

Effects of Scheduled, Unrecorded Quizzes on Students' Self-regulated Learning

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Abstract

There are several reasons a teacher might give a quiz. Typically, a quiz is used to hold students responsible for staying current on course content. But a quiz can also allow a student to identify what he does not yet know and build on it. The focus on the student's use of formative assessment refers to self-regulated learning. This research study investigates the ways in which student self-regulation of learning is affected by a routine of classroom quizzes which are consistently administered (weekly), unrecorded, and test-like in quality. Data were collected through surveys, interviews and classroom observations by the teacher as researcher and were conducted in two classes of an Algebra I course at an independent (private) middle school for highly capable or gifted students. Initially, students had variable beliefs of the value of formal assessments. Students individually responded to quizzes by demonstrating one of three distinct behaviors. Research findings included inconsistent growth in student self-regulation of behavior, motivation, and metacognition. This study found that a weekly quiz routine is associated with positive traits, such as value, helpfulness, and usefulness. It was also associated with increased motivation to prepare for summative assessments. In this study, unrecorded quizzing corresponds to a noticeable decrease of mathematics testing anxiety. Recommendations include further use of unrecorded formative quizzing. Future research of more-typical student populations is encouraged.

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Effects of Scheduled, Unrecorded Quizzes on Students' Self-regulated Learning

Assessment is a necessary part of learning. It is an integral piece of the brain's cycle, synonymous with “active testing”. When assessment occurs, new learning is meshed with previous knowledge and is tested before being revised further (Zull, 2002). Volante (2010) describes the entire learning and testing process as a recursive cycle. For the learning-testing process to be effective, the student must take part in three phases: test preparation, test performance, and test reflection (Schutz & Davis, 2000; Zeidner, 1998, Volante, 2010). These three phases are embodied within the formal assessment that occurs in a classroom. Test preparation includes instruction, homework, and studying which prepares a student for the formal assessment. Test performance is the assessment itself and reflection includes the ways in which a student responds to and is affected by assessment results. For students to benefit fully from assessment, they must have the opportunity to take part in all three phases of it.

Frequently, when students take assessments that are meant to have a formative, or guiding, role it is the teachers who typically benefit from the information obtained. In this way, learning is controlled by adults; students seldom make decisions about their own learning. Teachers may be able to identify the student's current progress toward achieving learning goals, but there is little value placed on investigating how students might independently use these formative assessments as a tool to develop self-regulation.

Formative Formal Assessments

In the classroom, teachers may use informal assessment in the form of impromptu questioning, discussion, and homework checks. Teachers may also use formal assessments, such as quizzes and tests, projects, and essays. A formal assessment can serve as either a formative or summative tool.

When one thinks of assessment, the summative type usually comes to mind. Bloom, Hastings, & Madaus (1971) argue that summative assessments, such as end-of-unit tests, measure whether or not the students were ultimately successful in learning what was expected of them (as cited in Chappuis & Stiggins, 2005). This is a “final step” in the learning-testing cycle; after in-class instruction, practice, and daily homework, learning is concluded by taking a test. Mid-chapter quizzes may be summative in nature, but only when they are used to evaluate how successful the student was in learning what was expected of him thus far.

When an assessment is not used in an evaluative role, it can have a formative purpose. In the educational literature, the term “formative” is used to describe some assessment or evaluation, but has several similar yet inherently different meanings (Cassady, 2005; Stiggins & DuFour, 2009; Torrance & Pryor, 2001; Volante, 2010). Buchanan (1998) describes formative assessment as an attempt to provide the instructor with an accurate estimation of student ability at a particular point. Heritage, Kim, Vendlinks, & Herman (2009) describe a systematic process to continually gather evidence and provide feedback. While many researchers describe formative assessment as a process in which the teacher is given power to act, others define it in a way that gives

the student power to act.

The National Council of Teachers of Mathematics (NCTM) (2000) Assessment Principle states that, “assessment should support the learning of important mathematics and furnish useful information to both teachers and students” (p. 22). However, several authors assert that learners must take a more active role in the assessment process (Black and Wiliam 1998; Torrance and Pryor 1998). In this research study, I will use the term “formative assessment” to refer specifically to the process that some researchers have named “assessment for learning.” This meaning is appropriate for reflecting the value of the learner's need to assess his own work and progress in learning through growth in self-regulation (Butler and Winne 1995; Perrenoud 1998, Dixon & Haigh 2009). In this way, the student is empowered to actively promote his own learning and engage in behaviors conducive to that end. In my observations of local middle school and high school mathematics classes, formative assessments are generally scored and recorded as part of the student's overall course grade. This rewards speedy learning while punishing students who learn more slowly, even though slower-learning ones might ultimately gain a more thorough understanding of the concept. In my study, I intend to explore the effects that routine, unrecorded, formative assessments have on student self-regulated learning.

Previous Research

Research on the benefits of formative assessment is ongoing, but the student-empowered aspect, as I have defined it, has not been incorporated routinely throughout classrooms (Neill, 1997; Wolf, 2007). In classrooms where assessment with a focus on the student's improvement does occur, the assessment manifests in several ways. While

one teacher might primarily use daily exit slips, another might use weekly quizzes. While one teacher might schedule an assessment every two lessons, another might give impromptu assessments, with no regularity at all. Assessment is a crucial component of the learning cycle, but little is known about which type and what frequency of testing are most effective.

Prior research has generally looked at how assessment for learning has impacted scores of assessments of learning. Some researchers have compared the effects of daily versus weekly assessments on student performance (Dineen, 1989; Marcell, 2008; Shirvani, 2009). Others have experimented with additional assessment variables. For example, Townsend and Wheatley (1973) compared summative results for classes given combinations of daily and weekly assessments along with various amounts of midterm exams. In this study, the schedule of weekly assessments was loosely set, resulting in an assessment every “fourth or fifth meeting.” In my research, I will add to the literature that exists by enforcing a consistent (same day of the week, every week) schedule of formative quizzes.

The literature that exists encompasses a wide range of student populations and sample sizes. Shirvani (2009) focused on high school sophomores, most of whom were Hispanic, in a geometry course in a rural area. Townsend and Wheatley (1973) focused on college-level geometry and calculus students at a California university. The educational literature that exists regarding formative assessment seems to be disproportionately college-level, and disproportionately foreign (particularly United Kingdom and New Zealand). Several prominent studies on formative assessment were set

in non-mathematics classes. Few studies that are focused on Algebra I students exist. It is particularly vital that educators identify ways to improve achievement and self-regulation in Algebra I students because of this course's status as “gatekeeper” to higher-level math and science (Khadaroo, 2008). A recent U.S. Department of Education (2008) report notes that “the sharp falloff in mathematics achievement in the U.S. begins as students reach late middle school, where, for more and more students, algebra course work begins” (p. xiii). I will add to the body of literature by incorporating a population of Algebra I students. I will expand on prior studies and analyses by focusing on an independent middle school population. This population will undoubtedly have demographics which vary from the populations of previous studies in similar research.

Most previous research has focused on how assessments for learning improve quantitative performance on assessments of learning (Geist & Soehren, 1997; Kika, McLaughlin, & Dixon, 1992; Weber & Olsen, 1972). This quantitative focus, however, limits the conclusions that can be drawn from research. In such a study, summative scores can be correlated with the formative performance. But that does not truly explore and represent what assessment for learning is, nor how students perceive their role in assessment. By looking solely at “mid-” and “post-” scores, it is not clear to what extent the learner engaged in self-assessment or took proactive measures to improve his learning. Ideally, the ultimate goal of formative assessments (assessments *for* learning) should be to both inform teachers of student learning gaps *and* inform students so that they can be proactive in their own learning process. In my research, I expect to find a positive impact, specifically, growth in student self-regulation. In this research, I will

investigate the following question: How do unrecorded weekly formative quizzes affect student self-regulation in mathematics?

Self-Regulation

The National Research Center on the Gifted and Talented (NRC/GT) defines self-regulation as an integrated learning process consisting of the development of a set of constructive behaviors that affect one's learning (Siegle, Reis, & McCoach, 2006). Self-regulation of learning involves the student's ability to behaviorally, motivationally, and metacognitively regulate his own learning process (Zimmerman, 1986).

Self-regulation of behavior involves a student's active control of the various resources (including peer and faculty support) that are available (Garcia & Pintrich, 1994; Pintrich, Smith, Garcia, & McKeachie, 1993). Self-regulation of motivation involves controlling and changing beliefs such as self-efficacy. It also includes control of emotions, personal goal setting (Bandura, 1989), and the desire to apply appropriate strategies to achieve goals (Zimmerman, 1989). Self-regulation of metacognition involves the student's ability to review their progress independently, to know if they have made significant progress toward a goal, and to monitor that progress (Garcia & Pintrich, 1994; Pintrich et al., 1993).

Bandura and Cervone (1986) contend that all students use self-regulative strategies and influences to guide their efforts (as cited in Zimmerman, Bandura, & Martinez-Pons, 1992). Some gifted and highly-capable students have better self-regulated learning development than their peers. However, many have succeeded academically in spite of poorer self-regulation because of high ability, social conditions,

or personal issues (Siegle et al., 2006).

