to compare and cross-check data collected from interviews with people having various viewpoints or from follow-up interviews with the same people. When using triangulation, the researcher examines each of the information sources and finds evidence that supports a theme (Creswell, 2012). The use of triangulation in a research study serves as a powerful strategy for increasing the credibility of the research study (Merriam & Tisdell, 2016). I triangulated the data by developing codes from the interviews. As I read the interviews, I developed multiple codes based on each of the participants' responses to each of the interview questions.

Next, I grouped the same codes and similar codes together to form categories. Once the categories were developed, I went back and reread all the participants' responses and sorted the responses based on the topics of the categories. Lastly, similar categories were grouped together to form themes.

Peer Review

A peer reviewer was used in this research study to ensure reliability and validity. A peer reviewer is someone who examines the findings of a study and meets with the researcher periodically to ask questions to help the researcher revisit ideas and consider various ways of looking at the data (Lodico et al., 2010). According to Merriam and Tisdell (2016), graduate students have peer reviewers embedded in their dissertation process because committee members read and comment on the researcher's findings. My committee chair served as a peer reviewer of the research study by reviewing the data and the codes to reduce threats to the validity and reliability of the data analysis process. As the data and codes were reviewed, revisions were made to correct any issues.

Rich, Thick Description

Lastly, rich, think descriptions were used in this research study to ensure reliability and validity. According to Merriam and Tisdell (2016), rich, thick description is referred to as a highly descriptive, detailed presentation of a setting and more specifically, the findings of a study. Embedded in rich, thick descriptions are descriptions of the context, the participants involved, quotes from the participants, and activities of interest to support the findings of the research study (Merriam & Tisdell, 2016). The research study includes all the components that are outlined in a rich, thick description to ensure that the findings of the research study are accurately represented through the eyes of the participants.

Section 4: Results

Introduction

The participants in my study were middle-grade mathematics teachers from three middle schools in the study site school district. The participants selected to participate in the study were middle-grade mathematics teachers who had taught for a minimum of 3 years. Out of 38 middle-grade mathematics teachers in the study site school district, 30 of were eligible to participate in the study. From the 30 eligible participants, nine voluntarily agreed to participate in my study. I selected all nine of the middle-grade mathematics teachers who volunteered to participate. The nine participants represented sixth grade, seventh grade, and eighth grade.

According to Creswell (2013), a general guideline when conducting qualitative research is to study a few individuals so the researcher can collect extensive detail about the individuals studied. All nine middle-grade mathematics teachers in the study site school district had a minimum of 3 years' experience teaching at the grade level they taught when interviewed. Some participants did have experience teaching at the elementary-school level and the high-school level. The nine middle-grade mathematics classroom teachers ranged in experience from 4 to 20 years in the classroom.

Demographic Information

Merriam and Tisdell (2016) suggested that all interviews contain demographic questions that relate to the interviewee and the nature of the study. I began the face-to-face interviews by asking demographic questions outlined in Table 5 below. To protect the identity of the participants, I assigned each participant a number from 1 to 9. I had participants from each grade: sixth, seventh, and eighth.

Table 5

Demographic Data for Teacher Participants

Participant	Current grade	Years teaching	Previous grades taught
1	6th grade	8	6th, 7th, 9th
2	6th grade	12	6th, 7th, 8th, 9th, 10th
3	7th	7	6th, 7th, 8th, 9th
4	8th	16	4th, 5th, 6th, 7th, 8th
5	7th	20	5th, 6th, 7th
6	7th	16	3rd, 4th, 5th, 6th, 9th, 10th
7	6th	4	6th, 8th
8	8th	9	7th, 8th
9	8th	10	8th

Findings

This basic qualitative research study focused on four research questions investigated through individual face-to-face interviews with nine middle-grade mathematics teachers.

RQ1: How do middle-school mathematics teachers use formative benchmark data to plan for and guide their classroom practices to meet the individual needs of students?

RQ2: How do middle-school mathematics teachers inform their students about their strengths and weaknesses as measured by the benchmark test?

RQ3: What challenges have middle-school mathematics teachers encountered as they use formative data to plan instruction?

RQ4: What supports and resources do middle-school mathematics teachers perceive they need to sustain and improve their use of formative data to plan instruction?

Six major themes arose from this basic qualitative research study analysis. These themes were (a) professional development for formative data, (b) understanding benchmark data, (c) classroom practices and student needs, (d) students' understanding of their math achievement, (e) students' low achievement in math, and (f) resources needed. A description and discussion of each theme is provided below.

Theme 1: Professional Development for Formative Data

All nine participants stated they had received some form of professional development in the study site school district. Some participants stated the professional development received did not relate to understanding formative data. Participant 7 replied, "I have received training on using manipulatives. I have received training on using best practices in the classroom. I can't remember any training on using formative assessments." Participant 8 discussed receiving professional development on differentiated instruction but could not recall professional development on using formative assessment. Participants 1, 2, and 4 talked about professional development that was not directly related to understanding formative data. Specifically, Participant 4 stated that professional development takes place within the school building with the grade-level team. Participant 4 stated, "Professional developments—I don't know if it was really formative. It was mainly on the use of manipulatives. Most of our professional development takes place during our PLC, professional learning communities, that we have with the grade levels."

Other participants discussed some professional development they had received about understanding formative data. Participant 3 discussed professional development regarding formative data conversations but could not provide insight regarding professional development about how to read the data or disaggregate the data. Participant 6 stated,

> I have received county-wide professional development hours where we have analyzed Milestone data and compared the data to other schools. I have also gone to professional development in regards to formative assessment on how what formative assessment is and how to use it in the classroom.

Both Participant 3 and Participant 6 have had some professional development related to formative assessment, but neither participant could give specific details about what the professional development entailed or how it contributed to their personal understanding of how to use formative data. Participant 9 described the professional development experience in more detail:

> I've received district-wide assessments with our director, and I've also received professional development within the content in my building from our mathematics coaches. I've gone out of the school district for training for formative assessments. I had professional development during the summer where they had a group come from a particular university. They came in and trained us on how to make a test, the purpose of the questions, the questioning, the answer selections, how to make constructed responses, and to make them useful and beneficial for instruction purposes and not just for a waste of time or distractors.

The participants' responses revealed that the professional development received about understanding formative data varied from no professional development on formative data to some type of professional development using formative assessments. The participants attended professional development within their school buildings and some of the participants went to professional development outside of the school district.

Theme 2: Understanding Benchmark Data

All nine participants discussed the process of analyzing their benchmark data. There were common responses from all the participants on how they analyzed their data to determine whether students needed remediation on standards where they did not score at a proficient level. The research supports that benchmark tests are implemented by teachers so that teachers can analyze the formative assessment data to inform classroom practices (Carlson et al., 2011).

A common assessment platform is used in the study site school district where all middle-grade students complete benchmark tests. This platform is called SchoolNet. Once the test is completed, the teachers can go into SchoolNet to see students' data from the benchmark test. SchoolNet also allows teachers to obtain various reports regarding the benchmark data. For example, teachers can obtain a report that shows how students scored on each individual standard. Research evidence shows that many teachers are not capable of using the information from benchmark tests because they lack the training to do so, lack adequate materials, or do not have enough curricular time available (Heritage & Yeagley, 2005; Herman & Gribbons, 2001; Stiggins, 2005).

A few of the participants discussed how they used SchoolNet to administer pretests, posttests, and mid-check assessments to their students. Participant 1 teaches sixth grade and explained that the assessments are given for each unit in the mathematics curriculum. The purpose of giving the assessments for each unit is to determine how students are progressing on learning the standards. In the words of Participant 1, "it allows me to identify students' strengths and weaknesses within the unit we are working on. It helps me to provide further instruction for the students." Participants 3 and 8 stated similar views to those of Participant 1 regarding conducting formative assessments for each unit. Participant 3 stated, "I analyze the data to observe what students are struggling with and it helps guide the instruction of what to teach and what to remediate."

