

Running head: THE ROLE OF FORMATIVE ASSESSMENT

Exploring the Role of Formative Assessment in the Secondary Mathematics Classroom

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Abstract

There has been a tremendous amount of research in the last two decades about assessment, especially that concerning formative assessment and its implementation and effectiveness. How can educators effectively use assessment for the purpose of informing their practice and guiding how they progress students' learning forward? This study took an exploratory look at a secondary mathematics classroom to develop a clearer understanding of the role formative assessment played in one secondary classroom for both teacher and students. Data from classroom observations, interviews, and surveys were analyzed using mixed methods to create a portrait of the role formative assessments in the classroom. Key findings include: the teacher's strength in her ability to gather formative information, the strong connection between assessment and personal relevance, and the roadblock that time presents to providing meaningful formative assessments for all students.

Keywords: formative assessment, secondary Mathematics

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Acknowledgments

This is my first year teaching, after three years of subbing. I am teaching all 7th grade Mathematics. I entered this graduate program with the hopes of earning a middle level mathematics endorsement and improving my teaching practices and mathematics skill base. As a new math teacher it was very important to me that I be able to observe, analyze, and reflect on a secondary veteran mathematics teachers' practices. This project provided me such an opportunity and created a tremendous learning and growth opportunity for my own teaching practice.

I am very appreciative for many individuals' support throughout this masters program. I would like to thank my parents, especially my mom, for constant support and motivation. I would also like to thank my close friends that constantly checked in on my progress and acted as a sounding board for the venting of my frustrations when the research and writing process weighed me down.

I would like to thank Professor Anita Lenges who made me excited about teaching math, her passion for math and teaching knows no limits. Also, I owe much to our program's new Professor, Sunshine Campbell, for providing excellent feedback on the many drafts of our papers. Finally, I would like to thank the teacher I observed for this project for letting me be a part of her classroom and welcoming me into a new school.

In today's educational system, there is an increase in high-stakes testing and a demand for accountability. This prioritization is reflected in the push for summative assessments that provide a summary of students' learning. These types of assessments, administered at the school, district, state and national levels, aim to provide a summary of what students have learned already and serve as a measure by which students and schools are compared and ranked. This type of assessment, however, does little if anything to provide teachers with the information they need to move students' learning forward.

Formative assessment, unlike summative assessment, is a systematic process of gathering evidence about student learning, while it is happening (William and Black, 1996). That information is then used to inform teaching practices and serves as a guide for how to move students forward toward a learning goal. If student learning is the goal of education, this type of assessment is vital; formative assessment and the teaching process are inseparable, one cannot happen without the other.

A tremendous amount of research has gone into the topic of assessment in mathematics. In the last two decades, and especially the last ten years, formative assessment, its implementation and effectiveness, has been a heated topic for study and debate. A bulk of the research in this area has detailed the many necessary components for effectively using formative assessment. Recent work has looked in-depth at the prerequisite teacher skills (Black & William, 1998; Ginsburg, 2009; Heritage & Niemi, 2006; Heritage, 2007; Heritage et al., 2009; William & Black, 1996), necessary classroom conditions (Allsopp et al., 2008; Watson, 2006), as well as the importance of the role of student as formative assessor (Andrade & Valcheva, 2009; Brown, 2007; Schunk, 2003; Usher, 2008). An area that is beginning to receive some attention is an attempt to answer

the following question, “How effective are teachers at actually using information from formative assessments to move students forward in their learning process?” This area has been identified as an area of great difficulty for teachers (Dixon & Haigh, 2009; Doig, 2006; Gearhart & Saxe, 2004; Heritage, 2007; Heritage et al., 2009; Watson, 2006; Wiliam & Black, 2004).

This study will attempt to build on current research, by taking an exploratory look at secondary mathematics classrooms with the goal of answering the broad question:

- What is the role of formative assessment in the secondary mathematics classroom? Within that question, I will also explore the following sub-questions:
 - *How are teachers using assessment, especially formative assessment, in their classroom?*
 - *What are both teachers’ and students’ beliefs about assessment and its purpose?*
 - *How are teachers communicating feedback to their students concerning their learning; and what are students doing with this feedback?*

The Basics of Formative Assessment

Assessment is a common part of every classroom and teaching practice. Teachers assess their students to see what it is their students have already learned or are currently learning as a result of being in their class, and having received their instruction and taken part in their classroom activities and assignments. What assessment is used for, and when it is conducted, varies greatly among different teachers and in different educational settings.

There are two main types of assessment in the educational field, formative and summative. Wiliam and Black (1996) devoted an entire article in the *British Educational Research Journal* to exploring the meaning and consequences of formative and summative assessments. There are many different definitions of both, but the main idea put forth in educational research literature is that summative assessment is done in retrospect; it is a summation of what the student has learned at a particular point in time (Doig, 2006; Black & Wiliam, 1998; Wiliam & Black, 1996). An assessment becomes formative when the results of the assessment are used to inform or guide future teachings (Wiliam & Black, 1998). Formative assessment can be defined as a systematic process for continually gathering evidence on what is being learned while instruction is underway (Heritage & Niemi, 2006). The feedback gathered provides critical information regarding where the student is currently, in relation to where the teacher wants him/her to be in achieving a desired learning outcome or goal.

Since the onset of using these two terms for assessment, it has been stressed that the terms 'formative' and 'summative' be used to describe the functions they served, not the assessments themselves (Wiliam & Black, 1996). In a research study conducted by Vaden-Goad (2009), a college professor, he changed the role of assessments in his introductory mathematics courses to be formative instead of summative. He found that by changing the function of the assessment, there was an increase in the amount of information the students retained as well as an increase in their levels of motivation. In the following sections, as I review the literature on formative assessment, I will describe some effective formative assessment practices that have been identified as well as some of the common difficulties.

Teachers Effectively Using Formative Assessment

There are many things that teachers hope to realize about their students' learning, which can be achieved through formative assessment. The main components include: student performance, thinking and knowledge (underlying cognitive processes), learning potential, and affective domains such as motivation (Ginsburg, 2009). The ways in which teachers can gather this type of information is through observation, questioning, dialogue, as well as demonstration and written response (Heritage & Niemi, 2006). The transition from obtaining the information gathered from formative assessment to the actual implementation of an informed practice is very challenging for teachers (Dixon, 2009; Doig, 2006; Gearhart & Saxe, 2004; Heritage, 2007; Heritage et al., 2009; Watson, 2006; Wiliam & Black, 2004).

Formative assessment, as innovative informal assessment that guides teaching, has been found to correspond to significant learning gains for students, as Black and Wiliam (1998) found in their cornerstone literature review, "Inside the Black Box: Raising Standards Through Classroom Assessment." In their review, they also voiced concerns about how difficult it is for teachers to implement formative assessment and use gathered information to guide future teaching. Much educational research has been devoted to establishing guidelines for effectively using formative assessment. The main concern is that the teacher is able to establish where students currently are at, where they are going, and most importantly, how they are going to get there.

To find out where students are currently at in the landscape of learning, the teacher needs to be continually conducting informal and formal assessments. The classroom must be structured in a way such that, effective classroom discussions,

activities, and tasks allow the teacher to bring forth evidence about students learning (Allsopp et al., 2008; Heritage, 2007; Watson, 2006). Teachers need to create conditions in the class where students feel they are respected and valued, and that their ideas matter and are of importance; the classroom should be a connected community of learners (Heritage, 2007). In this type of environment students can be observed as they work in groups or individually, the teacher can reflect on meaningful written work they turn in such as an exit slip or quiz, and dialogues can take place between the teacher and student.

In order to figure out where students currently are in their learning, teachers need to be engaged in the process of ongoing gathering and interpreting evidence. Observing students while they are working, especially in groups, allows many opportunities for conducting formative assessments. These assessments can be made on-the-fly, where teachers are making inferences on student work in the moment, or as curriculum-embedded, which could take longer and be a reflection made after the lesson is completed (Heritage, 2007).

Another form of evidence that teachers can use to interpret current student understanding is analyzing the work that students produce. Student work can include homework, quizzes, exit slips, projects, and other types of artifacts where students convey their understanding. In order to use student work in a formative fashion, teachers must structure activities in such a way that make the students' thinking and level of understanding visible. Then, teachers must be able to accurately interpret this evidence of student knowledge (Heritage, 2007).