In this action research study, I will explore the development of self-regulation among a group of students who have been identified as highly-capable and who likely already exhibit average or above-average abilities to self-regulate their learning.

Generally, the degree to which students self-regulate their own actions and behavior involves the consistency of their self-observation and self-monitoring, the judgments they make regarding their actions, choices, and attributions (Pajares, 2002). I will investigate the ways in which students' self-regulation of behavior, affect, and/or learning strategies develop in conjunction with the treatment of weekly, unrecorded quizzes.

In order to explore beyond the ways teachers make use of formative assessment and focus on student perceptions of formative assessment and responses to it, qualitative research must occur. Only through eliciting feedback from learners and questioning them can I unveil the extent to which they grow from the process of taking assessments within the course of a chapter or unit rather than only at the end of it. In this study, I will explore the ways in which students' self-regulated learning in mathematics can be influenced by routine, unrecorded formative assessment.

Research has previously shown improvement in summative performance as the frequency of formative assessment increases (Feldhusen, 1964). Students generally score higher on final exams when they have had midterms than when they have not, and generally score higher when they have had multiple quizzes than when they have only had one (Townsend & Wheatley, 1973). However, the extent to which *regularly-scheduled* assessment affects learner motivation, consistency of effort, self-efficacy

beliefs, and the resulting actions they take must be clarified. This is a missing piece of information which can be valuable to all teachers who may not be fully informed of best practices, but simply want to incorporate teaching methods that will help rather than hinder their students.

Evidence exists that teachers' perceptions of teaching and learning strongly influence how they teach and how successful students are at learning (Brown, 2004). If an improved way of offering assessment for learning exists, this realization may amend the way teachers have traditionally used formative assessment. Because changes in teachers' attitudes are correlated with changes in the formative assessment practices they employ (Dekker and Feijs, 2005), the opportunity exists to improve the teaching practice, ultimately improving learners' abilities to develop skills needed for life-long independent learning.

The goal has been to determine how teachers can best be helped by giving formal formative assessments. However, I believe the ability of *learners* to use formative assessment as a tool for personal growth is paramount. Marzano (2009) and Sadler (1989) identify one aspect of effective teaching as helping students identify individual progress on a learning goal. Ideally, my research will go further. I hope to ultimately inform teachers on how they can promote increased student success by structuring formative assessment so that it can be better utilized by students.

I am interested in *what ways* students variably use formative assessment as a growth tool. I am equally interested in how particular uses of formative assessment affect students' anxiety, particularly when preparing for a summative assessment. Wigfield and

Meece (as cited in Posamentier and Jaye, 1996) identified two components to mathematics anxiety: cognitive (intellectual) and affective (emotional). Cognitive anxiety involves worrying about failure and its consequences. That research by Wigfield and Meece (1988) noted a positive relationship between this type of anxiety and students' perceptions of ability and ultimate performance. Affective math anxiety involves fear, feelings of nervousness and discomfort. Wigfield and Meece found a negative correlation between affective anxiety and student perceptions of their ability. I hope to discover whether my treatment of Friday quizzes has a noticeable affect on the affective anxiety levels of my students.

To be clear, there are numerous paths a teacher can follow leading from formative assessment data toward the summative assessment. However, the focus of this study is how the student grows independently because of that formative assessment experience.

Chapter 2: Research Methods

Setting

I have taught Algebra I at Elysian Middle School for five years and I conducted my research on the students enrolled in that course during the first trimester of the 2010-2011 school year. Elysian is an independent middle school serving grades 6 through 8. The school is located in a suburban community in the Puget Sound region of Washington state. Elysian is fully accredited by the Pacific Northwest Association of Independent Schools (PNAIS) and generally follows Washington State course standards, though it is not obligated to do so. The mathematics curriculum is based on the NCTM standard in addition to the state standards.

The school's mission is to serve highly-capable students. From the school's website, the school “offers a challenging and engaging curriculum in a uniquely personal environment” while guiding social and emotional development. A majority of the 108 students who attend live locally and many parents enroll their children because they feel the children are not sufficiently challenged in the public school setting. Several additional students live 10 to 40 miles away and attend because an advanced program or gifted and talented program is not accessible in their public school district. Students must apply for admission and are selected based on the strength of their transcripts, letters of recommendation and writing samples, and by scoring near the top 10% on a nationally-normed admission test.

Elysian MS does not have median family income data available. Due to an informal look at family occupational status and the fact that this school requires tuition, I am confident in identifying the typical socio-economic status as upper-middle class.

Ethnicity is self-reported as predominantly white (62.7%) and Asian (27%), with several other ethnic categories represented in lesser numbers. The community is known for its political and community activism, and is among the most politically liberal areas in the state based on voting records.

Participants

At Elysian, all students are required to take Algebra I in eighth grade or earlier. As such, the two periods I am teaching are comprised of a total of 36 students-16 boys and 20 girls. All students are 12 or 13 years old and have scored highly on standardized mathematics tests in the past. This high-school-level course satisfies the Algebra I requirement for all local high schools.

All but one of the Algebra I students all have attended this school for at least one year, and all attended a local, public elementary school. I believe I have already developed a rapport with most of these Algebra I students because I was a co-teacher of their pre-algebra course last year.

There is noticeable variation in the mathematics histories of these students. Some have consistently scored higher than others in mathematics, some have more consistent work habits than others, and some are noticeably more comfortable in math class than others. All students in this population, however, are very comfortable interacting with their peers and with teachers at the school. I believe that all of these students enjoy attending school and each is motivated to learn and do her best.

Role as a Researcher and Teacher

During the first academic week of the school year, I engaged my students in a

brief discussion of *my* simultaneous roles as a teacher and student. I informed them of my need to conduct research and explained my personal interest in the topic. I asked that each student participate but also stressed that it is a voluntary choice. Each student, regardless of consent, was to follow the treatment which was embedded in the course structure. As a teacher-as-researcher, I would not have the same experience as an independent researcher would. The entire sample of students already knew me, both as a teacher and as a member of the community. I have engaged with several of them in extracurricular activities, including MathCounts, sports teams and as their community service leader. Consequently, they had a significant amount of background knowledge on me and certainly did not respond to me the same way they might have responded to an unknown researcher taking notes in the back of the room. My responsibility to effectively teach the two Algebra I classes superceded my desire to use the classes for research. I made frequent informal observations, but due to the dynamic nature of the classroom, I was occasionally unable to record them. My dual role required me to put extra effort into ensuring the students' actions and responses were authentic. I also needed to take into account my “values, assumptions, beliefs, and biases” and how they might affect me from having a truly objective lens within this study (Mertens, 2010). These concerns are discussed further within possible threats to validity.

This convenience sample of participants allowed me to expand on the existing research of formative assessment by its nature as middle-school aged, “highly capable,” and attendees of a non-public school. There is minimal literature regarding studies on formative assessment which include these sample demographics.

Treatment

Scheduled weekly quizzes were administered throughout a 6-week period. Each quiz session lasted approximately 15 minutes and was based on class content since the previous quiz (or chapter exam). Quiz items were written in short-answer format. After all students completed a quiz, it was immediately corrected in class. Each student corrected his own work. Quiz items were intentionally written in a format and structure similar to exam items (see appendices A-C for examples). This raised the value of these quiz items above that of typical homework questions. Simply by taking part in the quiz, the students gained familiarity with the format of the exam. Each student was allowed to keep her own corrected quiz and was under no obligation to share her results with anyone, including the teacher. Though students did not need to report their results to me, I did make informal observations about the types of errors and frequency of errors students were making. I could then ensure students received extra practice on these concepts. A student who was absent on the scheduled quiz day had the opportunity to take the quiz on the day she returned.

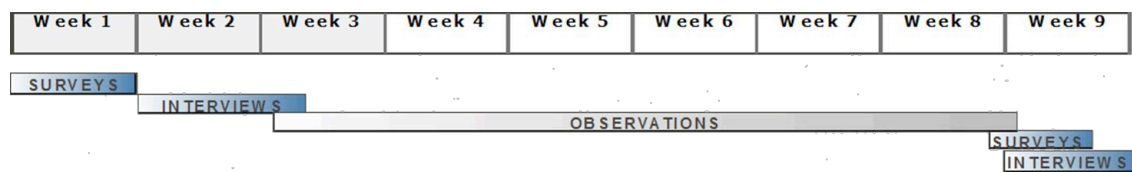
Sources and Collection of Data

The aim of my research was to understand how students, rather than teachers, use formative assessment as a tool. Extensive literature exists on the ways in which teachers use assessments to guide their instruction plans leading up to the summative exam (Dekker & Feijs, 2005; Dixon & Haigh, 2009; Harlen, 2005; LeMahieu, 1984). However, I suspected that many teachers administer quizzes not so that the teacher will be informed of student learning progress, but for the purpose of indirectly motivating students to work

harder or study more. This is especially true when that quiz is scored and recorded, rather than simply being for practice. It is reasonable to believe this scenario might urge a student to engage in behaviors that are conducive to effective learning (e.g. additional studying) simply so that he does not score poorly on the quiz. But would the student respond in a similar way if quizzes were not “worth points” and therefore could not improve or lower the overall cumulative grade? If quizzes were used to inform the student of her current progress and identify her strengths and weaknesses, and were not only used by the teacher, would she independently improve her ability to self-regulate her learning?