Other participants discussed how they used a Common Formative Assessment throughout their particular grade level. The Common Formative Assessment is given to all the students in the same grade level within the school. It is given at the completion of a math unit. Participant 7, who is a seventh-grade math teacher, described how they build remediation into future lessons for low achieving students. Participant 7 stated that this is done so that the teacher does not fall behind regarding the pacing of the mathematics curriculum. Participant 9 also conducts Common Formative Assessments at the completion of each unit. However, Participant 9 discussed a different view of what takes place upon reviewing the formative data:

> I look at the Common Formative Assessment data and I search for two or three standards where students did not score on a proficient level. Then, I create rotation stations based on the chosen standards. Each station has activities and tasks that will remediate each of the chosen standards. For example, if I choose three standards from the Common Formative Assessment, I will have three

> rotation stations with tasks for those three standards and the fourth rotation station will have something to do for the current standard we are working on in class.

One participant, Participant 4, explained that teachers create assessments for their math students. Participant 4 stated that they look at the formative data from the teacher-made assessments and identify gaps in learning that the students may have. Participant 4 also stated that they share the data with the students so that they are aware of their progress and progression.

Theme 3: Classroom Practices and Student Needs

McKinney et al. (2013) argued that classroom practices are the most powerful indicator for raising student achievement in mathematics. Therefore, it is important to understand how teachers engage in classroom practices (McKinney et al., 2013). All nine participants described various classroom practices that are used in their classrooms.

Small group instruction was the most common practice described by the participants. Most of the participants did not describe in-depth how the small group instruction is used in the classroom. For example, Participant 3 said, “I try to incorporate my small group during class time.” Participant 2 explained, “I try to incorporate pull out groups with my students based on the data. It is difficult to incorporate pull out groups and continue teaching the math curriculum.” Participant 1 did describe how small group instruction is used in the classroom. Participant 1 stated,

> I have a co-teacher in my classroom. So, I do use small group instruction and stations. I may station myself inside the classroom with a small group while the other students do a gallery walk or a scavenger hunt outside of the classroom or

> even inside the classroom. They are engaged in that activity while I am working with my small group.

A few other classroom practices mentioned were parallel teaching, one on one instruction, use of manipulatives, use of warm-ups, and using OneNote in Microsoft Office. Parallel teaching is when two teachers are both instructing students on the same topic or different topics. The students are split into two groups and after receiving instruction from one teacher, the students switch to the other teacher. As Participant 1 discussed, parallel teaching can only take place if the teacher has a co-teacher in the classroom. Participant 4 explained how one on one instruction takes place in their classroom. "Once I get my students started with their lesson, certain students know that I am available and they will come to me so I can work with them one on one." Participants 2 and 6 talked about the use of manipulatives in their classrooms. Using manipulatives gives students something tangible to work with to help them in understanding the math concepts. More specifically, Participant 2 stated, "I try to implement hands-on activities by using white boards and various types of manipulatives. I also try to incorporate games that are engaging and relatable to the students."

Only one participant, Participant 5, described the use of OneNote in the classroom. OneNote allows the participant to individualize the students' assignments. In the words of Participant 5,

> I only use One Note in my classroom. I started using it as a notebook because my students would always lose their notebooks and any notes I gave them. One Note allows you to group students and I can create assignments to send to the students.

> I can individually send students what I want them to work on. That way, those students that may need to remediate on a particular standard can work with that standard and that standard alone.

All the participants spoke about some form of warm-up. The participants justified the use of warm ups. Warm-ups are used to review math standards previously covered. These can be standards where students did not score on a proficient level from recent formative assessments or standards where students did not quite grasp the concept.

All the participants discussed informal ways of collecting data from the students to guide their classroom practices. Participant 1 discussed four different strategies in which data are collected to guide classroom practices. Participant 1 stated,

> I don't really do many formative assessments besides the benchmark assessments, I use more informal assessments. I may have the students complete a ticket out of the door. I may implement teacher observations as I'm walking around listening to student conversations. I am listening for vocabulary usage and strategies that they are employing with each other. I may also use error analysis and temperature checks.

Participants 2 and 3 described similar methods as Participant 1. Teacher observations and pop quizzes were commonalities of informal ways to collect data amongst all the participants. As discussed, teacher observations are the quickest way to determine if students are grasping the math concepts being taught.

Theme 4: Students' Understanding of Their Math Achievement

Feedback has been consistently found to have a strong positive effect on learning and achievement (Einig, 2013). Teacher feedback to students is crucial if formative assessment is to positively influence student understanding and assessment scores. All the participants discussed a way in which they helped students understand their math achievement. Analyzing the results of the formative assessments was discussed by all the participants. However, the participants stated that due to time constraints in the classroom, they did not completely review the formative assessments given to the students. Most of the participants stated that only misconceptions were addressed. Participant 2 stated, "I do go over test scores, I do show the students the question that's missed the most. I go over, not really who did what, but, the most missed questions from formative assessments." Participant 3 and Participant 6 also stated that they do not review all the formative assessments with the students. When asked why, the response was, "I want to but I tend to not have the time." Participant 5 did elaborate on "trying to review all of the questions" from the formative assessments because it was a way of talking to the students to discuss their thought process when choosing their answers.

The study site school district expected that the mathematics teachers would analyze the data and reteach the material to students whose score was not on a proficient level based on the formative assessments (Principal, personal communication, December 3, 2019). Participant 8 stated,

> I do not review the formative assessment with my students. I will analyze the results and from the data analysis, I reteach the standards. After a few days or a week of remediation, I will reassess the students on those particular standards.

Participant 7 discussed "trying to find different activities to present the information in different ways." Participant 4 discussed reviewing standards with students by way of afterschool tutorial, early morning tutorial, and through working lunch sessions.

Several of the participants did discuss ways in which the data analysis took place with their students. Participant 1 referred to a data tracking sheet used by students. Participant 1 explained how the data tracking sheet worked, "I use a tool in my class, the student data tracking sheet. So, the students are responsible for tracking their own data on their formative assessments. And, I believe, that encourages the students to perform better on their assessments." Participant 9 also discussed the data analysis process,

> I've started using a data tracking sheet where the students go over the formative assessment and see which questions they got wrong and align the questions to the standards and the students track their progress on various standards. I may review some questions similar to those questions on the formative assessments, but, I don't necessarily go over the assessment.

Analyzing the formative assessment data, reviewing, and reteaching standards from the formative assessments was how the participants helped students understand their math achievement.

Theme 5: Students' Low Achievement in Math

The use of formative assessment data plays a major role in helping to identify low achievement in mathematics. According to many researchers, formative assessment has significant influence on improving learning and reducing gaps in achievement (Black & William, 1998b; Chappuis & Stiggins, 2002; Fox-Turnbull, 2006; Fyfe & Rittle-Johnson, 2016; Martin et al., 2015; Marzano et al., 1993; Meehan et al., 2003; Nawaz & Rehman, 2017; Robinson et al., 2014). The information gathered from formative assessment data can assist teachers in identifying areas of difficulty for students in mathematics. Teachers also can create a plan from the formative assessment data to help students be more successful in mathematics.

Participant 1 expressed the challenge of creating a learning plan for students who display multiple math deficiencies from previous grade levels. Participant 1 said,

> It's really a challenge because the students that I have who are not doing well on formative assessments are students who have deficiencies from second, third, fourth, fifth grade. I hate to say impossible, but it's unrealistic to assume, think that me, as the teacher, as one person, can increase student achievement in mathematics from first or second grade to the students' current grade. I don't expect the students to master anything, that would be extreme. But I do expect the students to show some type of growth.

Participant 1 further explained that some of the students who show multiple deficiencies in mathematics are in the Response to Intervention (RTI) process or have an Individualized Educational Plan that places them in Special Education. Participant 2 discussed a similar response to Participant 1 for students who have math deficiencies from previous grades. Participant 2 said,

> the ones that just cannot grasp the concepts or the ones that have low reading levels also display low comprehension when it comes to mathematics. So, with those students or with that particular student, I just have to figure out creative ways to get them to understand and it is a struggle, it is a major struggle.
>
> Regardless of how I teach it, they still struggle, so, I just look for progression.

Both participants discussed that progression is their motivation with these students because mastery is not an obtainable goal for these students. Participant 3 talked about the RTI process for their struggling students and mentioned moving students from one Tier to the next when students were not showing any growth at all.