Meaningful conversations with students about their mathematical understanding is another way to elicit evidence. One form of dialoging with the student is the clinical

interview. An interview with the student about a particular mathematical content is designed to encompass the best features of a mathematical task and observations (Ginsburg, 2009). The clinical interview can lead to a great deal of knowledge about student thinking; it is a way to inform the teacher about what they know, how they are getting there, and what areas they are struggling with. Where it is often not feasible for a classroom teacher with large numbers of students to conduct clinical interviews, it is possible to conduct flexible student interviews, a process that was one of the four supported assessment practices that was detailed in an article on Mathematics Dynamic Assessment (Allsopp et al., 2008). The flexible interview allows teachers to gain deeper insights into students' mathematical thinking, in a more informal manner, and on a continual basis.

Just as important as determining where students are in their understanding is determining where they are going and what they have yet to learn. A prerequisite to using formative assessment is the teacher having a strong mathematical knowledge, not just of the math itself, but how students develop mathematical knowledge (Ginsburg, 2009). This is often referred to as pedagogical content knowledge (Shulman, 1986). Teachers need to be aware of the common student strategies as well as misconceptions. There are also three kinds of trajectories; normative information, cognitive trajectory, and trajectory of mathematical ideas (Ginsburg, 2009). Teachers must be aware of these trajectories because they need to be clear in their learning goals and objectives. Students need to have expectations clearly articulated and defined. Teachers need to be mindful of using precise mathematical language in a way that promotes clarity and understanding for their students (Heritage & Niemi, 2006). By clarifying, sharing, and creating a mutual

understanding of the learning goals and objectives, both teacher and students will have a clearer understanding of expectations in learning (Dixon, 2009; Hargreaves, Earl, & Schmidt, 2002).

For formative assessment to truly be informative, it needs to inform teaching practices. When a teacher conducts formative assessments, he/she is in a continual process of gathering evidence. What they do with the evidence is the important link in answering the question “how do we get them there?” With “there,” in reference to the teachers desired learning goal. Teachers need to infer the gap between students’ current learning and the desired instructional goal. Through this process a student’s emerging understandings and skills are identified so that ideas can be built upon, and the instruction can be modified, to better facilitate student growth and progress.

An example of a system that helps teachers structure, implement, and then use information gathered from formative assessment is Mathematics Dynamic Assessment (Allsopp et al., 2008). This informal mathematics assessment process ties together four research-supported techniques for assisting struggling learners: assessment of students’ interest and experiences; using concrete, representational, and abstract assessment within an authentic context; error pattern analysis; and flexible student interviews. The study showed that the teacher was able to gather valuable information using MDA which allowed her to group students, differentiate instruction, pace lessons appropriately, and decide on a starting point. She was also able to discover the ways students might learn best and the context in which to situate problems in order to make them accessible and meaningful for the students.

There are many ways for a teacher to establish where students are in the learning process. From there, educators need a clear understanding of how to progress students towards meeting the specified learning goals and targets. If there is care taken in the classroom climate that is created and maintained, lessons and student activities are meaningful and engaging, students thinking is made transparent, teachers are able to gather evidence of student thinking and accurately interpret it and then plan the next steps in closing the gap towards the desired learning goal, true formative assessment has occurred. The process of successfully using formative assessment is not limited to just the teacher, and in fact, there is much insight and furthering of learning to be achieved when the student also assumes the role of formative assessor.

Student as Formative Assessor

An important facet in formative assessment is feedback which is used to inform the learner. Students can assume the role of assessor when they critique their own work. Self-assessment is a type of formative assessment in which students reflect on the quality of their work, determine the degree to which it compares to explicitly stated goals and criteria, and then rework accordingly (Andrade & Valcheva, 2009). In this way, students are taking responsibility for their own learning. Research has shown that higher levels of student accountability and self-regulation are positively related to student learning rates and achievement levels (Brown, 2007; Schunk, 2003). Self-assessment impacts many things: the students' meta-cognition, their self-esteem, and their concept of self-efficacy (Hargreaves, Earl, & Schmidt, 2002; Schunk, 2003; Usher, 2009).

There are many reasons to have students self-assess, one of the primary being to boost learning and achievement. A review of literature on self-assessment and

mathematics presented by Andrade et. al (2009) showed that self-assessment for formative purposes was linked not only to an increase in mathematical achievement, but also to a more developed mathematical discourse, greater conceptual understanding, and an improvement in learner autonomy. Each of these outcomes is a desired goal for any teacher of mathematics students, regardless of student age or the content being covered.

Self-regulation is another important component of self-assessment. A study conducted recently in New Zealand of over 1,000 high school students found that there was a higher overall mathematics achievement found among students who believed that assessment makes them accountable for their learning and that it is a helpful tool for them (Brown & Hirschfield, 2007). The findings in this study were consistent with self-regulation theory which states that a student who controls their own learning, including taking responsibility and using feedback pro-actively, will experience greater levels of achievement (Schunk, 2003).

There are conditions, that when met, will help create a climate for more effective student self-assessment (Andrade & Valtcheva, 2009). Students of all ages are able to think reflectively about the quality of the work they do but often lack the necessary tools for organizing and framing these thoughts, as well how to use this information for refinement. How to self-assess is something that students can be explicitly taught to do. Teachers can provide direct instruction on self-assessment, its associated values, as well as model for the students what quality self-assessment looks like. By providing examples and clear criteria on which the students will base their assessment, students will have a much clearer idea of what they are doing, what is expected of them, and what a quality product will encompass. Students then must be provided opportunities to practice self-

assessing. The purpose of self-assessment is to inform and it should be used as an integral part of the revision process rather than the self-assigning of a grade on a summative piece. If the latter was the case, it loses its formative value. A great deal of thought, planning, and knowledge goes into effectively structuring and implementing formative assessment. Because of this, oftentimes teachers and students encounter many difficulties.

Common Difficulties

A review of the literature on assessment has shown a wealth of information on formative assessment in the mathematics classroom. A sizeable amount of this information is research that has shown the many difficulties associated with implementing formative assessment and using it for its fundamental purpose, which is both informative and guiding. There is no such thing as a quick fix in education and this has been proven through the numerous educational reforms and problems that continue to exist. The implementation and improvement of existing formative assessment practices takes time and serious attention.

One finding that emerged in multiple studies was the difficulty many teachers experience in using assessment information to plan subsequent instruction (Heritage et al., 2009; & Watson, 2006). One study utilized POWERSOURCE, a formative assessment strategy that, at the time, was being developed at the National Center for Research on Evaluation, Standards, and Student Testing (CRESST), at the University of California (Heritage et al., 2009). Teachers were asked to engage in three activities: interpret students' understanding of mathematical ideas, give feedback, and choose what they would do next in their instruction based on students' responses. A finding that

clearly emerged as the researchers analyzed their data was the difficulty teachers had in using student data to plan what they would do next in their instruction. This was an area of great difficulty as compared to interpreting student work, which proved to be less problematic. A suggestion for remedying this issue, put forth in the article, was a need for deeper content knowledge as well as a better understanding of the student learning process.

Another study also had similar findings to the Heritage study. The study done by Watson (2006) showed that teachers experienced difficulty in effectively using formative assessment to guide further teachings. This study followed two highly experienced teachers self-identified as practicing many of the necessary aspects of quality formative assessment. The study found that in both cases, the teachers lacked a strong connection between the use of formative assessment and then using the information from the assessment to gain an understanding of where students are and how to move them forward. The author suggested that a direction for improvement in using formative assessment would be extending teachers' questioning and tasks so that they were more focused on the development of conceptual understanding, as well as teaching students how to self-assess in terms of their mathematical understanding. One of the teachers in the study had students do a lot of self assessments, but these were more oriented toward the students' affective domain, in this case their feelings concerning the learning environment, rather than their abilities as mathematical learners.

In The King's-Medway-Oxfordshire Formative Assessment Project (KMOFAP), researchers assisted in developing formative assessment practices with the participating teachers in the study and helped guide them in the implementation phase (Black &

William, 1998). The majority of teachers were successful in raising student achievement. However, in four comparisons out of twelve mathematics teachers, the study yielded negative results. The authors' explanations ranged from the nature of the comparison groups to the lack of experience by teachers. Watson (2006) viewed this as raising the question of "whether there is something subject specific which makes adoption of formative strategies inadequate to raise achievement on its own." This relates to research which demonstrated a teacher's need for deep content knowledge, conceptual understanding, as well as pedagogical content knowledge (Ginsburg, 2009). Also important was the notion, previously discussed, that formative assessment itself does not result in specific instructional moves and that a teacher has to use his/her own 'intermediary inventive mind' to make specific decisions about the course of action he/she will take (Ginsburg, 2009).