The complexity of my study suggested a pragmatic mixed-methods approach with a modified one-group pre/post test design. This design is appropriate when “it is not possible to have a control group” and “under circumstances in which [the researcher is] attempting to change attitudes, behavior or knowledge that are unlikely to change [without this treatment]”(Mertens, 2010).

Figure 1. Approximate timeline of data collection.



Initial interviews followed initial surveys. After the observation period (during treatment), individual surveys were administered. Group interviews concluded the collection.

I investigated my research question by administering an initial survey to my classes. This survey was meant to gather students' general opinions (favorable/unfavorable) of assessments. It meant to elicit views of the value students place on assessment and the mindsets with which students approach them. I then individually interviewed six students--approximately 20% of my two classes. After the six-week treatment period, I again administered a survey, with some additional summary reflective items. Finally, I conducted a Socratic seminar-style, large-group interview (see Figure 1, for a summary of the data collection timeline). I originally planned to interview individual students, as I had before the survey. However, as the treatment period progressed, I believed that I would obtain richer student input, especially regarding their perceived benefits and complaints, with a different format. Throughout the treatment, I supplemented survey and interview data with teacher-as-researcher personal observations. This methodological triangulation was an attempt to, “map out, or explain more fully, the richness and complexity of human behavior by studying it from more than one standpoint” (Cohen, Manion, & Morrison, 1990, p.254).

Surveys. The initial survey was used to quantify the value students place on assessments, both formative and in general. The surveys were also used to inform me in conducting the individual interviews. I chose to use a survey because it is a highly-efficient means of collecting data from a large group, particularly if the data can be aggregated (Mertens, 2010). The written survey that was given to students was a 29-item inventory, based on the Students' Conceptions of Assessment V3 (Brown, 2002, Brown & Hirschfeld, 2007). I chose 4-point Likert items in order to “force choice” by withholding

the “neither agree nor disagree” option (Trochim & Donnelly, 2007). That way, the student could not choose to remain neutral or “not participate while participating.” The survey contained statements which suggested particular views of assessments. Some items related to the inherent value of quizzes and tests while other items related to how a student might use assessment results (see Appendix D, for the entire 29-item inventory).

After the treatment period ended, I administered the modified survey. This post-survey included most of the original 29 items, but also included 10 additional items which served to obtain summative views on the research process. I then quantitatively analyzed the pre/post changes in collective responses to the 29 Likert items.

The additional 10 items were useful in guiding follow-up prompts for large-group discussion. These 10 additional questions allowed me to receive feedback on the treatment from the entire sample (see Appendix E for the extended final survey).

I hypothesized that analysis of the survey data would reveal that students initially considered quizzing primarily as a grading opportunity and did not fully consider ways in which the results could be used formatively. I expected a final analysis to suggest that students could ultimately see quizzing as a meaningful way of practicing mathematics and informally assessing where learning is weakest in order to improve. Ultimately, I did not include all survey data in my analysis. Only that data which relates to the observations, interview responses, and emergent themes of my research are included in the analysis. For example, cumulative data for item A of the initial survey, “written quizzes and tests place students in categories” were not included because categorization of students ultimately was not a focus of my analysis.

Interviews. Following each survey administration, I conducted interviews so that I could obtain student views which expressed more clarity, detail, and emotion than the surveys allowed. The amount of depth to which a student could respond was obviously limited when choosing one of four Likert values. In an interview, a student might want to explain her reasoning for a particular response in more detail. She may also want to offer other insights about assessment that were not surveyed but may emerge as overall themes. During an interview, I would be able to press her for additional ideas relating to a particular survey response. The interview also allowed me the opportunity to pose supplemental open-ended questions which required lengthier explanations.

I planned to interview the same collection of students twice. This scenario would prevent the potential of student responses in the first interview being unrelated and incongruous with the responses of other students in the second interview. However, I decided during the treatment that I needed to hear detailed reflective thoughts from more than six participants. I decided to create, then join in as a participant in two large-group discussions. These discussions were based on the ideas and topics I would have posed in individual interviews.

After the initial survey, interviews were conducted within a week's time. Each student being interviewed had access to his previously-completed survey so that he could refer to it, if desired. I selected six students, based on the variety of survey responses, to interview separately. A noticeable variety in survey responses guided me in picking a variety of students. One-on-one interviews generally lasted 10 to 15 minutes each and occurred outside of class time, but located on the school campus. Interviews were audio-

taped, then transcribed to ensure that I had each student's complete response to each prompt.

During the first interview I derived prompts from both the student's survey responses and general trends observed among the collection of responses. I also included some pre-constructed prompts (see Appendix F).

During the group interviews, similar prompts were given. Those interviews also included questions based on responses to the second survey, which had recently been completed. They were also guided by observations I had made and possible themes I had noticed during the treatment. As a class, students seemed comfortable responding to my prompts, defending their ideas, and responding to other students' comments.

In all cases, the survey prompts were carefully chosen to elicit individual feelings, prior experiences, and mindsets regarding the perceived role and value of assessments. In compiling several pre/post interview cases, I expected to find changes in mindset that occurred within individual subjects throughout the duration of the study. I also expected to see trends emerge which emphasized the value of a routine of unrecorded practice tests at the classroom level.

Observations. In the role of teacher-as-researcher, I made informal observations, and whenever able, recorded them in a journal of field notes. These observations primarily occurred during class, but could also occur elsewhere, for instance if I noticed an algebra student reviewing his quiz at lunchtime. Field observations were planned to be anonymous; the behavior itself was what was important, not who exhibited it. I did, however, decide to attribute the behaviors to individuals by code, so that I could analyze

the frequency of individuals repeatedly showing new behaviors. Some examples of behaviors I looked for included in-class review of previous quizzes, mention of using past quizzes in a study group, and seeking out additional quiz-like problems for extra practice.

My choice of observation as a data collection method ultimately allowed for the triangulation of my data, providing a third method through which themes may be evident. This was an important step in ensuring the consistency of evidence across sources (Henning, Stone, & Kelly, 2009; Mertens, 2010).

Data Analysis

Very little educational literature exists with a qualitative exploration into the ways students have grown from fully utilizing formative assessment. Much of the research in this field has been limited to quantitative experiment/control groups and qualitatively investigating the manner in which teachers should make use of formative assessment. In my research, I followed a constant comparative methodology to identify emergent themes, then test my initial conceptions against my data (Glaser and Strauss, 1967; Mertens, 2010). In this systematic process, I planned to use initial student data to hypothesize themes and then revise my ideas, as necessary, as I encountered new evidence.

Initial surveys item responses were analyzed for emergent trends and commonalities with other questions of similar intent (see Appendix G for an example of a coded, memoed survey). These questions were generally grouped together within the survey. As an example, items A-E refer to ways in which teachers might use assessment results while items F-O refer to the student's perceived role in assessment. That analysis

gave me an introductory view of how my students viewed assessments, and the findings informed some of my individual interview questions.

The small sample size affected my ability to find significant change between initial and final survey responses to each prompt. I considered applying a Wilcoxon signed-ranks test to determine whether or not there were significant cumulative changes between individuals' pre-treatment and post-treatment responses to individual prompts. The Wilcoxon signed-ranks test is an appropriate test when conducting repeated measurements on a sample where a normal distribution can not be assumed (Wilcoxon, 1945). Ultimately, however, I aggregated the data among all students, grouping responses into “agreement” or “disagreement” (whether “somewhat” or “strongly”). I then utilized general observations of these findings, without formally testing for significance, to complement my qualitative observations.

The open-ended responses to individual interview prompts were transcribed from audio and individually coded for recurring ideas (e.g., meaningfulness, classroom atmosphere). As themes (e.g., inherent fairness of assessments, quizzes as source of anxiety) emerged through the sequential coding of transcript, I returned to previously-coded material for re-examination. I coded all materials myself, and memoed within my journal rather than dividing the analysis amongst others.

During the six-week course of treatment, my personal observations were informed by the recurrent ideas and key themes emerging from the initial survey and interviews. At the end of the treatment period, these observation field notes were transcribed into cleaner copy, then coded. As with the interview coding, I identified key ideas within the

observations and matched these with the ideas and themes that were recurrent in surveys and interviews. As an example, I noted that several students who were observed studying their past quizzes originally reported that quizzes provide useful feedback.

The final survey, which students completed at the end of the treatment period, was analyzed collectively for significant differences from the initial survey findings. I also investigated to determine whether the correlation within groups of questions had changed. A change would potentially demonstrate that students had collectively shifted their understanding of assessment from that of a teacher's tool (to grade students) to that of a student's tool (to facilitate improvement).