When implementing classroom practices and planning for mathematics instruction, teachers should plan so that students are engaged in the class and motivated to complete the mathematics assignments. This would help to achieve student success in mathematics. Yu and Singh (2018) agreed that instructional practices and teacher support are critical for student academic success. Participant 6 discussed a student who was failing the math class. However, the student showed proficiency on the formative assessments given in the classroom. Participant 6 discussed the difficulty level of keeping this student engaged in the class and motivated to complete the daily assignments. Not completing the assignments affected the student's overall achievement in the mathematics classroom. Other factors may contribute to students' low achievement in mathematics. Participant 5 talked about students not being good test-takers. According to

Participant 5, this specific student does well in class and is passing the class. But, Participant 5 explained that "the student may experience test anxieties because the student does not score on a proficient level when taking assessments." Participant 7 discussed a student who was a low achieving student in mathematics due to absences and deficiencies from previous years. Participant 7 stated,

> I have a student that does not perform well on the formative assessments. This student misses a lot of school. The student does not do any homework and is low performing in class. The student has deficiencies from previous years.

Theme 6: Resources Needed

Access to resources and time to collaborate will assist teachers in helping increase student achievement. Based on research conducted by Heitink, Van der Kleij, Veldkamp, Schildkamp, and Kippers (2015), teachers need support with instructional resources, materials, and examples. The researchers also stated that teachers need to engage in conversations with their colleagues about formative assessment and teaching practices (Heitink et al., 2015). When resources are plentiful and collaboration is occurring, teachers are more likely to experience student achievement in mathematics. Two of the teachers, Participant 4 and Participant 5, discussed resources that are always available to them. Participant 4 explained that the mathematics teachers on their grade level were a resource. In the words of Participant 4, "all the sixth-grade math teachers help each other so much…. I know when one is a little tired, we pick each other up and whatever we have, we share." Participant 5 described how the leadership team in their building, the mathematics coach, and the mathematics director, were a readily available resource.

Participant 5 specifically referenced that these resources helped them to understand formative assessment data and shared ideas.

All the participants stated that they needed more time to use benchmark data effectively. Participant 5 mentioned having more time to complete tasks during the day in lieu of taking work home. Other participants discussed having more planning time with the mathematics teachers as being a resource. Participant 3 explained, “I think more planning time to actually be able to sit down, dig into the data, and really be able to plan would help out so much.” Participant 7 stated that it would be beneficial to have planning time with the other mathematics teachers in the district. Participant 7 further explained that having planning time with mathematics teachers on various grade levels would help the mathematics teachers understand how the Common Core State Standards progress from year to year. For example, a sixth-grade mathematics teacher planning with a fifth-grade and seventh-grade mathematics teacher could potentially help the sixth-grade teacher understand what the students learned in the previous grade and what the student would learn in the future grade. Participant 5 agreed with the idea of planning with mathematics teachers on various grade levels because seventh-grade students have so many math standards to master. It would be helpful to identify what students learned from the sixth-grade mathematics standards to help keep up with the pacing of the seventh-grade mathematics standards.

The need for more professional development was discussed by multiple participants. Some of the participants mentioned the need for more professional development to analyze data. Participant 9 stated,

> professional development on using SchoolNet would be helpful. I've just kind of had to figure it out. Pulling the data that is needed for certain data tracking sheets and things like that, have been shown to us. But, just a professional development on how to use SchoolNet and all of its many functions has not been provided.

Participant 8 disclosed the same thought process by saying that more training was needed on using SchoolNet.

Other participants mentioned the need for more professional development in expanding their knowledge of more strategies to support struggling students and students who need that extra boost to get them to the next level. Participant 2 suggested all-day training and being able to go outside of the school district to visit other math classes to observe what is taking place. Participant 3 mentioned that some of the professional development provided in the school district took place after it was needed. More specifically, Participant 3 talked about the use of manipulatives. It was stated that it would be beneficial to conduct professional development on manipulatives at the beginning of the school year so that "the teacher can be prepared and have an instructional plan of how to implement the use of manipulatives." Being prepared with the resources available for certain standards could increase students' mathematical understanding. Participant 2 summarized it best when the comment was made, "I just feel as if you allow math teachers to go to more professional development, they will be exposed to more resources that could increase student achievement in mathematics."

Discrepant Cases

Discrepant data are data that do not align with the findings or results of the other data being collected. Merriam and Tisdell (2016) suggest purposefully seeking data that may not support the findings of a qualitative research study. During the data collection process, all the participants communicated their understanding of formative assessment data and the use of formative assessment data in the mathematics classroom. However, during the data analysis process, I recognized discrepant data from Participant 2's interview. Participant 2's interview involved a conversation about the classroom practices being used in a Language Arts classroom. The data were considered unrelated to the research questions.

Evidence of Quality

As this basic qualitative research study was conducted, I was the sole data collector and data analyzer. I followed certain procedures to ensure accuracy of the data. Before I began the data collection process, I obtained permission from the Walden University IRB. I developed working relationships with the participants. The trustworthiness of the data collection process is directly linked to the trustworthiness of those who collect and analyze the data as well as their competence to interpret the data (Merriam & Tisdell, 2016). I developed these relationships by being honest with the participants, I described the entire data collection process step by step, and I discussed with the participants how participating in the study may have affected them.

To ensure validity and reliability throughout the data collection and analysis process, three methods were chosen to analyze and interpret the data. Those methods were triangulation, peer review, and rich, thick descriptions. All three methods were thoroughly described in Section 3. Merriam and Tisdell (2016) reported that the credibility of qualitative research is dependent upon the researcher and the various methods chosen by the researcher. These methods were chosen because these methods are most often used in qualitative research (Creswell, 2012).

Section 5: Discussion, Conclusions, and Recommendations

Introduction

I designed a basic qualitative study to gain an understanding of how middle-grade mathematics teachers use benchmark results as formative data to guide instruction and meet the individual needs of students. Four research questions guided the study:

RQ1: How do middle-school mathematics teachers use formative benchmark data to plan for and guide their classroom practices to meet the individual needs of students?

RQ2: How do middle-school mathematics teachers inform their students about their strengths and weaknesses as measured by the benchmark test?

RQ3; What challenges have middle-school mathematics teachers encountered as they use formative data to plan instruction?

RQ4: What supports and resources do middle-school mathematics teachers perceive they need to sustain and improve their use of formative data to plan instruction?

I selected a purposeful sample of middle-grade mathematics teachers who had at least 3 years of teaching experience and who represented the three different middle-school grade levels, sixth, seventh, and eighth grade. I conducted semistructured interviews to provide meaningful and rich information to answer the research questions. Six major themes emerged from completing this basic qualitative research study: (a) professional development for formative data, (b) understanding benchmark data, (c) classroom practices and student needs, (d) students' understanding of their math achievement, (e) students' low achievement in math, and (f) resources needed.

Interpretation of Findings

The findings of my study revealed that the participants are analyzing the formative benchmark data, but participants appear not to be using the formative data effectively to plan for and guide classroom practices to meet the individual needs of students. All nine participants discussed some method of how they remediate standards when students do not score at the proficient level on their formative benchmark assessment. The most common response from the participants was remediating the standards as a warm-up activity. The participants explained that remediating the standards through the warm-up activity allowed the participants to remediate a certain standard and continue with the standards outlined in the mathematics curriculum. Only one of the participants explained a different method of reviewing standards when students did not score on a proficient level from the formative benchmark assessments. Participant 1 explained that they used group rotations in the classroom. The other participants expressed that they like the idea of small group rotations in the classroom but seldom had time to implement them. Based on the responses from the participants, analyzing the formative benchmark data is not an issue; planning for and using the formative benchmark data to guide classroom practices seems to be the disconnected piece of increasing student achievement.

The findings of my study revealed that most participants are not communicating with students about their performance on formative benchmark assessments. The participants are not informing students about their strengths and weaknesses as measured by the benchmark test. All nine participants discussed how they analyze the formative benchmark data to identify students' strengths and weaknesses on benchmark assessments. However, only two of the participants stated that they have their students analyze their formative benchmark data as well. The other participants stated that once they analyze the formative benchmark data, they plan to remediate the standards the students did not score in the proficient level on. The participants expressed that, due to the amount of curriculum that needs to be covered, it is nearly impossible to always inform students about their strengths and weaknesses on the formative benchmark test.