Numerous comparative studies, summarized by Heritage et al. (2009), show a lack of teachers' depth of knowledge in teaching mathematics, as compared to other, high-performing countries, such as Japan. In these countries new teachers spend a great deal of time collaborating with other teachers to deeply explore and refine individual lessons. This process helps novice and experienced teachers develop a stronger sense of how students develop their understandings of specific mathematical content and how they as teachers will be able to prepare lessons around their understandings as well as respond to common misconceptions. This is the type of information that is critical in successfully implementing formative assessment where a teacher is gathering data about the student understanding to successfully move individual students and the class forward, towards the desired learning goals.

In many countries, including the United States, teachers have experienced great difficulties in effectively incorporating formative assessment into their teaching practices (Black & Wiliam, 1998). When formative assessment is identified as an area of concern or focus, it is often only labeled as such and no concrete guidance in the form of suggestions, strategies, or tools such as professional development are provided for teachers (Black & Wiliam, 1998; Hargreaves, Earl, & Schmidt, 2002; Heritage et al., 2009; Watson, 2006). Research studies that proved to be the most successful in moving teachers to effectively using formative assessment in their classroom were those that encompassed the following: practicing classroom teachers were provided access to information on formative assessment; a collegial network for support and feedback was in place to support and offer mentoring by education professionals trained in the area of formative assessment; and teachers had an authentic means to connect formative assessment to their existing practices and actual curriculum (Allsopp et. al, 2008; William & Black, 2004; Gearhart & Saxe, 2004; Dixon; 2009).

Assessments in mathematics, both formative and summative, play a critical role in measuring student learning. There has been a great amount of research around the topic of assessment, but it was not until the last two decades that the term formative assessment, or assessment for learning, came into being. Since that time there has been a shift in educational research from focusing solely on summative assessment to a more expansive look at assessments including formative assessments. This newer line of research examines not only the implementation of formative assessment in the classroom but also the effectiveness of formative assessments at guiding teachers in their next instructional moves. Current research on assessment works to identify common

difficulties teachers experience in using assessment data as well as positive examples of systems and support networks that have been developed to aid and assist teachers in using data formatively. This study will build on the most current research by taking an exploratory examination of one secondary classroom and how formative assessments are being used in that classroom. This study will also examine how the teacher and her students use that information to move toward their learning goals.

Methods and Analysis

Overview

This research project is a detailed exploration of the role formative assessment played in a secondary mathematics classroom. In this section of methods and analysis I discuss the setting of the study, including the selection of participants and general information about the teacher and students in the case study classroom. Also included is information about the data: the type of data that was collected, how it was collected, and for what purpose the information served in answering the research question. Following this I provide an analysis of the data, including logistics, and an anticipation of the findings. I conclude this section by describing limitations to this study and how they could have impacted the conclusions made.

Participant Selection

The mathematics teacher I chose to observe was someone who teaches at the same school that I do. Ms. Smith has been teaching mathematics at the same school for 12 years; her entire teaching career. Being a first year teacher, my hope was that in using an experienced teacher's classroom, I would be able to gain a deeper insight by observing, analyzing, and reflecting on a veteran teacher's practices.

The school's surrounding area is primarily rural, with a rapid increase in large suburban housing developments. The ethnic composition of the school is primarily Caucasian with smaller minorities of Hispanic, African American, and Native American students being represented as well. The percentage of students receiving free and reduced lunch is 38%. The school selected was primarily due to its ease in accessibility because this is where I teach. The specific class for the case study was chosen for two

reasons. First, I needed it to be during a period I do not already teach, and second, the teacher was interested in volunteering and she indicated that she had a high level of use and familiarity with formative assessment.

The chosen class, and the information I gathered from teacher and student observations, interviews, and surveys helped me to conduct the broader overarching goal of *exploring the role of formative assessment*, as well as answer the following questions:

- How are teachers using assessment, especially formative assessment, in their classroom?
- What are the beliefs of both teachers and students about assessment and its purpose?
- How are teachers communicating feedback to their students concerning their learning?
- What are students doing with this feedback?

Data Collection

Qualitative methods of data collection are used in research when attempting to provide an in-depth description of a specific program, practice, or setting (Mertens, 2010). In my study I use multiple forms of qualitative data including observations, interviews, and surveys, to paint a picture of the role of formative assessment in a particular classroom. This study is essentially a case study; an approach that involves an in-depth exploration of a single case. The case may be based on any number of units of analysis. In my study the unit is the individual classroom (Mertens, 2010).

Data collection will exist on multiple levels. I spent approximately 10 hours in the classroom in order to get a more accurate portrait of the role of formative assessments in

the classroom for both the teacher and her students. Visits began in the first two weeks of school and spanned a month long period. Observations lasted an hour, which included the passing time when students were coming into class, through the 50 to 55 minute class period, and then the passing time that followed as students were leaving. Observations took place in some cases on back to back days, and other times were on non-concurrent days. The goal of the observations was to observe the class in many different settings. Observing on different days of the week, observing back to back classes, as well as days in isolation, I was able to develop a well informed view of the classroom workings. The schedule of observations also required some flexibility in order to accommodate the school schedule, the individual teacher's schedule, and my own schedule.

Observations. While I observed in the classroom, attention was focused primarily on the teacher, her interactions with individual students, and the role of formative assessment in the classroom. I recorded observations of each class period in the form of field notes. In conducting observations it is important that one is mindful of the biases she/he holds, and makes a conscious effort to limit those biases and take a neutral stance when recording what is happening in the classroom (Henning, J., Stone, J., & Kelly, J., 2008; Mertens, 2010). In this study I took on the role of complete observer, and attempted to fade into the background so that I could take detailed notes of the students in the natural setting, making as little impact as possible (Mertens, 2010). To help focus my observations, I used multiple checklists to keep track of the use of various types of formative assessment, both planned and in-the-moment used by the teacher (See Appendix A). A checklist can be a helpful tool when attempting to keep track of specific targeted behaviors, such as the use of informative feedback (Henning et al., 2009). I also

recorded of the schedule for the class, in daily lesson plans and weekly schedules, as I looked for the scope of assignments and assessments, paying attention to situations where the teacher changed her plans to account for information gathered from formative assessments.

Surveys. Both the teacher and students took the same survey toward the beginning of the study concerning their perceptions about various aspects of formative assessment. See appendices B and D for both the original survey and survey results. The teacher and students took the same survey because it addressed how assessment relates to them and also how they conceive it relating to their teacher, both areas of interest in this study. The survey that I used was created by selecting from a larger pool of questions found on a survey that was part of a doctoral dissertation focusing on teachers' conceptions of assessment (Brown, 2002). The COA-III, as this assessment was named, is based on four main conceptions of assessment: school accountability, student accountability, improvement, and irrelevance (unimportance).

Another source of information for the survey I created for this study was a later research study, co-conducted by the same author that focused on students' conceptions of assessment instead of teachers' conceptions (Brown & Hirschfield, 2007). I drew from both of these sources in creating my surveys to administer to teachers and students.

The survey took approximately 15 minutes. I conducted the survey by reading each question to the students aloud as they filled them out one question at a time. I did this in the hopes of getting accurate information, versus a rushed response or the students hurrying through it. While I administered the student surveys in the classroom the teacher left and took the same survey in another location. Surveys can be an effective

tool for quickly and easily getting a sizeable amount of information in a non-threatening way (Mertens, 2010). However, surveys do not always paint a full picture; they do not allow in-depth information from respondents; and their wording can sometimes bias the way a person responds (Mertens, 2010). The survey questions I drew from in creating the survey for this study had already been tested and revised by multiple sources; questions that caused negative error variance by being overly-correlated with each other or which had low loading on their intended factors had already been removed (Brown, 2002).

Interviews. I conducted both teacher and student interviews. The interviews provided a space for individually dialoging with teachers and students about their beliefs concerning assessment (especially formative) and its purpose. See appendix C for a full list of interview questions. Using interviews I was able to explore more deeply their underlying thoughts and conceptions. The interview questions allowed some freedom for the participants to explain their ideas and served as a springboard into further sharing of related ideas. Interviews allow a researcher to more fully understand the individuals' experiences and explain answers to a survey in more details (Mertens, 2010). I made sure that the teacher and students had previously completed the survey, so that I could have that information from the surveys available at the time of the interview.

I conducted one formal interview with the teacher at the end of the study, after she had completed the survey. Additionally, we engaged in many informal conversations throughout the study, which I recorded later in my daily field notes. Student interviews took place toward the end of the study, after they had taken the survey. The two students interviewed were selected from a larger list of those that had volunteered. The aim was

to interview two students that differed in their concepts of assessment, as determined by the previous survey; one with a high view of assessment, one with a neutral view, and one with a low view.