The final round of two large-group interviews was informed by key ideas that had emerged and continued to develop from any point within the initial survey, interview, observations, or final survey. The two large-group interviews were the last step in the data collection process so I expected to prompt students on clearly-apparent themes I had identified. In this way, the final interviews would be able to confirm my in-progress themes or they might suggest new insights which would cause me to review my qualitative data retroactively (see appendix D).

Throughout my data collection and data analysis, I incorporated peer debriefing. Peer debriefing involved my sharing of insights and suspected emerging themes with research peers in order to seek verification about the “constructions that are developing as a result of data collected and analyzed” (Mertens, 2010). This was particularly important because I made a hypothesis of anticipated results before beginning my research. During the interview processes, I also incorporated member checks, which consist of the

researcher seeking verification from the participant about the key themes being formed. Member checks, along with peer debriefing, served to preserve the credibility of my study. They ensured that I did not notice a potential theme in one collection of data, and then mistakenly see it appear in following collections of data, even though it did not really exist. These qualitative practices prevented my study from being adversely affected by confirmation bias.

Limitations of Research

As a researcher, it was my goal to reduce threats to the internal validity (credibility) and external validity (transferability) of my study. Internal validity refers to the assurance that changes observed in the dependent variable are due to changes in the independent variable and not alternative explanations. External validity refers to the generalizability of one study's results to other situations (Mertens, 2010). I attempted to eliminate possible threats to the validity of this study, yet several remain within this experimental design.

Threats to validity. I chose not to use a control group due to the limited population size that was available to me. Therefore, results (emerging themes) may have been influenced by factors that were not part of the treatment.

A possible threat to validity is the testing process. Students might have identified the second survey as seeming extremely similar to the first survey. Consequently, an individual might have intentionally chosen to answer the second survey so that her responses were either identical or completely different from her original responses. This would make the data unreliable. Also, an interviewee may have noticed a connection

between her initial survey responses and the interview prompts. She could then have completed her final survey untruthfully in order to influence the final interview questions. I believe this threat was significantly reduced due to my rapport with the students and my role as teacher.

Another potential threat to validity is instrumentation. I believe it was minimal and would only have occurred due to changes in myself as the observation instrument. I do not believe the surveys caused a threat to validity because they differed only to the extent that the final survey contained additional questions which were intended for the participant to summarize or evaluate the overall treatment.

Even though students may not have understood the role of consistent, unrecorded quizzing as a research treatment, they must have realized that “assessment” was a key focus of the experiment. For many students, this realization would have come when they noticed all items on the survey referred to assessment. In all cases, the realization should have occurred before the treatment period began. This may have motivated students to put extra effort in any class activity they found synonymous with assessment. It might also have caused students to develop unnaturally high opinions of any assessment-related class activities. I planned to alleviate any possible Hawthorne Effect by engaging in every scheduled quiz and related discussions or activities as though it was a routine part of the class structure rather than an experiment of focus (Mertens, 2000).

The ability to identify particular themes and key ideas, but not others which actually might have existed, rested in my choice of methods for gathering and measuring data. I reduced this threat to validity by cross-validating data with methodological

triangulation, as well as peer and member checks.

Realistically, the most likely threat I envisioned was that students may answer a survey or interview question inaccurately in order to give me the responses they thought I wanted to receive. The students in my sample share close bonds with each other and might even have planned ahead to give personally-inaccurate responses as a group if they felt it would help me. In my initial description of the research process, I stressed to students that it was crucial to the success of the study that each respond individually and honestly.

Chapter 3: Description of Participants and Research Findings

I teach a distinct population that is not widely included in educational research. My students are members of an independent school, so their families pay tuition for them to attend my class. My students are in middle school, and each of my students is academically gifted or highly capable. Each of my students *wants* to be in my class and each wants to be successful.

Among faculty at my school, there is much collaboration to ensure students do not have disproportionately-excessive homework on any given night. My students tend to have multiple after-school commitments which, at best, must likely cause occasional stress with time management. At worst, it might result in less attention paid to academics, in the form of a rushed homework assignment or failing to study for a test. As faculty, we want to be proactive in helping our students to develop successful time management skills while remaining mindful that the homework we assign is not the students' only commitment. I put effort into respecting time commitments and major assignments in other classes, and I try to plan large assignments and assessments accordingly. But what if I could create a new routine classroom procedure which would result in student benefit? This routine would provide my students additional practice time with the material. Hopefully, it would also improve them as students and as learners. In a sense, my hope was that they would internalize what I introduced to them.

Unit exams are the primary summative instrument in my classroom, and account

for 70% of the student's overall grade. At this point, the student is no longer practicing concepts and mastery is expected. Occasionally students are given a mid-unit quiz but I typically use these summatively, particularly if a long weekend or school break is approaching. Based on my experience with these students, it is reasonable to believe that they will prepare for an upcoming quiz the same way they would prepare for an upcoming test. My plan was to test something that would help prevent students “cramming” right before, or feeling overwhelmed with pressure to succeed. Therefore, I researched the role of weekly quizzes in my algebra classes and how I could make them more beneficial to students.

Each of the quizzes I administered consisted of 3 to 5 questions which, as I explained to the class, were test-quality questions, “problems you would be expected to solve on a test.” These quizzes typically took students 10-15 minutes, though I was willing to allow any student the necessary time to finish without feeling rushed. After completion, correct solutions were posted, quizzes were corrected by the students themselves, and they had the opportunity to review and discuss (in a whole-class setting) any problems which caused confusion. A key aspect of my research was a focus on how quizzes are used formatively by the student. Though I did make observations on student performance as they corrected their work and reflected afterward, I was most interested in the ways students might grow as a result of these experiences.

In an effort to make my treatment very focused, I put two conditions on the quizzes. The first was the routine weekly nature of the quizzes. These quizzes took place every Friday. Therefore, students were able to anticipate the event, removing any stress of

an unannounced pop-quiz. Students would not need to be reminded of it, and a student who was absent on Thursday would not return to the surprise of a quiz. Additionally, I assumed that students would benefit from this routine because it would be a frequent source of test-worthy questions; if students felt like they were struggling with a concept, only a few days would pass before they would have the opportunity to take a “practice test.” A student who was absent on Friday would still have the experience of participating because quizzes were posted on the class blog/website.

The second condition I put on the weekly quizzes was that they would not be recorded in the grade book. Ultimately, these Friday quizzes were meant to be practice. My goals were to explore how students develop in response to taking these quizzes, and to discover whether or not there was noticeable benefit to students from this classroom feature (a weekly quiz) which requires very little planning by the teacher. Since the quizzes were not intended to be a summative display of student proficiency, I hoped that by not recording scores in the gradebook, students would feel unencumbered by pressure, expectations of any type, or thinking of it as a test. Ultimately, observations of my students would show what value they put on the new routine. Rather than a routinely-scheduled Friday quiz being worth five points, or 2% of the course grade, for example, I hoped a student might show that the quiz was valued as additional test prep material, or as an opportunity to get in some extra practice problems. The quiz might even be a means of students developing an improved attitude toward mathematics assessments. Because my class is fairly homogeneous, especially compared to local public schools, I decided I would focus on overall class trends rather than case studies of individuals.

Introduction to Students

The focus of this action research was on 33 middle school students taking high school-level Algebra I. Though I encouraged all 37 of my students to participate, four declined. Those who declined still took part in the treatment, as it was an established classroom procedure. However, their comments and observations were not recorded. The 33 participants were from two classes but each experienced the same daily classroom instruction and they took identical quizzes.

My students have a close relationship with each other. As 7th and 8th grade students in a relatively small school, they have known each other for at least one full year. One student who is new this year quickly meshed into the school culture. My students are in class with these same peers throughout the school day, and were grouped together last year, as well. There is no major discord between students, and all students want to be there. Several students feel that mathematics is their strongest subject, but several feel it is their weakest. Some students express a daily struggle with math, and while some express personal comments, such as “I’ve never been really good at math,” others express grade-based comments, like “I never get above 85% at math.” The clear predominant theme among all of my math students is that they deeply want to be successful at math and have a history of excellent academics. These students are rarely absent and rarely turn in an assignment late. There is an interesting dichotomy of opinions of grade importance. While many students respond to just about any assignment with “how much is this worth?” or “can I redo this if I get a low score?” just as many express that they do not care what an assignment is worth, or even if it is worth anything. Many students

believe that math practice is “to help me learn, not to give me a grade.”

The participants (except for one new student, and two students who were new as 7th graders last year) were in the same mathematics class, with the same math teacher, in 6th grade. This course featured regularly scheduled unit tests, and occasional, unannounced quizzes. Students did not experience quizzes in every unit. Therefore, the predominant assessment was summative, and any formative assessment occurred by homework and in-class discussion. In-class assignments, and the occasional pop-quiz were textbook-based, while the unit exam was teacher-created.