The findings of my study revealed that the participants felt they needed more professional development to better use formative benchmark data to plan instruction in the mathematics classroom. Most of the participants discussed that they had never received training on the use of SchoolNet. SchoolNet is the assessment platform where teachers can access the data from the formative benchmark assessments. There are many reports available in SchoolNet, but the participants stated they had never been trained on how to read the reports in SchoolNet. The participants said they learned through trial and error or from gaining information from other mathematics teachers on which reports to use to assist in planning for classroom instruction. Classroom practices is another area where the participants expressed a need for more professional development. Some of the participants expressed that the professional development provided by the study site school district was not relevant to their needs.

The findings of my study revealed that the participants would like more planning time with other mathematics teachers in their building or with other mathematics teachers in the county. All the participants stated that more planning time would be useful for analyzing formative benchmark data as well as planning classroom practices that would increase student achievement in mathematics. Participant 2 suggested that being able to go outside the school district to visit other mathematics classes to observe what they are doing would help with planning classroom practices.

Lastly, the findings of my study revealed that all the participants perceived that they needed more time to plan for instruction using formative benchmark data. They also perceived that they need more classroom teaching time. The participants expressed their fear of falling behind in the mathematics curriculum as they attempt to use formative benchmark data to guide classroom practices. The participants understand the importance of remediating standards when students do not score on a proficient level. The issue is implementing classroom practices to remediate low performing standards and teaching current standards to stay aligned with the mathematics curriculum.

I conducted this study to answer four research questions. The data collected and analyzed from this basic qualitative research study produced six themes that provide solutions to the research questions. All six themes are thoroughly described in Section 4.

Research Question 1

RQ1 was answered by Theme 2 (understanding benchmark data) and Theme 3 (classroom practices and student needs). Theme 2 showed that the participants did analyze formative benchmark data. All the participants in this study described a method of how data were analyzed, which is the first step in using formative data to plan for and guide classroom practices to meet the individual needs of students. SchoolNet was used to analyze data because it provides the participants with various data analysis reports.

Some of the participants also used Common Formative Assessments to determine how students were progressing on standards taught. However, the participants did not know how to use the data to guide classroom instruction and meet the individual needs of students. Theme 3 showed that the participants implemented a minimal amount of classroom practices to meet the individual needs of students. The participants mostly used warm ups to reteach those standards that students did not score on a proficient level from the formative assessments. Some participants discussed small group instruction, but those participants did not use small group instruction on a consistent basis. The participants stated that they attempted to incorporate small group instruction when time permitted.

Research Question 2

RQ2 was answered by Theme 4 (students' understanding of their math achievement). Theme 4 showed that the participants provide some type of feedback to their students from the formative benchmark assessments. The participants explained that, due to time constraints in the classroom, they did not consistently provide feedback to the students regarding their results from the formative benchmark assessments. Several of the participants explained how the students analyzed their own formative benchmark assessments using a data tracking tool to identify their strengths and weaknesses. Most participants discussed how they reviewed misconceptions from the formative benchmark assessments with their students in a whole group setting. Therefore, the students were not informed about their strengths and weaknesses as measured by the formative benchmark assessments.

Research Question 3

RQ3 was answered by Theme 5 (students' low achievement in math). Theme 5 showed that the participants were challenged by students' mathematics deficiencies. The participants were challenged because students display math deficiencies that cause them not to score on a proficient level on formative benchmark assessments. The participants explained that students' deficiencies in previous grade levels have widened the achievement gap in middle-grade mathematics. Another challenge that the participants faced is that some of the students identified were Special Education students. The participants expressed that they did not have the background needed to address students' learning disabilities.

Research Question 4

RQ4 was answered by Theme 1 (professional development for formative data) and Theme 6 (resources needed). Theme 1 showed that the participants perceived that they needed professional development that related to the issues of understanding formative data and using formative data to plan instruction. The participants also perceived that they needed to observe successful teachers in other districts. The participants expressed a need for more time to plan, as well as time to plan with other grade levels. Theme 6 showed what the participants felt was needed to better their use of formative data to plan instruction. The participants perceived that more professional development was needed about understanding formative assessment data. The participants perceived that more professional development was needed about effectively using classroom practices to increase student achievement and meet the individual needs of students.

The conceptual framework for this basic qualitative research study was the model of formative assessment developed by Black and Wiliam (2009) based on Ramaprasad's (1983) three key processes in learning and teaching: "establishing where the learners are in their learning, establishing where the learners are going, and establishing what needs to be done to get the learners there" (Black & Wiliam, 2009, p. 4). The study was designed to gain an understanding of how middle-grade mathematics teachers use the benchmark results as formative data to guide instruction and meet the individual needs of students. The use of formative benchmark data to guide instruction and meet the individual needs of students represents the key processes in learning and teaching as outlined by Ramaprasad (1983). The use of formative assessments in the classroom helps the teacher to determine what the students have learned, what they need to learn, and what they need to know about their learning. The conceptual framework was evident throughout the themes that developed from my analysis. Formative assessment is an intricate part of increasing student achievement. Simply stated, formative assessment connects the results of an assessment to modifications in instruction with a goal of improvement in student achievement (Wiliam, 2011).

Implications for Social Change

According to many researchers, formative assessment has significant influence on improving learning and reducing gaps in achievement (Black & William, 1998b; Chappuis & Stiggins, 2002; Fox-Turnbull, 2006; Fyfe & Rittle-Johnson, 2016; Martin et al., 2015; Marzano et al., 1993; Meehan et al., 2003; Nawaz & Rehman, 2017; Robinson et al., 2014). This study focused on how middle-grade mathematics teachers use formative benchmark data to guide instruction and meet the individual needs of students. The findings from this study provided the study site school district with information that could assist in developing interventions to assist middle-grade mathematics teachers to better use formative assessment data to guide instruction and meet the individual needs of students. The results of this study will benefit middle-grade mathematics teachers who will be the recipients of the interventions. Positive social change will occur when mathematics teachers increase their use of formative benchmark data to guide instruction and meet the individual needs of students.

Recommendations for Action

As a result of the findings of my study, I recommend the following actions. I recommend that middle-grade mathematics teachers be provided with time to analyze results of formative assessments and plan for remediation of students who are not achieving proficiency. Nelson (2013) agreed that the use of benchmark tests can increase the performance of low-achieving students on standardized tests by helping teachers to develop instructional interventions such as remediation and reteaching, tutorial programs, and in discussing benchmark results with students. I recommend that teachers receive professional development about understanding formative data and professional development that would help them use formative assessment data to develop effective instruction to increase student achievement.

I will provide a copy of the study to each middle-school administrator, the study site school district's administrators, and the mathematics coaches. I will offer to describe the study outcomes to the middle-school mathematics teachers at each school. I will encourage the study site school district's administrators and the middle-grade mathematics teachers to implement the recommendations based upon the description of the outcomes.

Recommendations for Further Study

As a result of conducting this study, I have the following recommendations for further studies. I recommend that researchers develop a large statewide quantitative study that surveys middle-grade mathematics teachers about formative assessment data used to guide classroom instruction and meet the individual needs of students. I also recommend that studies be developed to learn about the outcomes of effective use of formative assessment on student achievement in mathematics.

Summary

The purpose of this basic qualitative study was to gain an understanding of how middle-grade mathematics teachers use the benchmark results as formative data to guide instruction and meet the individual needs of students. In the study site school district, middle-grade mathematics teachers have used benchmark tests as a form of formative assessment and received formative data from the benchmark tests for the past 12 years. However, student achievement in middle-grade mathematics has not improved. I implemented a qualitative research approach to gain an understanding of how middle-grade mathematics teachers use formative data to guide instruction. The results of my study showed that middle-grade mathematics teachers are minimally analyzing formative assessment data and using the results in the classroom. This indicates that middle-grade mathematics teachers in the study site school district need more interventions to effectively analyze formative assessment data and use that data to guide classroom practices. It is important for research to be conducted in schools to help improve teaching and learning. Given that teachers' instructional practices are the most powerful indicator for raising student achievement in mathematics (McKinney et al., 2013), it is imperative to better understand how teachers engage in these practices.