Process for Data Analysis

As is the nature of qualitative study design, there was a great amount of data to analyze. The goal of this study was to develop a clearer sense of the role formative assessment plays in the classroom and the related teacher and student experiences. I used multiple sources of data to triangulate my initial findings. Triangulation is necessary in qualitative data analysis. By using multiple sources and methods of data collection, and then cross checking gathered information, the researcher can check for consistency in evidence and establish greater credibility of associated findings (Mertens, 2010). The data collected through the field notes and checklists was compiled and analyzed for emerging patterns or themes in the use of formative assessment. These themes were written up in a few summarizing paragraphs to highlight the important information that came about in answering the original guiding research questions. Situations and examples selected for inclusion in the findings section of the paper are mentioned or used directly as an excerpt, to highlight an important finding. Data from the interviews were analyzed, looking for recurring themes that were later coded. The survey data was analyzed according to the scheme developed by Brown (2002). The responses by students were analyzed on an individual basis as well as looking at a class average. The teacher responses were also analyzed and then comparisons were made between the teacher and students results, looking for either a connection or disconnect between

conceptions of assessments in the classroom. In total, the multiple forms of data were analyzed and compared by looking for emerging ideas, themes, commonalities and differences.

Limitations of this Research Study

A short duration, individual case study, with one author has many limitations compared to a larger scale study with many researchers. Nonetheless, the smaller explorative case study, such as the one I conducted, still contains a wealth of information to be gained concerning teaching practices, classroom interactions, and student learning. Videotaping was not used to aid in observations, yielding less detailed descriptions of the occurrences in the class. The student interviews only examined a total of two students; therefore there are many other students whose view points might not have been expressed. The teacher and the individual class that was chosen for this study had to meet certain designated criteria, but the school from which they were selected was chosen out of convenience. Time spent in the classrooms was limited due to the scope of the project, so the picture depicted of the classroom was only based on the specific time I was there and may not be as clear or accurate a picture as it could have been if I was there observing every day and for a longer duration of the school year.

The purpose of this study is explorative in nature, and my exploration of these classrooms and formative assessment, is restricted. It is limited by the time I was present in the classrooms, what I was able to be attentive to during the course of my observations, and the amount of students that shared their thoughts and perceptions through the interview. These limitations could impact the results of the study by showing a more

narrow view of the actual classroom learning environment and perceptions held by the entire class.

Findings

This study took an exploratory view of formative assessment's role in one ninth grade algebra classroom. I was specifically interested in: the teacher's use of formative assessment, beliefs the teacher and students held about assessment, and the feedback process concerning student learning. The aim of this study was to use multiple forms of data, collected via observations, surveys, and interviews, to gain a clearer understanding of formative assessment and its many complexities in classroom use and implementation.

In the section following I will provide some further background information by summarizing the teacher, students, and class in which the study took place in. I will also set the stage by providing some insight into recent district changes and new policy and program adoptions. Finally, I will present data aimed to answer the three main sub questions of the study:

- *How are teachers using assessment, especially formative assessment in their classroom?*
- *What are both teachers and students beliefs about assessment and its purpose?*
- *How are teachers communicating to their students' feedback concerning their learning; and what are students doing with this feedback?*

The study gave way to three major findings. First, the teacher demonstrated strength in her ability to gather formative information. Second, there exists a strong connection between assessment and personal relevance. And third, lack of time was a major roadblock for truly meaningful formative assessment for all students. These findings will be addressed in detail, drawing from and intertwining three different data sources: observations, surveys, and interviews.

School Context and Participants

I am a first year mathematics teacher, and new to the district and school. I conducted this study with a fellow teacher at my school that was interested in the topic of my study, and was suggested by her peers as a good teacher to observe. She has taught at this middle school her entire career, over a decade. Ninth grade algebra, where this study took place, is a course that has been included in her teaching schedule every year and she feels very comfortable and familiar with the material. This algebra class was smaller than the rest of her classes, having only 24 students. Most of her other classes have an enrollment around 30-35. The school tracks students by standardized tests and teacher recommendation, placing them into either remedial (below grade level), benchmark (at grade level), or advanced courses (above grade level). The class I observed included all "benchmark" ninth grade students, with a mixed range of abilities.

The classroom where this study took place is in a small rural school district that housed six elementary schools, two middle schools and one high school. The district has experienced a rapid student growth in the last two decades due to economic growth and close proximity to the local Army/Air Force base. The middle school in which this study took place was the original junior high, and it draws from a surrounding area that is of a lower economic level than the newer junior high that was built in a new housing development.

In the last decade, the district has experienced an extremely large influx of military families. Because of the district's high number of military families, and its failure to meet their Annual Yearly Progress (AYP), the district was eligible to apply for a grant from the Department of Defense. Two math teachers, one from each of the middle

schools, applied for a grant from DoDEA (Department of Defense Education Activity).

The grant application was titled, "Assisting military students struggling with mathematics: Response to intervention for Middle School." The district was awarded the three year grant which began in the summer of 2010 and will finish in the year 2013. The DoDEA Grant Program includes a rigorous evaluation process that focuses on accountability of funds and measuring and tracking student performance outcomes.

A few of the primary goals of the grant directly relate to assessment, the topic of my study. One of the goals is for teachers to come together across the district and create common mathematics unit plans, as well as formative and summative assessments. Also, a major priority is for teachers to regularly monitor student progress and determine each student's mastery of essential learning. Through the grant, math teachers in the district are given approximately one to two days a month of collaborative professional development where they meet to work on the creation and implementation of the grant goals.

It is important to note that it was the recent changes in the student and community population, as well as the districts' failure to meet AYP that made the school able to apply for the grant. The receiving of the grant's funds, newly purchased resources, such as differentiated curriculum, and the time made available for professional development, had become available to the mathematics teachers of this district just prior to the onset of this study.

Finding 1: The teacher demonstrated strength in her ability to gather formative information

One of the main driving questions of this study was to determine Ms. Smith's familiarity with formative assessment, and more importantly, how or if, she was using it in her classroom. Through my observations in this ninth grade algebra class I had the opportunity to witness approximately 500 minutes of classroom teaching and interactions in the classroom. At the end of my observation period, I conducted a semi-formal interview with two students and the teacher. The observations and interviews provided the most relevant data and supporting evidence. I also gave a 30 question Assessment Perception survey to both the teacher and students. The survey data provided additional supporting evidence for the way in which the teacher implemented and used assessments formatively.

In looking for evidence of formative and summative assessment in the classroom, I had constructed a lengthy list of different types of formative and summative assessments to aid in my observations and detections of when they were put into action by the teacher. As an intent observer, I took detailed field notes of classroom interactions, paying particular attention to instances of assessment. After the observations, I looked back at the field notes, marking off my checklist of formative and summative assessment instances. I also employed a memoing technique, which allowed me to create a more focused outline of the observed time period (Henning et al. 2009).

I observed the class for a time spanning approximately a month, and in this time, I saw only a few instances of summative assessments. I saw one summative assessment given in the form of a chapter tests. In keeping track of the classes' daily agenda on the

whiteboard, I noted one additional test that took place during my observation period, which I did not witness. I did have the chance to observe the class doing the test corrections for the exam I missed.

In my study I was more concerned with formative assessment. This type of assessment is very specific in its use; it is to be given and used with the aim of collecting evidence on student understandings and misconceptions to guide further instruction and teaching. Various types of formative assessments, in the form of quizzes, homework assignments, group projects, questioning and conversations, exit slips, and check-ins, took place many times throughout the course of my observations. Although it would be helpful to see an average number of instances per class that formative assessment occurred, that would be very difficult to do without using a video recorder and a teacher microphone, which would be necessary to capture all teacher interactions. Every time the teacher spoke to an individual student about their progress on a problem, circulating around the room, speaking to many different students, that could be viewed as formative assessment because evidence of their learning is being collected. Instead, my aim of this study was to see how the teacher was using formative assessment. During this study I was able to see that she was not only using formative assessments, but multiple types of formative assessment and they were employed at multiple times during each class period I observed. Below is a selection of the formative assessments I witnessed while conducting my observations. Although it isn't exhaustive, the selection of assessments are representative of Ms. Smith's extensive knowledge of formative assessment as well as her earnest attempt at including and using multiple types of formative assessment in her class.

Ms. Smith had an impressive ability to gather information on student understanding via questioning. She questioned students frequently throughout the class period, asking many different students probing questions. She would not come out and tell them the answer or what they did wrong but instead questioned them to get further clarification and assist the students in figuring out their own mistakes and misconceptions. Her questioning techniques not only helped inform her of their understanding but also helped inform the student, as I discovered through the student survey data and responses during the interview process. Becoming more aware of one's own level of understanding is important in developing the student self-regulation skills (Brown, 2007; Schunk, 2003). She questioned with ease, moving from one student to another, having them build off of each others ideas. Often times I witnessed her make a half a dozen students ideas visible, off of one warm-up problem. These starter activities took place at the beginning of each class and lasted approximately ten to fifteen minutes; allowing many opportunities for Ms. Smith to circulate around the room, at times, talking to almost every student in class either during individual work time or during the whole class discussion that followed.