These students then proceeded to Pre-algebra. Some of the more proficient, dedicated students completed this course as an independent summer study. In this arrangement, students were on their own to cover material, take book tests and quizzes for self-guided formative tools, and then were required to show a high level of mastery on the actual teacher-created end-of-course exam. Students who studied pre-algebra independently had little opportunity to gain experience with teacher-created problems before the summative assessment. Those students who do not follow summer study cover Pre-algebra as 7th grade students. This course was co-taught by the 6th-grade math teacher and me. In this class students again had significant textbook homework, occasional text-based pop quizzes, and planned, teacher-created unit exams.

Students who follow the standard mathematics sequence at this school have thus experienced a routine of only occasional text-based pop quizzes, which are weighted the same as tests, and those teacher-created summative assessments.

My participants include six students who are in 7th-grade, having successfully

completed independent study. These students blend in with the larger group of 8th graders, and are actually held in higher-esteem by others for having ascended in mathematics.

Many Algebra students report feeling a high degree of stress toward upcoming tests and major assignments among their classes. Those students also report that an upcoming quiz creates no less pressure than an upcoming test. Though these students completed a 6th grade advisory program which focused on success techniques such as organization, assignment planning/time management, and stress management, few students seem to have mastered these. Upcoming summative assessments are a major stressor in the lives of many of my students. Others report that they do not ever plan to study for assessments, because they have never needed to and likely have not learned how.

Research Findings

This action research model involved a mixed methods approach, resulting in both qualitative and quantitative data. While the quantitative data is necessary to show trends and the extent to which students within the classroom held common viewpoints, the qualitative data allows for exploration into the thoughts, conceptions, and intricacies of behavior among my students. There is value in realizing which trends exist, which do not exist, what procedures support student learning, which do not, and ultimately if, as a teacher, I can enact a simple procedural change which causes academic and personal growth in my students.

My action research brought many initial student mindsets to light. As students experienced the routine unrecorded quizzes for several weeks, certain mindsets changed.

Additionally, some that I expected to change did not. Students responded to the procedure in a variety of ways. This was possibly the first time students had been assigned unrecorded quizzes, and the level of importance placed on them varied. Individual, and whole-class Socratic Seminar-style interviews revealed many contrasting ideas, and several similarities in terms of how this procedure did or did not make them better math students or improve their confidence, self-esteem, and stress management.

In reporting my findings, I will describe general student mindsets regarding quizzes. In order to provide a thick, rich description so that the reader can generalize (Mertens, 2010), I will describe several trends in mindset and beliefs that were clearly evident from initial student surveys. I will then identify mindsets that stayed consistent or were not overtly noticeable over the course of the treatment. Comments and observations will supplement that data. I will next present the three general ways, based on my observations and student interviews, that students used this quiz opportunity. I will then focus on those beliefs and mindsets that did change. I will describe general ways in which student self-regulation changed throughout the research, and these will be supported by initial and final interviews as well as observations. I will conclude by summarizing the big picture of my findings.

Survey results. Before my treatment began, some students held strong beliefs about the nature and purpose of assessments. For the purpose of my initial analysis, I identified each participant as either agreeing with or disagreeing with each survey item (“agree” and “strongly agree” were considered agreement as I looked for trends).

Formal assessments. Based on initial responses to the “Conceptions of Assessment” Survey (see Appendix E for relevant pre/post-survey results), 88% believed that formal assessments provide students with useful feedback and by the end of the treatment, that had risen to 95%. In addition to the slight increase in agreement with this statement, there was a significant increase in the proportion of students who “strongly agreed” with the statement. Interestingly, the students who agreed that formal assessments “provide *me* [the student] with useful feedback” declined, though not significantly, from 97% before the treatment to 88% afterward. Over the course of treatment, students grew in belief that assessments, whether formative or summative, report useful information. But while some students generally felt that way, they themselves were not particularly affected. These students had the view that quizzes “are helpful...but not for me.” They seemed to appreciate the idea of weekly, unrecorded quizzes as a positive feature of the class, but a decreasing majority believed it was personally beneficial.

Initially, 66% students agreed that assessments do not only provide feedback, but actually cause students to improve their learning. On the final survey, 77% agreed with that statement. As with the survey item regarding feedback, many individuals' responses on improved learning changed from “agree” to “strongly agree.” When considering whether the students themselves experienced improved learning from assessments, the initial and final survey results were unchanged at 71%. Though a higher rate of students initially agreed with the personal effect than with the general effect, that pattern was reversed at the end. Because this survey response was unchanged, I looked closer, noting

that only four of the original students who disagreed also disagreed at the end. This observation lends validity to the use of trend reporting rather than individual cases studies because, in order to show trends as accurately representative of the whole class, it should be evident that opinions were changing among individual students. I wanted to make sure that I would not report aggregated data on a group of individuals who had not changed their responses.

A similar survey item inquired of students whether assessments were beneficial to them. Students might have interpreted “beneficial” a number of ways, not just as providing feedback. The agreement rose from 75% before the routine ungraded quizzes, to 85%. I informally questioned two students, a 7th grade girl and an 8th grade boy, and each agreed that, “they're beneficial not just because they show you where you stand, but because it gives you another opportunity to get better.” Students were valuing the routine quizzes because of their role as tools with which to improve. Students saw the quiz as something they could personally use, not just as something that was for the teacher to use. Students also seemed to understand the formative role that a quiz can have. They treated it as a way to check progress rather than as the sole measure of mathematical success.

Though the quizzes were appreciated and valued by the majority of students, some negative views of quizzes persisted. Only 11% of students initially remarked that taking a test or quiz is an enjoyable experience. In informal interviews, I learned that enjoyment was because those students expected to excel and another quiz brought about another opportunity to excel. Post-survey, still 11% agreed. Several additional students

remarked to me during class that, while quizzes and tests still are not fun, these “Friday quizzes are pretty fun.”

The statement with the largest change toward disagreement involved the effect of assessment on the social climate of the class. Initially 38% believed assessments promoted a positive classroom atmosphere. Several students remarked that the effect is positive because upcoming assessments give an opportunity for study groups to form, for peers to come together for a common goal, and to bond. After several weeks of Friday quizzes which had no bearing on student grades, only 9% described the affect of assessment on social climate as positive. I did not expect this decline because it seemed that an unrecorded practice activity would fit the students' stated purpose as a bonding tool, particularly in the ways students could prepare for it together and use its results in the future. Perhaps students became bored with the routine. Additionally, our quizzing routine may also have reminded students of the typically-individual (i.e., no groups, no talking) nature of assessment. That type of environment clearly is not very social.

The statement with the largest change toward agreement involved the fairness of exams. In response to whether formal assessments are “fair for all,” only 47% agreed prior to treatment. Many of those expressing disagreement did so strongly. After our treatment with routine, unrecorded quizzes, 69% responded that assessments were (are) “fair for all.” Very few of those expressing disagreement did so strongly. In follow-up interviews, several students expressed thoughts like, “when everyone gets the chance to practice questions that could be on the test, so they know where they are weak, and what is expected for the test, that is fair.” I believe more students came to see assessments as

fair because they believed our Friday quizzes were fair. Problems were straight-forward, based on recent class lessons, and all students were given time to finish. Perhaps a child who had missed class recently would find an assessment unfair, but our assessments were unrecorded, anyway.

Mid-unit quizzes. Though students ultimately expressed value for and appreciation of our Friday quizzes, their survey responses regarding mid-unit quizzes (not just our unrecorded ones) reflect less consistent opinions.

When asked if mid-unit quizzes are valuable to the student, 72% of students initially agreed. Several strongly agreed, but many strongly disagreed also. After the treatment, 72% still agreed they were valuable. Though the total percentage remained unchanged, very few students strongly disagreed in the final survey and more than 50% of the students who initially agreed now strongly agreed. The *value* placed on mid-unit quizzes did not match the *helpfulness* attributed on those quizzes. While 77% of students noted that mid-unit quizzes helped them improve their test performance, only 67% believed the use of such quizzes helps them ultimately succeed in mathematics. These results are not significantly contradictory, but it does suggest that some students consciously differentiate between a high math test score and mathematics success. Informal interviews reiterated that certain students see quizzes as a means of guiding test performance, but do not believe that a test determines their success.

Student reactions. My algebra students were not enthusiastic to begin routine quizzes. Most of them would prefer to go to class and develop confidence that they are learning successfully without having to take a quiz or test to tell them so. The unrecorded

nature of the quizzes comforted many students and the classes were willing to “help me out” in my role as a student. Over the course of the study, several students expressed interest in the ultimate findings. One student was interested to eventually read “what [you] found out about [us].”

During this treatment, students took five weekly quizzes. Though the students all sat quietly as they quizzed, seemingly taking it seriously, there was some variety in the ways students followed-up. Students responded in one of three general ways to the quizzes. After correcting the quiz, but before moving on to the next agenda item, students typically decided either to permanently move on from the experience, save the quiz for later, or deliberately use the quiz as a tool. Most students exhibited the same response throughout the five weeks. For example, a student who used the first quiz as a study tool generally used quizzes 2-5 as study tools also. Very few students reported that they used some quizzes for follow-up but did not use others at all. This lack of mid-treatment flexibility in the way students used the quizzes suggests that many students had fixed study skills and learning-related behaviors which were already established.