Over the past 7 years, I have learned to develop a quality research study. The development of a quality research study afforded me the opportunity to research, develop, analyze, and evaluate data as they relate to formative assessment. The completion of this study has allowed me to grow as an educator, a scholar, and a teacher leader. This research study increased my knowledge of more effective ways to use formative data to plan instruction and meet students' individual needs in the classroom. I am now able to provide the teachers in the study site school district with research-based strategies on the use of formative assessment and the effects it has on student achievement. Being a teacher leader allows me the opportunity to provide professional development on the use of formative assessment and its effect on student achievement which may lead to positive social change in that when teachers improve their use of formative assessment in the classroom, student achievement in mathematics may be improved. To conclude, the goal for this basic qualitative research study is for teachers to understand the importance of using formative data to guide instruction and meet the individual needs of students. When this is done, students' achievement in mathematics will increase and students will be prepared for high school and beyond.

References

Abbas, R. A. S. (2016). A program based on developmental mathematics approach to develop higher order mathematical thinking levels and mathematics appreciation for primary stage students. *Education, 136*(3), 378–390. Retrieved from https://www.questia.com/library/p5118/education

Adabor, J. K. (2013). Harnessing formative and summative assessments to promote mathematical understanding and proficiency. *Association for University Reginal Campuses of Ohio, 19.* Retrieved from http://aurco.net/Journals/AURCO_Journal_2013/Harnessing_Formative_AURCO_Vol19_2013.pdf

Akpan, J. P., Notar, C. E., & Padgett, S. A. (2012). Formative assessment: A basic foundation for teaching and learning. *National Teacher Education Journal, 5*(1), 83–97. Retrieved from https://ntejournal.com/

Amunga, J. K., & Musasia, M. (2011). Disparities in mathematics achievement among secondary schools: The case of Kenya. *Problems of Education in the 21st Century, 28*, 8–18. Retrieved from http://www.scientiasocialis.lt/pec/

Andersson, C., & Palm, T. (2017). The impact of formative assessment on student achievement: A study of the effects of changes to classroom practice after a comprehensive professional development programme. *Learning and Instruction, 49,* 92–102. https://doi.org/10.1016/j.learninstruc.2016.12.006

Baas, D., Castelijns, J., Vermeulen, M., Martens, R., & Segers, M. (2014). The relationship between assessment for learning and students' cognitive and metacognitive strategy use. *British Journal of Educational Psychology, 85,* 33–46. https://doi.org/10.1111/bjep.12058

Baskarada, S. (2014). Qualitative case study guidelines. *The Qualitative Report, 19*(40), 1–18. Retrieved from https://nsuworks.nova.edu/tqr

Beckett, D., Volante, L., & Drake, S. (2010). *Formative assessment: bridging the research—practice divide. Education Canada, 50*(3). Retrieved from http://www.cea-ace.ca/education-canada

Black, P., Harrison, C., Lee, C., Marshall, B., & Wiliam, D. (2003). *Assessment for learning: Putting it into practice.* New York, NY: Open University Press.

Black, P., & Wiliam, D. (1998a). Assessment and classroom learning. *Assessment in Education: Principles, Policy & Practice, 5*(1)*,* 7–73. Retrieved from https://www.tandfonline.com/toc/caie20/current

Black, P., & Wiliam, D. (1998b). *Inside the black box: raising the standards through classroom assessment.* London, United Kingdom: King's College London School of Education. Retrieved from http://www.jstor.org/stable/20439383

Black, P., & Wiliam, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability, 21*(1), 5–31. https://doi.org/10.1007/s11092-008-9068-5

Bowman-Perrott, L., Davis, H., Vannest, K., Williams, L., Greenwood, C., & Parker, R. (2013). Academic benefits of peer tutoring: A meta-analytic review of single-case research. *School Psychology Review, 42*(1), 39–55. Retrieved from https://naspjournals.org/loi/spsr

Bowman-Perrott, L., deMarin, S., Mahadevan, L., & Etchells, M. (2016). Assessing the academic, social, and language production outcomes of English language learners engaged in peer tutoring: A systematic review. *Education and Treatment of Children, 39*(3), 359–388. https://doi.org/10.1353/etc.2016.0016

Box, C. (2019). *Formative assessment in United States classrooms*. Cham, Switzerland: Palgrave Macmillan. https://doi.org/10.1007/978-3-030-03092-6_2

Bulunuz, N., Bulunuz, M., & Peker, H. (2014). Effects of formative assessment probes integrated in extra-curricular hands-on science: Middle school students' understanding. *Journal of Baltic Science Education, 13*(2), 243–258. Retrieved from http://www.scientiasocialis.lt/jbse/

Burns, D., Darling-Hammond, L., & Scott, C. (2019). Closing the opportunity gap: How positive outlier districts in California are pursuing equitable access to deeper learning. *Learning Policy Institute.* Retrieved from http://learningpolicyinstitute.org/product/ positive-outliers-closing-opportunity-gap.

Buyukkarci, K. (2014). Assessment beliefs and practices of language teachers in primary education. *International Journal of Instruction, 7*(1), 107–120. Retrieved from http://www.e-iji.net/

Carlsen, W. S. (1991). Questioning in classrooms: A sociolinguistic perspective. *Review of Educational Research, 61*(2), 157–178. https://doi.org/10.3102/00346543061002157

Carlson, D., Borman, B. D., & Robinson, M. (2011). A multistate district-level cluster randomized trial of the impact of data-driven reform on reading and mathematics achievement. *Educational Evaluation and Policy Analysis, 33*(3), 378–398. https://doi.org/10.3102/0162373711412765

Chan, P. E., Graham-Day, K. J., Ressa, V. A., Peters, M. T., & Konrad, M. (2014). Beyond involvement: Promoting student ownership of learning in classrooms. *Intervention in School and Clinic, 50*(2), 105–113. https://doi.org/10.1177/1053451214536039

Chappuis, S., & Stiggins, R. J. (2002). Classroom assessment for learning. *Educational Leadership, 60*(1), 40–43. Retrieved from https://www.ascd.org/portal/site/ascd/template.MAXIMIZE/menuitem.4

Chen, C. H., Crockett, M. D., Namikawa, T., Zilimu, J., & Lee, S. H. (2012). Eighth grade mathematics teachers' formative assessment practices in SES-different classrooms: A Taiwan study. *International Journal of Science and Mathematics Education, 10,* 553–579. https://doi.org/10.1007/s10763-011-9299-7

Cheng, Q. (2014). Quality mathematics instructional practices contributing to student achievements in five high-achieving Asian education systems: An analysis using TIMSS 2011 data. *Frontiers of Education in China, 9*(4), 493–518. https://doi.org/10.1007/bf03397038

Chin, C. (2007). Teacher questioning in science classrooms: Approaches that stimulate productive thinking. *Journal of Research in Science Teaching, 44*(6), 815–843. https://doi.org/10.1002/tea.20171

Chiu, C. W. T. (1998). *Synthesizing metacognitive interventions: What training* *characteristics can improve reading performance?* Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA. Retrieved from https://files.eric.ed.gov/fulltext/ED420844.pdf

Cleary, T. J., & Kitsantas, A. (2017). Motivation and self-regulated learning influences on middle school mathematics achievement. *School Psychology Review, 46*(1), 88–107. https://doi.org/10.17105/SPR46-1.88-107

Cohen, D., & Crabtree, B. (2006). *Qualitative research guidelines project*. Retrieved from http://www.qualres.org/

Common Core State Standards Initiative. (2015). In the States. *Common Core State Standards Initiative.* Retrieved from http://www.corestandards.org/in-the-states

Connelly, F. M., & Clandinin, D. J. (1990). Stories of experience and narrative inquiry. *Educational Researcher, 19*(5), 2–14. https://doi.org/10.3102/0013189X019005002

County Public Schools (2019). Retrieved from https://www.publicschoolreview.com/

Creswell, J. (2013). *Qualitative inquiry & research design. Choosing among five approaches.* Thousand Oaks, CA: Sage Publications.