Ms. Smith also had students frequently taking short quizzes. The quizzes were formative in that they addressed concepts the students had just practiced, giving both Ms. Smith and her students a better idea about their understanding of the material, and any misconceptions they might still be. The quizzes also served as an indicator for the teacher of when her students would be ready for the summative assessment or if she needed to re-teach or take a different approach with the material. She would grade the quizzes, but without the giving away the correct answer. This allowed Ms. Smith to

facilitate small group activities where the students got into groups to help each other figure out and correct their mistakes, as well as share their correct work and teach their peers. This provided another opportunity for her to circulate freely around the room and use her high-level questioning techniques to small-groups and individual students, gathering more evidence of their learning and understanding, probing deeper, eliciting their thoughts, ideas, and hopefully making visible misconceptions that need to be further explored and eventually corrected.

Homework grading was another opportunity for assessments to be formative for both the teacher and the student. During my observations I noted the students filling out a homework grading rubric (see figure 1). During the teacher and student interviews I asked about this rubric and its purpose. Ms. Smith told me that the rubric she provides for the students to grade their homework allows a student to assess themselves in two different but equally important categories, effort and achievement. She shared with me, “I will always use these. I think it is important to have the students reflecting on both the aspects of effort and achievement truthfully, and that the sheets make it more meaningful for them and all of the homework papers more manageable for me. I think that it is important for them to be continually self-assessing and be lifelong learners.”

Figure 3.1

Homework Scoring Rubric Name: Date:			Score: /8 Assignment: Purpose:	
	4	3	2	1
effort	I worked until completed. I pushed myself even when it was difficult. I showed ALL OF MY WORK.	I worked on the task until completed but skipped over some difficult parts. I SHOWED ALL WORK.	I put some effort it, but stopped when it became difficult. OR I finished, but only showed some work.	I put in very little effort
achievement	I exceeded the objectives of the lesson (more than 80% correct).	I met the objectives of the lesson (about 70-80% correct).	I met a few of the objectives of the lesson, but not all (50-70% correct).	I did not meet the objectives of the lesson (I missed more than half).

Another example of how the quizzes were used formatively was when I saw the teacher have the class do a mandatory in-class retake of a quiz. I asked her why it was mandatory, because I knew it was normally an option for the students and was to be done on their own time. In response she made the following remark, “This is really important material, foundational stuff they need to know how to do in order to move on. Their first quizzes showed that a lot of students were not getting it. I need to know that the re-teaching and additional practice has made an impact, and that they now are getting it.” In this case it was evident that the information she had gotten from the quiz was being used formatively to guide her further teachings, and even further assessments. One of the students I interviewed made reference to Ms. Smith’s quizzing and testing policies, by stating that “if we don’t seem to be getting it, and that we all bomb a quiz, we won’t

move on, we will go back and review. The quizzes show her and us if we can move on or not.” The same held true for their summative assessments. One day I noticed a note on the board indicating that the Chapter Test had been pushed back. When I asked Ms. Smith about it she said that they “needed more time to really master the material before I will test them on it.”

Each of the selected instances above shows that Ms. Smith was keenly aware of formative assessment and its vital importance in guiding instruction. She used other types of assessments as well as those detailed above. Additional examples of formative assessments she used regularly included check-ins at the beginning, during, and at end of class via self scorings, thumb-indicators, group work, and exit slips. All are good examples of formative assessment, but it was her superb questioning techniques that elicited the most valuable information from the students on a daily basis and guided her subsequent teachings.

Observations and interviews served as the main sources of information and support for the finding that the teacher regularly implemented and used formative assessment and that she was best able to gather formative information through her high level questioning techniques. The surveying process elicited further supporting evidence. The survey contained 30 different statements about assessment, which the students and teacher ranked from 1, which is strongly disagree, to a 4, which is strongly agree. The students’ responses to each question on the surveys were totaled and then an average was calculated for the classes’ response to each question. This data was compared to Ms. Smith’s response to the same questions on one master survey so that it would be easy to identify where their responses were similar and where they differed.

A portion of the survey questions directly related to the question of how assessments were being used in the classroom. I wanted to better understand how the entire class felt about Ms. Smith's use of formative assessment in the classroom. The survey allowed me to obtain information from all students in the class on many different aspects of assessment in the class. The results of the survey showed that Ms. Smith and the students had similar responses on many of the survey questions. The similar scores indicated a shared perception of assessment for both teacher and students in many areas. Some of the responses where they scored the same included assessment as: impacting the way that a teacher teaches, not an interference of teaching, the teacher is not filing away and ignoring their results, a way to determine how much students have learned, a measure of student learning against a set criteria, and providing feedback to students about their performance. The results of the Assessment Perception Survey helped provide more support for the finding that Ms. Smith was aware of and implementing formative assessments to determine what the students were learning and then providing meaningful feedback.

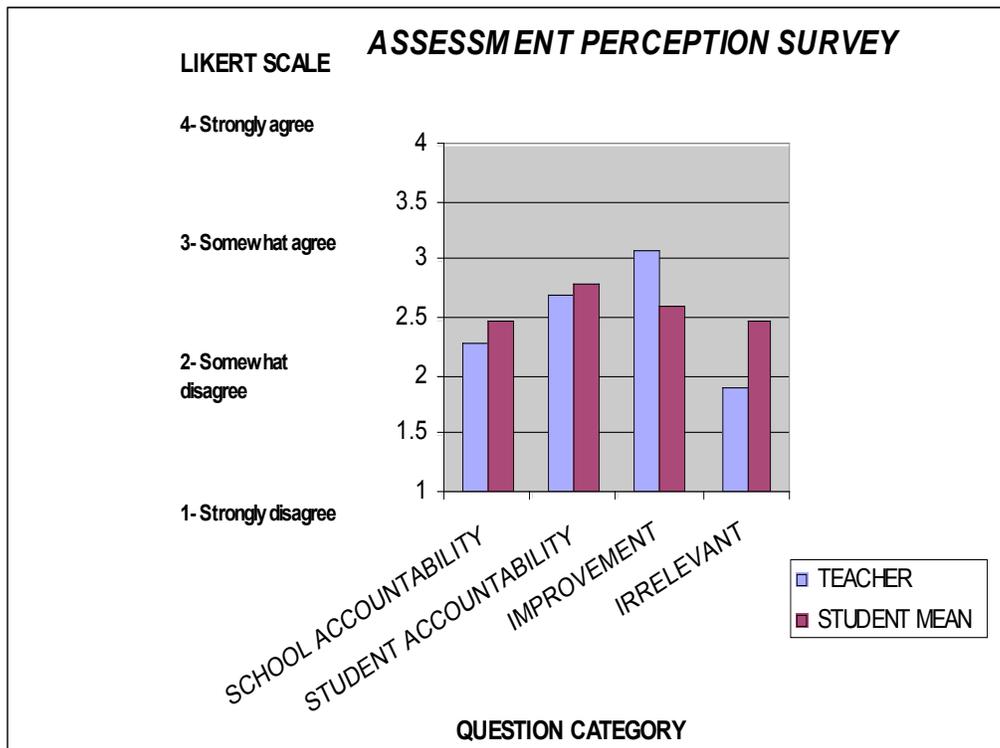
Finding 2: The connections between beliefs about assessment and relevance

Beliefs were an important area of focus for my study. I wanted to know how the teacher and students in the class viewed assessment. Their perceptions would reveal to me their underlying feelings and attitudes about assessment. Through multiple avenues of data collection I was able to draw out information about their beliefs. The observations yielded the least information, whereas the survey information was more informative, but not too elaborate. Surveying proved to be a quick and efficient way to get responses from all students in the class and the teacher on many different aspects of

assessment. It also served as a tool for selecting the two students I interviewed. The interviews gave the most detailed and in-depth information.

Survey questions were based on four main categories, or different viewpoints on purpose of assessment. These include a view that assessment is for: school accountability, student accountability, improvement, or that it is irrelevant. I decided to use these four categories because I thought they would best break down the information I was trying to determine about perceptions and assessment. In looking through past research, these categories, or a modification of them, were used in similar research studies (Brown, 2002; Brown & Hirschfield, 2007). The four point Likert scale allowed me to see how individual students, the class as a whole, and the teacher felt about the purpose of assessment, as determined by their level of agreement to different categories of questions.