Permanently moving on. Some students took the Friday quiz and then immediately wanted to move on with a clear mind. After the first quiz was self-graded, I allowed a couple minutes of time to process and reflect independently, but gave no instructions about what to do with the student work. Two students separately brought their papers up to my desk but I said that it was not for me to collect. When one of them asked me if he could throw it away, I remarked, “I wouldn’t throw paper away...but recycle it if you want to.” Both of these students disagreed [in initial surveys] with the

helpfulness and usefulness of written assessments, and strongly disagreed with the placement of value in mid-unit quizzes. Once the two initial students put their papers in the recycle bin, three more students quickly followed. On subsequent quizzes, the number of students immediately recycling their quizzes increased. After the last quiz in the treatment, 24% of the students recycled it. Of those students, all but one disagreed on the final survey with the positive attributes [helpfulness, usefulness, and value] of assessments.

Students who demonstrated this behavior of quickly putting the test experience behind them made a variety of remarks to me. Two did this because they “never study for math tests.” Several others did it because they “didn't have any issues on the quiz so they [do not] need it anymore.” Another pointed out that “I took it just like it was a test, and I got 100%.” The students who did not save their quiz, and were not interested in having it available in the future, considered it as a progress check, a way to see where they are now. They did not consider that the document could have value as a study guide, even if no errors were made. “If I was weak on some concept, I would have saved the quiz to review and help me improve,” remarked a student. The students who fell into this group generally reported on their surveys that they do not find assessments useful, helpful, or valuable. They also generally show more self-confidence in mathematics and are among the high scorers in the course. To the students in this group, the quiz was just part of the daily agenda, and having completed it, it was time to move on to something new.

Saving it for later. Throughout the five-week period of routine quizzes, several students showed a different behavior. These students would immediately reflect on their

quiz performance, then save it for later. After these students checked their quizzes, they used class time to actively evaluate their performance. These students would hesitate to move on to the next item in the agenda; they would prefer to immediately discuss their mistakes and make sense of them before moving on. These students wanted to be active in the correction and reflection process. After I put up answers to the first quiz, reflective comments were audible. One normally-quiet student remarked to his table partners that it was “100% as I expected...I need more review on formulas and equations.” At the same time, four students, sitting in one table cluster, huddled in together. I observed several minutes of asking for clarification and students explaining their reasoning and solutions to their peers. Several more students went to the bookshelf to get a copy of the textbook, then sat quietly, independently looking at the section related to the quiz.

Unlike the aforementioned group, this group of students thought of the quiz as more than a progress check. This group was interested in immediately using the results. However, these students did not intend to use the corrected quiz as a study tool in the future. Students in this group agreed in individual and group interviews that,

“after I reviewed in class, I filed the quiz away. I didn't plan to use it to study for the test, but if I happened to come across it later, I would look back at it and remind myself of how I did and where I was weak.”

This group included students who gave a variety of responses to the initial survey prompts regarding positive beliefs about written assessment. For every such prompt, each of the four Likert options was chosen by at least one student from this group. This group's final survey results showed very little change. Additionally, this group was split 50-50 in their final survey responses on whether quiz scores should be recorded. These students

found value in the experience of taking this Friday quiz, but did not necessarily value the ability to refer back to it as a study guide. This group did not deliberately plan to ever use the quiz in the future.

Using it as a tool. Several students seemed very invested in the quiz routine and did more than simply complete it and then file it away. Within my algebra classes, I observed ten students who not only reflected immediately after the quiz, then saved it, but either took it out at a future class, or referred to using it as a study tool. This signaled to me that these students were intentional in their desires to benefit from this experience. These students filed their graded quizzes in a place that was quickly accessible to them. Even students who are generally lacking in organizational skills found an easily-accessible place to store their quizzes.

Students in this group referred back to their quizzes sometime before the unit assessment. On the Monday after the first quiz, one student had his quiz out at the beginning of class and was asking a girl at his table to explain how she solved one of the problems, because it was different than how he solved it. Over the course of that week, I casually noticed that the recent quiz was out on a student's desk nine times. Twice, students were asking each other to help explain a problem. The other seven times, individual students appeared to be studying the questions. Some were just looking, and some were actually re-solving problems. Two had their textbooks out alongside the quiz and were looking back and forth between the two. As late as the final week in the treatment, two students were reviewing multiple previous quizzes individually, though the class had already taken a unit test covering material from the first 3 quizzes. When I

questioned one student about my observation, she noted that, although “(she) used it to study for the test, (she) just wanted to make sure she remembered (a math concept) correctly.” Students incorporated these Friday quizzes into their study plans and routines in various ways. In many cases, our Friday quiz routine allowed students to develop new study plans and routines.

Students' mindsets regarding the value of our unrecorded, weekly quizzes fell into three distinct groups. Some students treated the quiz as simply a class activity required of them. They showed little interest in the results. Other students showed little interest in active follow-up, but committed to saving the document “just in case.” These students had predominantly responded in the initial survey that assessments were helpful, useful, and valuable. They also strongly believed mid-unit quizzes would be more helpful if unrecorded and were glad our quizzes were not recorded. In the final survey, students from this group reported feeling much less comfortable at making mistakes than students who displayed the two other behaviors. This final group of students was interested in the quiz results and actively followed-up. They embraced the opportunity afforded by this experience and consciously planned to use the past quizzes for future study.

Effects on self-regulation. My goal in this action research was to introduce a classroom routine that any teacher could easily do in his/her own classroom. My plan was then to simply observe, without giving suggestions or guidance of any kind. At first this freedom was uneasy for some students, but they quickly adapted. As I observed, I wanted to discover whether any students showed growth in their mathematics self-regulated learning, and if so, to what extent. I was specifically looking for signs that students had

developed constructive behaviors, new mindsets, or cognitive strategies in order to be more effective learners.

Self-regulation of behavior. Many students spent seemingly little effort and time on Friday quizzes. However, several students described in final interviews that, though they have “never studied for math tests,” they did actually use these corrected quizzes to study for our class summative assessments. These students remarked that they felt comfortable taking this step, and felt it would benefit them academically. Even a student who said she did not remember “ever studying for a math test” happily announced to the class that she used our quizzes to study for the first unit exam.

Although only 22% of students said they made an effort to study for our quizzes, 46% said these quizzes caused them to study more for summative assessments than they had in the past. Though some students do not study for math as a general rule, the low percentage of students who studied for the weekly quizzes signifies that many students embraced unrecorded quizzing as a formative tool, where they could “see where [I] am now and what [I] need to work on.” No students stated that they ultimately studied less for summative assessments because of these quizzes.

In my initial interviews I discovered that my students rarely study together. For social studies and science they were much more apt to form study groups than for mathematics. In our final interviews, multiple students remarked that they had consciously begun to form study groups with peers. These groups formed at school (outside of math class), at home, and online (3 students formed a Skype review group to review quiz concepts). The graded quizzes provided easy access to test-like material and

it became convenient to quiz each other, to ask for explanations, and to write practice questions (that were like our quiz questions) for each other. As mentioned earlier, I also observed a significant amount of in-class attention and reflection on the quizzes. This occurred not just immediately following the quizzes, but for days afterwards. Thus, the Friday quiz routine promoted student benefits evident in the ways their time management, use of study environment, equipment, and use of peers improved.

Self-regulation of affect. This type of self-regulation involves changing motivational beliefs, goal orientation, and anxiety management (Bandura, 1989; Zimmerman, 1989). My students are generally stressed a lot; this issue frequently arises during school-wide activities focusing on social and emotional health. Though several seem never to be stressed about anything, many experience stress and anxiety about tests, simply because they count and act as a signal to others of a student's academic abilities. As I observed students throughout the treatment period, I could see the typical signs of academic stress, including the desire to review for other classes during math, and casual comments describing their calendars of what was due and when. I know that my students can feel this way about math tests too, that it is another thing added to their already full plates. Students were initially uneasy when reminded of the first quiz which was to occur the next day, and at the moment we began to quiz, several students showed their obvious signs of anxiety. However, upon administering the first quiz, then not recording it, a refreshing ease settled over the classes. Over the treatment period, during which my data collection was by observation of students, I never noticed visible signs of stress among them when taking, reviewing, or discussing solutions to a quiz. Students who, from

memory of last year, talked themselves out of correct answers and rarely finished an assessment within the allotted class period, did not express frustration or demonstrate these behaviors. While 60% of students responded before our treatment that they “have experienced test anxiety in the past,” only 36% of students felt as though our weekly routine did *not* diminish their anxiety and stress. None reported higher anxiety regarding math assessments, and even among the few students who originally responded to my survey with “Yes...a lot” or “I always worry about tests and quizzes and forget how to do things,” most of them reported less anxiety.