Creswell, J. W. (2007). *Qualitative inquiry & research design* (2nd ed.). Thousand Oaks, CA: Sage

Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (Laureate custom ed.). Boston, MA: Pearson Education

DiFrancesca, D., Nietfeld, J. L., & Cao, L. (2014). A comparison of high and low achieving students on self-regulated learning variables. *Learning and Individual Differences,* 1–9. https://doi.org/10.1016/j.lindif.2015.11.010

Dignath, C., & Buttner, G. (2008). Components of fostering self-regulated learning among students. A meta-analysis on intervention studies at primary and secondary school level. *Metacognition Learning, 3,* 231–264. https://doi.org/10.1007/s11409-008-9029-x

Dirksen, D. J. (2011). Hitting the Reset Button: Using formative assessment to guide instruction. *Phi Delta Kappan, 92*(7), 26–31. https://doi.org/10.1177/003172171109200706

Duckor, B. (2014). Formative assessment in seven good moves. *Association for Supervision & Curriculum Development,* 28–32. Retrieved from https://www.greatschoolspartnership.org/wp-content/uploads/2016/11/Formative-Assessment-in-Seven-Good-Moves.pdf

Einig, S. (2013). Supporting students' learning: The use of formative online assessments. *Accounting Education: An International Journal, 22*(5), 425–444. http://dx.doi.org/10.1080/09639284.2013.803868

Emanuel, D. C., Robinson, C. G., & Korczak, P. (2013). Development of a formative and summative assessment system for AuD education. American Journal of Audiology, 22, 14–25. https://doi.org/10.1044/1059-0889(2012/12-0037)

Ergen, B., & Kanadli, S. (2017). The effect of self-regulated learning strategies on academic achievement: A meta-analysis study. *Eurasian Journal of Educational Research, 69,* 55–74. http://dx.doi.org/10.14689/ejer.2017.69.4

Erickson, L. (2007). *Stirring the head, heart, and soul: Redefining curriculum, instruction, and concept-based learning.* Thousand Oaks, CA: Sage Publications.

Forster, N., & Souvignier, E. (2014). Learning progress assessment and goal setting: Effects on reading achievement, reading motivation, and reading self-concept. *Learning and Instruction, 32,* 91–100. https://doi.org/10.1016/j.learninstruc.2014.02.002

Fox-Turnbull, W. (2006). The influences of teacher knowledge and authentic formative assessment on student learning in technology education. *International Journal of Technology and Design Education, 16*(1), 53–77. Retrieved from https://link.springer.com/

Fyfe, E. R., DeCaro, M. S., & Rittle-Johnson, B. (2015). When feedback is cognitively-demanding: The importance of working memory capacity. *Instructional Science, 43,* 73–91. https://doi.org/10.1007/s11251-014-9323-8

Fyfe, E. R., & Rittle-Johnson, B. (2016). Feedback both helps and hinders learning: The causal role of prior knowledge. *Journal of Educational Psychology, 108*(1), 82–97. http://dx.doi.org/10.1037/edu0000053

Gipps, C. V. (2012). *Beyond testing: Towards a theory of educational assessment*. Washington, DC: Falmer Press. Retrieved from https://content.taylorfrancis.com

Good, R. H. (2015). *Improving the efficiency and effectiveness of instruction with progress monitoring and formative evaluation in the outcomes driven model.* Presented at the Abilities and Disabilities International Conference. Retrieved from http://cnal.edu.haifa.ac.il/videos/improving-the-efficiency-and-effectiveness-of-instruction-with-progress-monitoring-and-formative-evaluation-in-the-outcomes-driven-model

Goodrich, K. (2012). *Dylan Wiliam & The 5 Formative Assessment Strategies to Improve Student Learning.* Northwest Evaluation Association. Retrieved from https://www.nwea.org/blog/2012/dylan-wiliam-the-5-formative-assessment-strategies-to-improve-student-learning/

Hatch, J. A. (2010). *Doing qualitative research in education settings.* Albany: State University of New York Press.

Hattie, J. (2012) *Visible learning for teachers: Maximizing impact on learning.* London. UK: Routledge. https://doi.org/10.4324/9780203181522

Hattie, J., Biggs, J., & Purdie, N. (1996). Effects of learning skills interventions on student learning: A meta-analysis. *Review of Educational Research, 66*, 99–136. https://doi.org/10.3102/00346543066002099

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research, 77*(1), 88–118. https://doi.org/10.3102/003465430298487

Heitink, M. C., Van der Kleij, F. M., Veldkamp, B. P., Schildkamp, K., & Kippers, W. B. (2015). A systematic review of prerequisites for implementing assessment for learning in classroom practice. *Educational Research Review, 17,* 50–62. Retrieved from http://dx.doi.org/10.1016/j.edurev.2015.12.002

Heritage, M. (2010a). *Formative assessment and next-generation assessment systems: Are we losing the opportunity?* Council of Chief State School Officers (CCSSO), Washington D.C. Retrieved from http://www.edweek.org/media/formative_assessment_next_generation_heritage.pdf

Heritage, M. (2010b). *Formative assessment: Making it happen in the classroom.* Thousand Oaks, CA: Corwin Press. Retrieved from http://files.hbe.com.au/samplepages/CO2922.pdf

Heritage, M., & Heritage, J. (2013). Teacher questioning: The epicenter of instruction and assessment. *Applied Measurement in Education, 26,* 176–190. https://doi.org/10.1080/08957347.2013.793190

Heritage, M., & Yeagley, R. (2005). Data use and school improvement: Challenges and prospects. In J. L. Herman & E. H. Haertel (Eds.), *Uses and misuses of data for educational accountability and improvement: The 104th yearbook of the National Society for the Study of Education, part 2,* 320–339. Malden, MA: Blackwell. https://doi.org/10.1111/j.1744-7984.2005.00035.x

Herman, J. L., & Gribbons, B. (2001). *Lessons learned in using data to support school inquiry and continuous improvement: Final report to the Stuart Foundation* (CSE Tech. Rep. No. 535). Los Angeles, CA: University of California, Center for the Study of Evaluation. Retrieved from https://cresst.org/wp-content/uploads/TR535.pdf

Hodgen, J., & Wiliam, D. (2006). *Mathematics inside the black box: Assessment for learning in the mathematics classroom.* London, United Kingdom: NFER-Nelson. Retrieved from http://mrbartonmaths.com/resourcesnew/8.%20Research/Formative%20Assessme nt/Mathematics%20Inside%20the%20Black%20Box.pdf

Hoover, N. R., & Abrams, L. M. (2013). Teachers' instructional use of summative student assessment data. *Applied Measurement in Education, 26,* 219–231. https://doi.org/10.1080/08957347.2013.793187

Hudson, M. E., Browder, D. M., & Jimenez, B. A. (2014). Effects of a peer-delivered system of least prompts intervention and adapted science read-alouds on listening comprehension for participants with moderate intellectual disability. *Education and Training in Autism and developmental Disabilities 49*(1), 60–77. Retrieved from https://www.jstor.org/stable/23880655?seq=1

Hung, L. T., Hoang Ha, L. T., & Thanh Thu, L. T. (2019). Applying formative assessment techniques to promote students' learning outcomes and interest. *Advances in Social Science, Education and Humanities Research (ASSEHR), 258,* 315–320. Retrieved from http://creativecommons.org/licenses/by-nc/4.0/

Jameson, J. M., McDonnell, J., Polychronis, S., & Riesen, T. (2008). Embedded, constant time delay instruction by peers without disabilities in general education classrooms. *American Journal on Intellectual and Developmental Disabilities, 46,* 346–363. https://doi.org/10.1352/2008.46:346–363

Kingston, N., & Nash, B. (2011). Formative assessment: A meta-analysis and a call for research. *Educational Measurement: Issues and Practice, 30*(4), 28–37. https://doi.org/10.1111/j.1745-3992.2011.00220.x

Kwaku-Sarfo, F., Eshun, G., Elen, J., & Impraim-Adentwi, K. (2014). Towards the solution of abysmal performance in mathematics in junior high schools:

Comparing the pedagogical potential of two designed interventions. Electronic *Journal of Research in Educational Psychology*, 12(3), 763–784. http://dx.doi.org/10.14204/ejrep.34.14028

Leirhaug, P. E., & MacPhail, A. (2015) 'It's the other assessment that is the key': three Norwegian physical education teachers' engagement (or not) with assessment for learning. *Sport, Education and Society, 20*(5), 624–640. https://doi.org/10.1080/13573322.2014.975113

Leung, K. C. (2015). Preliminary empirical model of crucial determinants of best practice for peer tutoring on academic achievement. *Journal of Educational Psychology, 107*(2), 558–579. http://dx.doi.org/10.1037/a0037698

Lincoln, Y. S., & Guba, E. G. (2000). Paradigmatic controversies, contradictions, and emerging confluences. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed.) (pp. 163–188). Thousand Oaks, CA: Sage. Retrieved from https://www.stars.library.ucf.edu

Lipnevich, A. A., McCallen, L. N., Miles, K. P., & Smith, J. K. (2014). Mind the gap! Students' use of exemplars and detailed rubrics as formative assessment. *Instructional Science, 42*, 539–559. https://doi.org/10.1007/s11251-013-9299-9

Lodico, M., Spaulding, D., & Voegtle, K. (2010). *Methods in educational research: From theory to practice*. (Laureate Education, Inc., custom ed.). San Francisco, CA: John Wiley & Sons. Retrieved from https://www.josseybass.com

Low, S. H. (2015). Is this okay? Developing student ownership in artmaking through feedback. *Art Education,* 43–49.

https://doi.org/10.1080/00043125.2015.11519305

Ma, W., & Winke, P. (2019). Self-assessment: How reliable is it in assessing oral proficiency over time? *American Council on the Teaching of Foreign Languages, 52,* 66–86. https://doi.org/10.1111/flan.12379

Martin, C. L. (2015). Writing as a tool to demonstrate mathematical understanding. *School Science and Mathematics, 115*(6), 302–313. https://doi.org/10.1111/ssm.12131

Martin, C. S., & Polly, D. (2015). Using the AMC Anywhere web-based assessment system to examine primary students' understanding of number sense. In D. Polly (Ed.), *Cases on Technology' Integration in Mathematics Education*, 366–377. Hershey: PA: IGI Global. https://doi.org/10.4018/978-1 -4666- 6497-5.chOl 8

Martin, C. S., Polly, D., Wang, C., Lambert, R. G., & Pugalee, D. K. (2015). Perspective and practices of elementary teachers using an internet-based formative assessment tool: The case of assessing mathematics concepts. *International Journal of Technology in Mathematics Education, 23*(1). 3–12. https://doi.org/ 10.1564/tme_v23.1.01

Marzano, R. J., Pickering, D., & McTighe, J. (1993). *Assessing student outcomes: Performance Assessment Using the Dimensions of Learning Model.* Alexandria, VA: Association for Supervision and Curriculum Development. Retrieved from https://files.eric.ed.gov/fulltext/ED461665.pdf

McKinney, S. E., Robinsom, J., & Berube, C. T. (2013). "Real teaching" in the mathematics classroom: A comparison of the instructional practices of elementary teachers in urban high-poverty schools. *Teacher Education and Practice, 26*(4), 797–815. Retrieved from https://www.go.gale.com

McMillian, J. H., Venable, J. C., & Varier, D. (2013). Studies of the effect of formative assessment on student achievement: So much more is needed. *Practical Assessment, Research & Evaluation, 18*(2), 1–15. Retrieved from https://pareonline.net/getvn.asp?v=18&n=2

Meehan, M. L., Cowley, K. S., Schumacher, D., Hauser, B., & Croon, N. D. (2003). *Classroom environment, instructional resources and teaching differences in high performing Kentucky schools with achievement gaps.* Paper presented at the 12th annual CREATE National Evaluation Institute. Louisville, KY. July 24–26, 2003. AEL, Inc. Retrieved from https://files.eric.ed.gov/fulltext/ED478672.pdf

Merriam, S. B. (2009). *Qualitative Research: A Guide to Design and Implementation.* 2nd edition. San Francisco, CA: Jossey-Bass Publishers. Retrieved from https://onlinelibrary.wiley.com/

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative Research: A Guide to Design and Implementation.* 4th edition. San Francisco, CA: Jossey-Bass Publishers. Retrieved from https://onlinelibrary.wiley.com/

Mitten, C., Jacobbe, T., & Jacobbe, E. (2017). What do they understand? Using technology to facilitate formative assessment. *Australian Primary Mathematics Classroom, 22*(1), 9–12. Retrieved from https://files.eric.ed.gov/fulltext/EJ1138035.pdf

National Center for Education Statistics (2011). Trends in International Mathematics and

Science Study (TIMSS, 2011). Retrieved from https://nces.ed.gov/timss/results11.asp

National Council of Teachers of Mathematics. (NCTM) (2007). *Five "Key Strategies" for Effective Formative Assessment.* Reston, VA: Author. Retrieved from https://www.nctm.org/Research-and-Advocacy/research-briefs-and-clips/

National Council of Teachers of Mathematics. (2014). *Principles to action: Ensuring mathematical success for all.* Reston, VA: Author. Retrieved from https://www.nctm.org/Store/Products/Principles-to-Actions--Ensuring-Mathematical-Success-for-All/

National Mathematics Advisory Panel. (2008). *Foundations for success.* Washington, DC: U.S. Department of Education. Retrieved from https://www2.ed.gov/about/bdscomm/list/mathpanel/report/final-report.pdf

Nawaz, A., & Rehman, Z. U. (2017). Strategy of peer tutoring and students success in mathematics: An analysis. *Journal of Research and Reflections in Education, 11*(1), 15–30. Retrieved from https://pdfs.semanticscholar.org/bbb0/a85f4aa77435fe2154bd5f62b24fa8701297.pdf

Nelson, H. (2013). Testing more, teaching less: What America's obsession with student testing costs in money and lost instructional time. The American Federation of Teachers, 1–34. Retrieved from https://www.aft.org/sites/default/files/news/testingmore2013.pdf

Patton, M. (2014). *Qualitative research & evaluation methods.* Thousand Oaks, CA:

Sage Publications.

Phelan, J., Choi, K., Vendlinski, T., Baker, E., & Herman, J. (2011). Differential improvement in student understanding of mathematical principles following formative assessment intervention. *The Journal of Educational Research, 104,* 330–339. https://doi.org/10.1080/00220671.2010.484030

Polly, D. (2015). Examining how professional development influences elementary school teachers' enacted instructional practices and students' evidence of mathematical understanding. *Journal of Research in Childhood Education, 29,* 565–582. https://doi.org/10.1080/02568543.2015.1073198

Polly, D., Martin, C. S., Wang, C., Lambert, R. G., & Pugalee, D. K. (2016). Primary grades teachers' instructional decisions during online mathematics professional development activities. *Early Childhood Education, 44,* 275–287. https://doi.org/10.1007/s10643-015-0711-8

Public School Review (2019). Retrieved from https://publicschoolreview.com

Ramaprasad, A. (1983). On the definition of feedback. *Behavioural Science, 28*, 4–13. Retrieved from https://onlinelibrary.wiley.com/journal/10991743

Reinholz, D. (2016). The assessment cycle: A model for learning through peer assessment. *Assessment & Evaluation in Higher Education, 41*(2), 301–315. Retrieved from https://danielreinholz.com/wp-content/uploads/2018/12/2016-AE-Assessment-Cycle-Pre-Print.pdf

Robert, G. (2011). Formative "use" of assessment information: it's a process, so let's say what we mean. *Practical Assessment, Research & Evaluation 16*(3), 1–6.

https://doi.org/10.7275/3yvy-at83

Robinson, J., Myran, S., Strauss, R., & Reed, W. (2014). The impact of an alternative professional development model on teacher practices in formative assessment and student learning. *Teacher Development, 18*(2), 141–162. http://dx.doi.org/10.1080/13664530.2014.900516

Roskos, K., & Neuman, S. B. (2012). Formative assessment: Simply, no additives. *The Reading Teacher (65)*8, 534–538. https://doi.org/10.1002/TRTR.01079