Figure 3.2



The results from the survey indicate that the teacher and students had similar responses for each of the four categories, much closer than I thought at the onset of the study. This leads me to believe that Ms. Smith shares her views on assessment and its purpose, making it apparent for the students. This finding held true to what I observed during classroom interactions, both small and whole class conversations and discussions. It is also consistent with teacher and student responses during the interviews. If there had been an extreme difference in the answers of the students and Ms. Smith, it would have led me to believe there was a greater disconnect in the classroom between teacher, student, and expectations.

The Likert scale was 1 through 4, with 1 being strongly disagree, 2 somewhat disagree, 3 somewhat agree, and 4 strongly agree. In calculating the student averages often the averages came close to 2.5, which on a four point Likert scale is situated directly in the middle of somewhat disagreeing and somewhat agreeing, indicating a neutral response. These scores were not a result of averaging multiple scores of 1's and 4's, (of which there were relatively few, a combined 215 out of 660 responses; just 32 %). Rather their responses were more closely situated around an equal amount of 2's and 3's. These scores made it difficult to detect the students' feelings towards assessment other than it was neutral. Had the results leaned more strongly towards one end of the agreement scale it would have shown that they had stronger feelings towards assessment, positive or negative. To break down each of the four categories, the results were: school accountability, 2.3 for the teacher and 2.5 for students; student accountability 2.7 for teacher and 2.8 for students; improvement 3.1 for teacher and 2.63 for students, and irrelevance 1.9 for teacher and 2.5 for students.

The two areas that showed the greatest differences were views on assessment as improving and assessment as irrelevant. When taking the averages the teacher somewhat agreed that assessments are valid and serve a purpose of improvement for teachers and the students. The students, with a score of 2.6 leaned more towards neutral. The categories of Improvement and Irrelevance are negatively correlated, as determined by the previous research where this survey was used in a very large scale with over a thousand respondents, and proved true in this study as well. The higher the score one gave assessment for the purposes of improvement, the lower the score they assigned assessment as being irrelevant. The students gave the irrelevant category a 2.5, again showing more neutral feelings, where the teacher gave it a score of 1.9 falling just on the edge of strong disagreement and somewhat disagree. These two negatively correlated categories would help me later in determining which students would be interviewed.

The individual student survey responses provided a great deal of information from each student on a variety of questions about their perceptions of assessment. In conducting my interviews I wanted to select one student with a high view of assessment and one with a low view of assessment. This was determined by student's scores on the categories of assessment as improving and assessments as irrelevant. I selected students in this way because I was interested in seeing if they answered the interview question the same as they did the survey, and more importantly, uncover what might have led to these differences in views of assessments.

The interviews with the two selected students gave an opportunity to ask more detailed questions relating to the topics addressed in the survey. The student interviews revealed more about their feelings about being assessed and their perceptions of its

purpose. The student with the low view of assessment, Sam, did not talk as much and had a more difficult time sharing his thoughts. The student with a high view of assessment, Sara, spoke in more detail and was able to share her thoughts with more ease.

When interviewing Sam he shared that “a test or quiz tells the teacher and us what we have learned or what we need to learn more of.” He followed this up to say that when he gets back an assessment he will look at it to see how he did, but “I look at the points first and then usually just recycle it.” The student didn’t express opinions of a strong dislike or aversion toward assessments; he had more of an ambivalent tone, and really didn’t have a lot to say. Sam’s survey data showed a low score in both student accountability and improvement. As would be expected, his score, conversely, was high in the area of assessment being irrelevant, under the categories of assessment being bad, inaccurate, or ignored.

When asked about the student, Ms. Smith said that Sam is normally quiet in class, does not participate much in discussions, and gives very short responses when called on in class or when she asks him questions in one-on-one or small group settings. He is not consistent with turning in his work and as Ms. Smith put it “does just enough to get by.” It was difficult interviewing a student that did not give lengthy responses to the set interview questions. I had to extend the questions and do much probing to try and elicit his thinking and ideas, which was still very limited even with my rewording, rephrasing, and extending questions. This difficulty I had in interviewing the student mirrored what the teacher said about Sam and might shed further light on how difficult it would be to gather formative data on students like Sam when as a teacher, the best strategy you possess for formatively assessing, is questioning and dialogue.

The interview with Sara was much more detailed. Instead of having to probe to get my set questions answered, Sara took the lead, speaking comfortably and at length in her responses to my questions. When asked, Ms. Smith told me that Sara is very comfortable in conversing with her when she goes around to help and ask students questions, which is also what I noted during my classroom observations. Also, Ms. Smith held the view that Sara was a hard worker in her class.

In my questioning of Sara I ended up very focused on her views of assessment because I was able to get such detailed responses. Sara voiced an opinion that assessments “show you how far you, if you are getting it or not.” Also, she added that assessments tell you, “if or what you need to review to get it better.” Sara felt that assessments serve the same purpose for the teacher, they are an indicator of if the students are “getting it or not.” She followed up to say that, “I don’t whine like some of the kids do when it is time to take a test or quiz, I am used to taking tests. Even if I am on the line, or really close, I always come through and pass them.” These comments indicate a strong sense of accountability and self-regulation.

An important fact that struck me during our interview was the student’s comfort level with being assessed. Sara told me in detail about her familiarity with the testing process outside of school. The student shared that she experiences testing regularly in two different activities outside of school. For many years she has been participating in horse riding and karate, two activities that test at frequent intervals for mastery before the participant can move on to the next level of difficulty. She recounted recent tests she had needed to pass to progress forward, and how important that it was for her to take it seriously so she could move on. It is a noteworthy finding that the student who had a

high view of assessment and a low opinion of it being irrelevant, had a strong personal connection to testing in her life outside of school. Also important is Sara's ability to make the connection between assessing and its importance both in and out of school. These experiences, it appears, have probably shaped her views and attitudes about assessment in math and school in general.

The student interviews yielded much more telling data than the surveys and gave a richer insight into students on both ends of the assessment perceptions spectrum. The interview process allowed further exploration of their views of assessment and its relevance. It was made apparent that for one student interviewed, Sara, a strong sense of personal relevance made assessments much more meaningful and impacting. It would have been interesting to have interviewed Sara first, which would have sparked me to ask Sam more probing questions concerning his experiences with assessment outside of school, seeing if there existed a lack of connection to assessment and his world outside of school.

A major area of interest in this study was developing a clearer understanding of Ms. Smith and her students' beliefs about assessment. The survey, as compared to the interviews, did not provide detailed information on such a complex idea; it did however, provide a way to compare the teacher and all students' responses on identical questions. The close alignment in scores of Ms. Smith and the class average showed a closer sharing of perceptions of assessment than I would have originally predicted. This shared perception could indicate that she is making apparent her goals in assessing them. The interviews with Ms. Smith and two students allowed the most freedom for personal response and detailed thoughts on their experiences and beliefs. Sam and Sara, existing

on opposite ends of the spectrum in their views of assessment, made apparent their beliefs about assessment and its meaning (or lack of meaning) in their lives, and a connection to relevance in determining assessments importance.

Finding 3: Time is a major roadblock to providing truly meaningful formative assessment for all students

A great deal of research shows that teachers have the most difficulty not with implementing formative types of assessment, but actually using that information to guide subsequent teachings (Dixon, 2009; Doig, 2006; Gearhart & Saxe, 2004, Heritage, 2007, Heritage et al., 2009; Watson, 2006, Wiliam & Black, 2004). In this study I witnessed many instances in each observation where the teacher used formative assessments to guide her instruction. However, there were also instances in each observation where I witnessed missed opportunities to use student evidence formatively.

Feedback is a major component of sharing with students the information gathered from formative assessments. As witnessed in my observations, and supported by student comments during the interview, Ms. Smith gave the students consistent, informative feedback concerning their understanding and progress. I did however, on multiple occasions, notice the teacher spending a majority of her time interacting with just one student. Because of this she missed the chance to see how others were doing as well as missing seeing many hands that were being raised, leaving questions unanswered, and possibly did not get an accurate view of the majority's understanding.

Another area of formative assessment not being used to its full potential was the whole group questioning tactic. During one observation, I witnessed Ms. Smith going over the answers to the homework. She then asked the class, "Does anyone have any

questions about the homework?” and no one responded. The class then moved on to the next activity. The lack of response is not very accurate in indicating if they understood the material or not, thereby missing an opportunity to get an accurate understanding of how students are doing. One other instance of formative assessments and feedback being possibly misread or overlooked would be Ms. Smith’s use of the thumbs indicator. This is a check in with students where they can show the teacher a thumb up, sideways, or down to indicate their level of comfort or understanding of a topic. At times, it looked as though Ms. Smith was really taking note of what the students were indicating. However, on one instance, and possibly indicative of others, after the teacher asked for a check in with thumbs, I noted in my observation notes that she barely looked up. The students had given a mixture of responses, and I wondered if she had just asked out of habit. I was not sure if she could have even seen the responses the student had given because she looked up so quickly. After a quick glance Ms. Smith quickly moved on to the next item on the agenda.