Students appreciated the unrecorded nature of the quizzes. Originally, 68% of students believed that, in principle, quiz scores should not be recorded, and an equal amount thought they would be more helpful if unrecorded. This, they agreed, was because a quiz “that counts” has to be studied for. Then, “you worry about whether you are doing things correctly. And if the quiz didn't count, you could just relax and do it for practice and see how you do.” By the end, 79% of students agreed that our Friday quizzes should be used informationally and not entered into the gradebook. All students who disagreed were ones who originally denied feeling anxiety or stress with tests. Because tests are not a cause of worry, and since they performed well anyway, they felt all quizzes should count as they would bolster the student's grades. For the students who do feel even slight apprehension or anxiety when taking an assessment, our Friday quizzes were a outlet for them to test themselves and receive useful feedback in a low-stress situation.

By the end of my treatment, many students became comfortable with making mistakes. This is an idea that contradicts many aspects of our culture, and the treatment

may have partially contributed to that development. At the beginning of the year, I introduced my classroom as a space where students should feel comfortable making mistakes. But throughout this treatment, it was obvious that students had internalized this idea. Some students treated our Friday quiz as a practice test, and some treated it simply as a couple extra practice problems to do. My student observations as well as informal questioning revealed that students treated making a mistake on a quiz as a learning experience. Especially for those students who did not recycle the quiz immediately afterward, the quiz was considered a tool to check one's current progress. If a mistake was made, that was alright. It was an important reminder that the student needed extra practice. Ultimately 80% of students reflected in the final survey that they were comfortable making mistakes on the quiz. My students expected to do well, and tried to do well, but actually embraced the formative nature of these assessments.

Several of my students who originally had lower course expectations for themselves (as evident by the final grade they expected to receive) ultimately found Friday quizzes a positive experience. One student stated that she “appreciated knowing I would have a practice test at the end of every week. I tried to get 100% on it, but when I didn't, I tried to make sure I wouldn't make the same mistake on the test.” Friday quizzing promoted clear goal setting. Students became better able to regulate their feelings and plan steps to create an ultimate positive outcome.

Self-regulation of learning strategies (metacognition). During the period of time in which we had Friday quizzes, I investigated whether students developed new cognitive strategies. I looked to find instances of students using Friday quizzes as a starting point to

organize information, monitor their progress, rehearse or memorize content. I hoped that I would witness students making these adaptations in an effort to improve test performance and improve mathematics learning.

Sixty percent of students reported that they were motivated to do their best, even when the quiz did not count on their grade. Their motivation was evident in the ways in which many students made conscious efforts to file their quizzes with other student work. Students are encouraged to save past homework and notes, and use them to study for summative assessments. While some students filed away the first quiz, by the final quiz, many more were filing the quiz away. When I informally asked students about that, and in final interviews, students stated that they wanted to keep study materials organized. While some had definite plans to study their past materials, and others were unsure of the extent to which they would study, all wanted the quizzes in an accessible place for future use. Several students who began the routine with plans to study their past quizzes ultimately shared that they did. Some revealed that they studied mathematics for the first time, because of these practice quizzes of test-level questions. Only 29% of students, less than I hypothesized, reported that they changed how they studied because of our routine. I believe that many others who did not change their study habits still benefited by applying their current study habits with this additional source of material. Those students who weren't affected enough by our routine to intentionally improve their study habits still experience this additional practice with course material and many reported less anxiety because of the quizzes.

In saving their quizzes, students implemented a compilation of topics covered, a

selection of test-like sample questions, and a reminder of items which were successfully and unsuccessfully solved. This, itself, was a tool students consciously created to improve their standing and future learning. Reflecting on the five weeks of quizzes, almost half of students noted that the routine caused them to study for the summative assessments more than they would have prior to the treatment.

Summary of Findings

The goal of this study was to investigate the types of changes in student self-regulation that might occur when students experienced a routine of quizzes which were not to be recorded as part of their course grade. Separate from the formative changes I might make in the instruction that followed, students responded in a variety of ways. Though all students tried to do well on the quizzes, some put little weight on the results and simply moved on. Some students considered the quizzes helpful, but only used them incidentally. Others strongly valued the experience of taking formative quizzes and equally valued the ability to reflect back on it later and use it as a preparation tool. Although the routine of Friday quizzes lasted just five weeks, it improved the self-regulation of several students. No students felt adversely affected by this experience. Many students appreciated the opportunity to experience test-like questions ahead of a summative assessment. Many students appreciated that quizzes were not recorded, particularly those with high academic stress or test anxiety issues.

An additional finding from my research was that students strongly valued the routine nature of these quizzes. They appreciated the way a Friday (or any other day of the week) quiz clearly broke up larger units into precise groups of topics. Students could

focus on assessment of just a couple key Algebra ideas rather than the greater amount that would be included in a summative test that was recorded. Students felt they were better able to effectively self-assess their learning and develop strategies to improve when they could focus on this narrower range of material.

Chapter 4: Conclusion

Related findings of this research to the existing literature

My motivation for this topic of research spawned from my experiences as a classroom teacher. In my six years as an algebra teacher, my classes have been made up of students who are competent at completing homework assignments and are willing to do general review activities, such as practice chapter tests. However, I have generally failed to see the self-regulated study behaviors in mathematics that my students show in other subjects like science and language arts. The students who “do not ever study” for formal math assessments are the same ones who routinely form outside study groups to prepare for Language Arts assessments. These same students are even prone to taking out their science notes and flash cards in my math class for some precious additional study time. I was confused by students' determination to routinely study so thoroughly on other subjects while de-prioritizing mathematics. Even students who perform highly in my algebra class would benefit by reviewing material and practicing concepts with the same determination as they do for these other subjects.

In response to this situation, I planned to offer students additional opportunities, not just to practice algebra concepts in class (mandated study time) but with the goal of motivating students to want to increase their study time outside of class. I planned to improve formative assessment opportunities for my class, with the goal of nurturing their determination, motivation, and ability to study effectively. It was not my plan to simply add formative assessment with the goal of monitoring student progress. My intention was to promote the more-active student role in assessment which Black and Wiliam (1998)

and Torrance and Pryor (1998) advocate.

In reviewing the literature, I found minimal relevant discussion on my situation. My student population of academically talented and highly capable children undoubtedly included some who had high self-regulatory abilities but also some who have developed ways to be successful in spite of low self-regulatory abilities (Siegle et al., 2006). Because I found little research on my particular classroom situation and population, I used the existing literature as inspiration in developing my treatment plan.

Based on research from Dineen (1989), Feldhusen (1964), Marcell (2008), Shirvani (2009), and Townshend and Wheatley (1973), who focused on the regularity and frequency of assessments, I structured my treatment as weekly quizzes, with each taking place on the same day of the week. My study adds a new component to the literature, as Shirvani (2009), Townshend and Wheatley (1973), and several others conducted research on high school and college/university populations. My study also builds on the lack of existing research on formative assessment of highly capable students. Additionally, my research involves a treatment of providing formative assessment which is unrecorded, minimizing the *need* or *importance* of scoring highly and reducing the associated anxiety and pressure.

My research showed improved study habits, reduced anxiety, and greater confidence on summative assessments among many students. These supplement the findings of Geist and Soehren (1997), Kika et al. (1992), and Weber and Olsen (1972), that formative assessment can improve quantitative performance (i.e., scores) on summative assessments. The research literature is now more complete with this evidence

that routine, unrecorded formative assessment of highly capable middle-schoolers can promote development of attitudes and behaviors conducive to improvement in student learning in mathematics. Further, the ability of these quizzes to reduce anxiety in mathematics is crucial because of the strongly-negative relationship between affective anxiety and the student's ultimate performance (Posamentier and Jaye, 2006).

Implications for future teaching

As a teacher/researcher my investigation into the way my students responded to my implementation of scheduled, unrecorded assessment for learning was very encouraging. It seems a daunting and near impossible task to develop a classroom practice which will benefit all students, and benefit them equally. However, by enacting a few specific procedures within the course syllabus and routine (e.g., a quiz every Friday, student's grade will not be recorded, student corrects his own paper, teacher does not collect graded quizzes), I was able to reduce self-reported test anxiety in several students. I was able to provide additional (summative) test preparation material, as the collection of Friday quizzes could act as a study guide. Ultimately, Friday quizzing served as more than extra practice. It served as extra practice completed under testing conditions (e.g., silent room, no cooperative work, timed testing, test-like scoring). This provides an additional benefit to students, particularly in easing testing anxiety. Every week, students participated in a practice experience where they became familiar with the types of problems they would be expected to solve on summative assessments, and the quality of work they would be accountable for. This extra material encouraged students who rarely study for mathematics, to increase the time the devoted to studying. Students

who already study regularly, as well as those students who study inefficiently, now could study our course material with more focus and efficiency. These results have encouraged me to include this quizzing routine for the remainder of this year (with this particular group of students) as well as in future courses.