Sadler, D. R. (1989). Formative assessment and the design of instructional systems. *Instructional Science, 18*, 119–144. Retrieved from https://link.springer.com/journal/11251/volumes-and-issues

Saldana, J. (2016). *The coding manual for qualitative researchers.* Thousand Oaks, California: Sage Publications. https://doi.org/10.1177/1077800415603395

Salvin, R. E., Hurley, E. A., & Chamberlain, A. M. (2003). Cooperative learning and achievement, *In Handbook of Psychology, 7,* 177–198. https://onlinelibrary.wiley.com/doi/abs/10.1002/0471264385.wei0709

Santos, L., & Semana, S. (2015). Developing mathematics written communication through expository writing supported by assessment strategies. *Educational Studies Mathematics, 88,* 65–87. https://doi.org/10.1007/s10649-014-9557-z

Schneider, M. C., & Andrade, H. (2013). Teachers' and administrators'' use of evidence of student learning to take action: Conclusions drawn from a special issue on formative assessment. *Applied Measurement in Education, 26,* 159–162. https://doi.org/10.1080/08957347.2013.793189

Schram, T. H. (2003). *Conceptualizing qualitative inquiry.* Upper Saddle River, NJ: Merrill Prentice Hall.

Scruggs, T. E., & Ritcher, L. (1988). Tutoring learning disabled students: A critical review. *Learning Disability Quarterly, 11,* 274–286. https://doi.org/10.2307/1510772

Shepard, L. A. (2000). The role of assessment in a learning culture. *Educational Researcher, 29*(7), 4–14. Retrieved from https://journals.sagepub.com/home/edr

Shute, V. J., & Kim, Y. J. (2014). Formative and stealth assessment. *Handbook of Research on Educational Communications and Technology,*1–11. https://doi.org/10.1007/978-1-4614-3185-5_25

Stake, R. E. (2010). Case studies. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed., pp. 435–454), Thousand Oaks, CA: Sage. Retrieved from https://sebardestve.files.wordpress.com/2015/10/stake-case-studies-handbook-of-qualitative-research.pdf

Stiggins, R. J. (2005). From formative assessment to assessment for learning: A path to success in standards-based schools. *Phi Delta Kappan, 87,* 324–328. Retrieved from https://journals.sagepub.com/home/pdk

Stiggins, R. J., & Chappius, J. (2017). *An introduction to student-involved assessment for learning.* New York, NY: Pearson. Retrieved from https://www.worldcat.org/title/introduction-to-student-involved-assessment-for-learning/oclc/952387563

Trumbull, E., & Lash, A. (2013). Understanding formative assessment: Insights from learning theory and measurement theory. *WestEd,* 1–20. Retrieved from https://www.wested.org/online_pubs/resource1307.pdf

van den Berg, M., Bosker, R. J., & Suhre, C. J. M. (2018). Testing the effectiveness of classroom formative assessment in Dutch primary mathematics education. *School Effectiveness and School Improvement,* 29:3, 339-361. https://doi.org/10.1080/09243453.2017.1406376

van de Pol, J. (2012). *Scaffolding in teacher-student interaction. Exploring, measuring, promoting and evaluating scaffolding* (Doctoral dissertation). Retrieved from https://pure.uva.nl/ws/files/1766322/110510_09.pdf

Van der Kleij, F. M., Feskens, R. C., & Eggen, T. J. H. M. (2015). Effects of feedback in a computer-based learning environment on students' learning outcomes: A meta-analysis. *Review of Educational Research,* 1–37. https://doi.org/10.3102/0034654314564881

Vandevelde, S., Van Keer, H., & Rosseel, Y. (2013). Measuring the complexity of upper primary school children's self-regulated learning: A multi-component approach. *Contemporary Educational Psychology, 38*, 407–425. https://doi.org/10.1016/j.cedpsych.2013.09.002

van Diggelen, M. R. (2013). *Effects of a self-assessment procedure on VET teachers' competencies in coaching students' reflection skills* (Doctoral dissertation). https://doi.org/10.6100/IR752378

van Diggelen, M. R., Morgan, C. M., Funk, M., & Bruns, M. (2016). *Formative assessment: Enriching teaching and learning with formative assessment.*

Eindhoven, Netherlands: Eindhoven University of Technology. Retrieved from https://pure.tue.nl/ws/portalfiles/portal/14036034/booklet_formative_assesment_pages.pdf

Veldhuis, M., & van den Heuvel-Panhuizen, M. (2019). Supporting primary school teachers' classroom assessment in mathematics education: Effects on student achievement. *Mathematics Education Research Journal,* 1–23. https://doi.org/10.1007/s13394-019-00270-5

Wei, L. (2011). Formative assessment in classrooms: Operational procedures. *Journal of Language Teaching and Research (2)*1, 99–103. https://doi.org/10.4304/jltr.2.1.99-103

Wiliam, D. (2007). Keeping learning on track: Classroom assessment and the regulation of learning. In K. L. Frank Jr. (Ed.). *Second handbook of research on mathematics teaching and learning,* 1053–1098. Charlotte, NC: Information Age. Retrieved from https://discovery.ucl.ac.uk/

Wiliam, D. (2008). *When is assessment learning oriented? Keynote lecture.* Fourth biennial EARLI/Northumbria assessment conference, Berlin, Germany. https://doi.org/10.1080/03043797.2011.591486

Wiliam, D. (2011). What is assessment for learning? *Studies in Educational Evaluation, 57*(1), 3–14. Retrieved from https://www.elsevier.com/stueduc

Witte, R. H. (2012). *Classroom assessment for teachers.* New York: McGraw-Hill. Retrieved from https://www.mheducation.com/highered/product/classroom-assessment-teachers-witte/M9780073378701.authorbio.html

Wolfe, S., & Alexander, R. J. (2008). *Argumentation and dialogic teaching: Alternative pedagogies for a changing world.* London, United Kingdom: FutureLab (Beyond Current Horizons). Retrieved from https://www.robinalexander.org.uk/wp-content/uploads/2012/05/wolfealexander.pdf

Yalaki, Y. (2010). Simple formative assessment, high learning gains in college general chemistry. Egitim Arastirmalari - *Eurasian Journal of Educational Research, 40*, 223–240. http://dx.doi.org/10.14689/ejer

Yin, R. K. (2018). *Case study research: Design and methods* (6th ed.). Thousand Oaks, CA: Sage. Retrieved from https://us.sagepub.com/en-us/nam/case-study-research-and-applications/book250150

Yin, Y., Olson, J., Olson, M., Solvin, H., & Brandon, P. R. (2015). Comparing two versions of professional development for teachers using formative assessment in networked mathematics classrooms. *Journal of Research on Technology in Education, 47*(1), 41–70. https://doi.org/10.1080/15391523.2015.967560

Yu, R., & Singh, K. (2018). Teacher support, instructional practices, student motivation, and mathematics achievement in high school. *The Journal of Educational Research, 111*(1), 81-94. https://doi.org/10.1080/00220671.2016.1204260

Appendix A: Teacher Interview Questions

Teacher's Name (Pseudonym): ________________________________

Date:_____________

1. How long have you been teaching mathematics?
2. Describe your mathematics experience?
3. What grade(s) do you currently teach?
4. What grade(s) have you taught in the past?
5. What professional development have you received using formative assessment?
6. How do you with use benchmark test data as formative assessment to guide mathematics instruction?
7. What classroom practices do you implement in the classroom to meet students' needs as identified by the formative benchmark test?
8. Do you reteach standards not mastered on the benchmark assessment? If so, how is it done? If not, why not?
9. Do you review the benchmark test with your students? If so, how is it done? If not, why not?
10. Could you describe 1-2 students who did not do well on the benchmark? How did you identify their strengths and weaknesses? Do you discuss these with the student individually? Why or why not?
11. What other types of formative assessment do you use in the classroom to guide instruction? Meet the individual needs of students?
12. What challenges do you face with using formative data to guide instruction?

13. What supports do you feel you need in order to use formative data to plan instruction? Meet the individual needs of students?
14. What resources do you feel you need in order to use formative data to plan instruction? Meet the individual needs of students?