The teacher interview was very helpful in that it allowed me to ask the teacher more specific questions about her beliefs about assessment, its purpose and functions, and to bring up the previously noted specific instances where the formative assessments were not being used to their full potential. The interview also provided the time and space for her to step out of the question and include additional thoughts and concerns she has about assessment.

Ms. Smith stated that “formative assessment is to inform me of students’ understanding so that I can make better decisions about the next instruction. It is also to inform students about their understanding so that they can identify and strengthen their

weaknesses.” Worth noting is that fact that the day the interview was conducted the entire math department had been taking part in a DoDea grant activity and that the focus of the agenda was talking about the differences in and importance of the various types of formative and summative assessments. They spent the remainder of their time developing common assessments and figuring out how they would use those to measure student understanding, and figure out how to re-teach if the material was not understood by students.

When asked how assessments, specifically formative, guided her teaching practices she recounted that “I know we want to reach all kids, but it isn’t always practical, there is not enough time to do that, and some kids really lack putting forth effort.” She shares that in her larger classes, it is even more difficult to get around to so many students. She tells me of a system that she uses to gauge when to move on or how she can tell if the class is getting it and is ready for the summative assessment or to move on.

“A lot of times you are going to have a gauge in class, like your average kid that does the homework and tries, not the kid that always gets it every time no matter what you are teaching, or the ones that aren’t trying and don’t usually get it. That average kid that puts forth the effort is the one that tells me when we need to go back and re-teach. This serves as my red flag, if they aren’t getting it then we need to go back and do something different or spend extra time. It is more practical, and works in the moment to use this gauge, rather than analyzing a bunch of papers.”

As for the thumb indicator that was mentioned earlier, she says that “ it is helpful to make a quick scan, but the quiet people are sometimes afraid to voice their concerns, and will say they are fine, even if they don’t really get it and are struggling.” The concerns she voiced, coincided with what I viewed and wondered about during my observations. When I tell Ms. Smith that the research I have read indicates that teachers have a difficult time really connecting their assessments to guiding their subsequent teachings, or the next move, she voices a few major things that stand in her way of making that happen, “too many students, the crunch for time, and the pressure to get so many things taught in the course of a year.” These difficulties she shared, especially a lack of time, are a concern for many teachers and came up many times in the research as being an impeding factor.

The major findings that emerged from this study and the original guiding questions helped to develop a clearer sense of formative assessment and its role and purpose for both the teacher and students. In this study, I found that Ms. Smith displayed many formative assessment strategies in her teaching practice yet struggled with fully utilizing these strategies due to certain constraints, particularly a lack of time. The students in Ms. Smith’s classroom held beliefs about assessment that mostly aligned with the teacher’s beliefs. However, the two students I interviewed held differing beliefs regarding their views about the relevance of assessments. The major findings that emerged from this study and the original guiding questions helped to develop a clearer sense of the role of formative assessment in this mathematics classroom.

Conclusion

Relating findings from this study to current research

Throughout the course of this action research project I explored the role of formative assessment in one secondary mathematics classroom. Because the aim of this study was exploratory in nature, there were many aspects of assessment, especially formative assessment that I was looking at in this classroom.

There has been a tremendous amount of research conducted in the area of formative assessment. Earlier research focused on defining formative assessments and making clear the distinctions between the roles of formative and summative assessments (William & Black, 1996). In more recent literature the focus has shifted to the implementation and effectiveness of teachers' use of formative assessment (Dixon & Haigh, 2009; Doing, 2006/ Gearhart & Saxe, 2004; Heritage, 2007; Watson, 2006). The research revealed a shared difficulty for teachers to effectively use formative data to guide their subsequent teaching and move students forward in their learning.

My study looked at the types of assessments, formative and summative, that were being used and their frequency. However, the focus of my study was to build on the current research of teachers' effectiveness at eliciting and using formative information to guide their teachings. Prior research found this to be an area teachers' have the most difficulty with concerning assessment. Teachers were able to collect formative information in a variety of ways, but struggled in what to do with this information, and how it would change their lessons in the moment and subsequent lesson planning. In my study I wanted to look more closely at one teacher, Ms. Smith, and see how she elicited formative information and what difficulties or successes she had with using that data.

Through analyzing my data I found that formative assessment to guide future instruction was also a challenging process for Ms. Smith. Although difficult, with foresight, planning, and practice Ms. Smith was able to successfully gather and use formative data; which I witnessed on multiple occasions per classroom observation. A major difficulty of formative assessment, identified during my observations and also acknowledged by Ms. Smith, was time and resources. Large class sizes and an increased amount of material to cover, left her with just too little time and too much to do. She was not able to get around to everybody, giving the attention that was possible in smaller classes.

Prior research has targeted another difficulty associated with formative assessment; a lack of pedagogical content knowledge (Ginsburg, 2009). A lack of PCK can be characterized by a deficit in the ability to skillfully move students through the terrain of concepts, deciphering their misconceptions, and figuring out where individual students are in the landscape of learning. While this process can be difficult to detect, during my observations I witnessed many of the teacher's interactions with individual students and the entire class. During these interactions I was able to see how Ms. Smith collected important formative data and then used that data to change her teaching in the moment as well as alter future instruction later in the period and for subsequent days. Often times, it was Ms. Smith's high-level questioning techniques that allowed her to elicit such rich formative data. Her dialoguing with students, in many different settings, led to changes in the classes' schedule, re-teaching, sharing of student work, and group assessment activities.

During the teacher interview, Ms. Smith made apparent her familiarity with the content, and the common misconceptions students often had in the unit they were studying during my research. After teaching the same subject for over a decade, she was very comfortable with the content, knowing where students would have difficulties, and developing strategies for making their misconceptions visible. She used their mistakes as an opportunity for learning and growth, not only for a particular student, but also for the whole class. In my observations Ms. Smith displayed a strong pedagogical content knowledge and ability to collect as well as use data for formative purposes.

Implications of findings and their relevance to future educational practices

As a new teacher observing a colleague and veteran teacher in my content area, secondary mathematics, I am able to take away a great deal from the findings of this study and apply it to my teaching practices. Formative assessment is a difficult area of pedagogy for any teacher to be truly proficient. What I hoped to gain from this experience is a richer sense of formative assessment and its role in the mathematics classroom. I wanted to know: what kind of assessments the teacher was using, how they were being used, and what was being done with the results. Also of interest was the way in which students received feedback from the teacher and how that feedback impacted them. Lastly, I wanted to get down to a more personal level and see if I could find out more about how Ms. Smith and her students felt about assessment and its purpose.

Through data analysis, I came to three major findings, answering the guiding questions set out at the beginning of the study. The major findings of the study were: the teacher's developed ability in gathering formative data, the strong connection between

assessment and personal relevance for the students in the classroom as well as Ms. Smith?, and time as impeding truly meaningful formative assessment for all students.

In my future classroom practices I will focus on building my repertoire of formative assessments as well as improving the way that I use the data I gather. For formative assessments to be truly formative, they need to guide subsequent teachings, which often times alters the course of the lesson in that moment. I was able to observe some excellent examples of how this can be done. Throughout the course of many class periods I saw how the teacher's techniques could assist the entire class in moving forward according to their needs.

Some of the best examples that I observed were warm-up activities with high level probing questions, small group work with questioning from the teacher and students, quizzing followed by re-teaching opportunities, and self-assessment strategies for homework grading. In my own practice I will work to incorporate more of these formative assessments.

I also observed instances of missed opportunities to gather formative data that struck a chord with my own practice. Being an observer I was given a new lens to watch teaching and classroom interactions. One conclusion I came to is that I am going to avoid asking whole group questions. Whole class questions could include statements such as, "Did everyone get it?" or "Does anyone have any questions?" These types of almost rhetorical questions do not allow the right kind of opportunity to share formative information because students could be afraid to voice their concerns if they are in doubt, and not everyone will choose to participate. Instead, an exit slip at the end of class with a prompt about their learning or struggles during that day's work would be more accurate

data and allow everyone to respond. A whole class discussion about a topic of concern, where students are selected at random, could be used instead. This type of activity does require that the classroom is a safe place where students feel okay in making a mistake. Or, perhaps a question highlighting the learned skill could be asked immediately following, and then students could respond on an individual whiteboard.

One finding to come out of the study was how important it is for the teacher to make apparent for the students the connection between school and their outside lives and experiences. During the student interviews Sara spent a great deal of time telling about her experiences with assessments outside of school. Her favorite activities, horse riding and karate, frequently assessed her current skill level. These assessments provided her opportunity to advance to the next rank or a higher level. The connection between outside school activities to assessments in the classroom is a relationship that Sara opened my eyes to and something I know I will use in my future teaching. I am going to create situations and dialogue that help students to see the relevance of assessing. It is important to help students make the connections from education to their lives outside of school, because so often the culture of school seems like a distant foreign place from their home culture. I am going to make a point of having this be an individual writing piece, as well as small group and whole class discussion at the start of the year.

There are also many ideas about providing feedback that Ms. Smith used which I will incorporate in my own practice. I see a great value in letting students assess themselves with daily practice (homework). The rubric Ms. Smith's used is an idea that I really liked. Having students play the role of self-assessors, and not just on their mathematics skill but also assign themselves a grade for effort, will be a valuable

addition for both the students and the teacher. I was very impressed with the way Ms. Smith gave feedback to her students, often in Socratic form. She would answer a question by posing another question to them, probing them to think more deeply. Similarly, when giving feedback on formative quizzes, she would not come out and just tell her students the correct answers, instead she would have them work individually or in groups where they would find their own mistakes and help each other in a learning community.

Implications for future studies

Through my study I was fortunate to witness so many strong examples of implementing formative assessments and collecting formative data. Ms. Smith did share some of the same difficulties brought up in the literature about using the formative data. However, I found that Ms. Smith had far more success in using the data to guide her teachings than the teachers highlighted in the prior literature.

While conducting this study, I was really struck by the importance of questioning students; including the types of questions posed and the mathematical language that is used by the teacher and expected in return from the students. Mathematical discourse is a large area of study in itself, and I would be fascinated to look at this same class and analyze the role questioning and language played in the students' learning of mathematics. If I was to do this type of research I would want to audio tape, if not video tape, my observations and then create a transcript that I could closely analyze. I was not expecting to find Ms. Smith using such high-pressure questioning techniques with such

frequency. I would attribute much of her ability to elicit formative data to her questioning techniques.

Another unintended outcome was my finding that Ms. Smith demonstrated strength in assigning competence to her students. This too would be a great area to study further. I witnessed Ms. Smith working diligently to praise students for their efforts and small successes. In doing this she was attempting to build their confidence; it is especially important to raise the self-esteem of students who have not previously seen themselves as “good” math students. It would be interesting to see what surveys and interviews would reveal about how the students saw themselves as math students, and what impact, if any, Ms. Smith was making.

After conducting an action research project in another teacher’s class I am now more prepared to do the same with my own teaching practice. This being my first year teaching I feel fortunate that I was given the opportunity to observe and analyze a veteran mathematics teacher. The teaching profession is a process of continual assessment; whether it be students, other teachers, or ourselves. This project has stirred in me an excitement to conduct an action research project in my own class.

Closing Comments

The choice to look at formative assessment for this action research project came from my own experience in secondary mathematics. During middle school, and even more so in high school, the focus was almost entirely on summative assessments. Throughout the course of the Masters in Education program I was continually shocked by the idea of formatively assessing students. It seemed so simple and obvious to

incorporate formative assessments into the mathematics classroom. If that is the case, then why had I not experienced it during my own schooling? In undertaking this study I hoped to find a class, differing greatly from my own mathematics experience, where the teacher was well versed in formative assessments. I was not sure how effective the teacher would be at using the formative data gathered, especially since this was an area in the literature that showed a common struggle for teachers. However, I was pleased to find Ms. Smith including many different forms of formative assessment, and more importantly using the data that was gathered to guide further teaching. It would be interesting to go back to my old school and see if my former teachers are still assessing the same way, or if changes have been made to push for more formative assessments; I know in the school where I currently teach there is a push from the district for all teachers to focus more on gathering and using formative data. Through this study, I have learned a great deal about formative assessment and I am already incorporating what I learned in my own classroom teaching practice.

Appendix A- ASSESSMENT CHECKLIST

Observation # _____ Date: _____ Lesson Focus: _____

TYPE OF ASSESSMENT	FREQUENCY	DETAILS
Summative (final)		
Summative (test)		
Formative (quiz)		
Formative (entry task)		
Formative (questioning in group setting)		
Formative (questioning in individual setting)		
Formative (whole group check- ins i.e. thumb indicator)		
Formative (in class practice problems)		
Formative (group work- tasks/projects)		
Formative (students self- assessing)		
Formative (homework)		
Formative (exit slip)		

Appendix B ASSESSMENT SURVEY

Directions: Check the appropriate box to reflect the extent to which you disagree or agree with the following statements.

1= strongly disagree 2= somewhat disagree 3= somewhat agree 4= strongly agree

STATEMENT	1	2	3	4
Assessment provides information on how well schools are doing				
Assessment is assigning a grade or level to student work				
Assessment is a way to determine how much students have learned from teaching				
Assessment provides feedback to students about their performance				
Assessment is integrated with teaching practices				
Assessment results are trustworthy				
Assessment interferes with teaching				
Teachers conduct assessments but make little use of the results				
Assessment results should be treated cautiously because of measurement error				
Assessment is a good way to evaluate a school				
Assessment places students into categories				
Assessment establishes what students have learned				
Assessment helps students improve their learning				
Assessment information modifies ongoing teaching of students				
Assessment results are consistent				
Teachers are over-assessing				
Assessment results are filed and ignored				
Teachers should account for error and imprecision in all assessment				
Assessment measures the worth or quality of schools				
Assessment is comparing student work against set criteria				
Assessment identifies how students think				
Assessment is an engaging and enjoyable process for students				
Assessment allows different students to get different instruction				
Assessment results predict future student performance				
Teachers pay attention to assessment only when stakes are high				
Assessment has little impact on teaching				
Assessment is an imprecise process				
Assessment measures students' higher order thinking skills				
Assessment makes students do their best				
Assessment changes the way teachers teach				

ID _____

Appendix C Semi-formal Interview Questions***Teacher:***

- What is the purpose or function of formative assessment?
- Do you use both formal and informal assessment in your class, an example of each?
- In what ways do you communicate with your students about their learning (feedback)?
- In what ways do you use student work (written and orally communicated) to inform your teaching practice?

Student:

- What does assessment look like in a math class? Is that the same way you have experienced assessment in this class, or is it different?
- What is the point of assessment for both students and teachers?
- In what ways does your teacher give you feedback relating to your learning?
- If you receive feedback, what do you do with that information?
- Have you experienced other types of assessments in other classes that have helped your learning or understanding? Any examples?

Appendix D ASSESSMENT SURVEY RESULTS

■ Teacher Response ()

Student Mean

1= strongly disagree 2= somewhat disagree 3= somewhat agree 4= strongly agree

	1	2	3	4
	1.0 1.5 2.0 2.5 3.0 3.5 4.0			
STATEMENT	- - - - -			
	1.4 1.9 2.4 2.9 3.4 3.9			
Assessment provides information on how well schools are doing		2.7	(3)	
Assessment is assigning a grade or level to student work		2.5	(3)	
Assessment is a way to determine how much students have learned from teaching			(3) 3.1	
Assessment provides feedback to students about their performance			(3) 3.0	
Assessment is integrated with teaching practices		2.9		(4)
Assessment results are trustworthy		2.9	(3)	
Assessment interferes with teaching		(2) 2.0		
Teachers conduct assessments but make little use of the results		(2) 2.2		
Assessment results should be treated cautiously because of measurement error		(2)	3.0	
Assessment is a good way to evaluate a school		(2) 2.5		
Assessment places students into categories		(2)	3.0	
Assessment establishes what students have learned			(3) 3.0	
Assessment helps students improve their learning		2.4		(4)
Assessment information modifies ongoing teaching of students			3.0	(4)
Assessment results are consistent		2.6	(3)	
Teachers are over-assessing		(2)	3.0	
Assessment results are filed and ignored		(2) 2.0		
Teachers should account for error and imprecision in all assessment	(1)		3.0	
Assessment measures the worth or quality of schools		(2) 2.3		
Assessment is comparing student work against set criteria			(3) 3.0	
Assessment identifies how students think		2.5	(3)	
Assessment is an engaging and enjoyable process for students	(1) 1.3			
Assessment allows different students to get different instruction		(2) 2.5		
Assessment results predict future student performance		(2) 2.1		
Teachers pay attention to assessment only when stakes are high	(1)	2.8		
Assessment has little impact on teaching		(2) 2.1		
Assessment is an imprecise process		2.8	(3)	
Assessment measures students' higher order thinking skills		2.9	(3)	
Assessment makes students do their best		(2) 2.9		
Assessment changes the way teachers teach		(2) 2.4		

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