The Friday quiz routine took about 15 minutes of class time each Friday. It was incorporated in my lesson planning and each student knew that, when Friday came around, she would have this additional opportunity to practice some focused test-like questions. Among the collective group of students, there were noticeable benefits to our new classroom routine. The favorable views I hold of my research results are bolstered by the realization that I did not notice any negative results of having the class follow this treatment. Nor did any student ever complain about or criticize the new class routine. Even the students who responded that our routine did not have a significant effect on them still responded that it was a nice and helpful feature of the class, because the opportunity would be there if they chose to fully utilize it. In a basic cost/benefit analysis of implementing this quiz routine, I believe that losing 15 minutes every week from other potential classroom activities is a value when considering the noticeable growth that several students demonstrated.

As I planned my research treatment, I expected a variety of student responses—I did not believe all students would respond alike. However, I did not expect the variety of student behaviors, with some students immediately throwing away their quizzes, others saving them for formal review, and a spectrum of behaviors in between. The many distinct responses re-emphasize the reality that each student is a unique individual, with

unique habits, behaviors and motivations. My research observations strengthen my resolve to support students in as individualized a way as possible, tailored to their unique needs.

My experience with this research further strengthens my belief in the value of giving students unrecorded mathematics quizzes. A significant motivating factor in my choice of research question was my confusion with the overwhelming variety of assessment routines throughout middle- and high school mathematics classes. I hoped, in this research, to gain some insight into potential best practices for formative assessment. In many local high school math classes, the class routine includes a quiz scheduled every Friday. This routine of four days instruction followed by an assessment is probably meant to keep students from falling behind. A Friday quiz can act as a formative instrument which motivates the student not to fall behind while showing the teacher the extent to which students are having difficulties with recent concepts. Generally, these quizzes are recorded and count for a portion of the student's overall course grade.

Initially, I realized that my research might ultimately demonstrate that my assessment routine was ineffective, far from a best practice. However, my experience in this action research supports my disagreement with recording quiz scores. When a course structure includes both quizzes (midway through a unit or chapter) and tests (at the conclusion of that unit or chapter), I believe the quizzes should be used only with the formative role as a “checkup” from which both student and teacher can learn. During a quiz, I do not believe a student should be held responsible for mastery of material; the summative unit test is the instrument to assess mastery of concepts. Unless a teacher is

giving assessment specifically to evaluate student retention on concepts (as on a final exam), I do not believe a student should be held responsible (i.e., by having the grade recorded) for mastery on a quiz. Students' experiences reported during my research support this belief. Students strongly valued the opportunity to assess their progress, without pressure or threat of doing poorly. If a student did poorly on a Friday quiz, I would notice as I monitored the room. I could then consider how to support that student's learning in additional ways. Equally as important, the student would see he did poorly in this no-risk environment and have the opportunity to improve in time for the summative assessment. I believe I now have powerful support for continuing the routine, unrecorded nature of student quizzing.

Limitations of this research and areas of future research

My topic of investigation presents several areas for further research both within my classroom and within the education community. In my classroom, I am interested in any minor adjustments to the conditions of my treatment which might promote greater cumulative benefit or reach those students who did not seem particularly affected by my original treatment. I wonder if requiring students to save their graded quizzes, rather than being able to throw them away immediately, would encourage those students to use them in future review. I also wonder if the results of my treatment might vary if quizzes were scheduled on a day other than Friday, or with a different frequency than once a week.

I am interested in how my assessment routine might be modified by the availability of computer technology, such as online quizzing programs like Quizlet. Sources like these allow teachers to create and publish quizzes and even have the

capability to report student data to the teacher. This data can include who has attempted the quiz, testing conditions (including date, time, and duration of testing) along with individual scores and cumulative class data. I am interested in discovering how the success of unrecorded formative quizzing might be affected (positively or negatively) by allowing students to complete a similar quiz on their own time. Such a quiz could be mandated as part of the class syllabus. This change in testing conditions would allow for the quiz to take place outside of class, freeing fifteen minutes of class time. It would give the student similar test-quality questions and display correct answers afterward. However, limitations involved in computer and internet technology could potentially limit the student's ability to print and retain a paper copy for future studying. And not all students have internet access at the time of day when it might be most convenient to study.

In future research, I would want to increase the number of students taking part. The relatively small scale of this research (only 34 students) affected the ability to generalize the effects of my treatment in changing student's self-reported beliefs and mindsets. Similar research needs to be conducted on a much larger group of students, and ideally among multiple teachers' classes. Sample size is perhaps the greatest limitation on the findings and generalizability of my research. It would also be crucial to repeat this topic of study on a more-normal, public school population which likely would consist on many students who do not know how to “do school.”

The treatment period of Friday quizzing spanned just six weeks. With a longer treatment, I might have seen more noticeable growth in a greater number of students. I

plan to incorporate this Friday routine into all future mathematics classes. I am interested to see the extent to which a lengthier treatment (an entire school year vs. six weeks) affects student development and growth. With a greater amount of time, I believe I can move beyond gathering data and provide additional focus and support for the individual students who seem less affected by the routine.

My action research attempted to fill in a crucial gap in the literature, in terms of the population demographic and the qualitative nature of focus. The literature is still missing a qualitative analysis on the role of (unrecorded) formative quizzing on public school students of the same age as my sample (age 11-14). The dynamics of a larger public school might result in research which yields different results, particularly because my population is a distinct subset (highly capable, academically talented) of the public school population. Qualitative research on this topic is also lacking among high school and older populations, and I can not even guess what results might come from research on elementary school students. I would also like to conduct the quantitative research on this topic, which is absent from the middle school-age literature. I am curious if my original treatment on unrecorded weekly quizzes would show quantitative improvement on summative exams, using a control group design.

The concept of weekly, unrecorded formative quizzing would likely benefit students in any mathematics course. Large-scale implementation of this routine comes with a small time commitment but noticeable student benefit. This routine could be introduced in any course in which objective learning goals need to be assessed. Routine quizzing can formatively guide students in subjects ranging from science, foreign

language, and visual arts (where problem solving and the ability to demonstrate a skill are important) to social studies and language arts (where memorization of facts and the ability to synthesize complex ideas are stressed). I know that it has been largely successful in my classes, with my subset of the general middle school population.

Following up with the participants

Two months after concluding the treatment with my Algebra students, we still incorporate the Friday quizzes. As before, they are unrecorded and allow each student an opportunity to practice test-quality questions shortly after the material is introduced. In this way, it is formative. During the final, group interview in this study, the students strongly suggested that we continue this routine. Students who originally embraced this new routine continue to show growth in their self-regulatory learning skills. Those who did not originally embrace the new routine are still being encouraged to find ways to use the Friday quizzes productively. I plan to continue this routine with my algebra students while ensuring that I remain very intentional about how I conduct this practice. Perhaps I will be able to reach even the students who, in this research study, seemed minimally affected by the routine.

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Appendix A

Quiz Given to Students on Friday, October 8th, 2010

QUIZ “Number Sentences Review”

1. If one number is added to five less than twice the number, the sum is 37. Find the number.
2. How many boys are in a class of thirty-eight, if the boys outnumber the girls by four?
3. If twice a number plus ten is equal to four times a number minus ten, what is the number?

Appendix B

Quiz Given to Students on Friday, October 15th, 2010

QUIZ “Operations with Variables”

1. Simplify:
 $-3(4x-5) - 6(7-2x)$
2. Solve for “y” in terms of the other variables: $4yz = 36y^2$
3. Solve for “m” in terms of the other variables:
 $\frac{1}{2}m + 16c = 8d$

Appendix C

Quiz Given to Students on Friday, November 19th, 2010

QUIZ “Graphing Linear Equations”

1.
 - a. Give the equation for ANY line, in standard form.
 - b. Then, write the same equation in slope-intercept form.
 - c. Identify which value (in your answer to part b) represents the SLOPE and which represents the Y-INTERCEPT.

2. Katie wants to buy a combination of hot dogs and drinks at the movie theater. Hot dogs is \$4 and Drinks are \$2 each. She has \$12 to spend. The amounts of hot dogs (x) and drinks (y) that she can buy are given by the equation:

$$4x + 2y = 14$$

Identify the X and Y-intercepts, then graph this equation to find all 4 possible combinations of hot dogs and drink that can be purchased. List these combinations.

Appendix D

Initial Survey Given to Students

Initial Student Conceptions of Assessment

Please circle the number (1-4) which best represents *the extent to which you agree* with the statement given. Please respond to every statement. The words “I” “me” and “my” refer to *you*, the participant.

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

Written quizzes and tests...

a. place students in categories	1	2	3	4
b. compare student work against set criteria	1	2	3	4
c. measure my progress against achievement objectives	1	2	3	4
d. assign a grade or level to my work	1	2	3	4
e. determine if I meet the standards	1	2	3	4
f. provide students feedback about their performance	1	2	3	4
g. provide <i>me</i> with useful feedback	1	2	3	4
h. help students improve their learning	1	2	3	4
I. help <i>me</i> improve my learning	1	2	3	4
j. help me see what I still need to learn	1	2	3	4
k. positively affect the social climate of the class	1	2	3	4
l. make students do their best	1	2	3	4
m. make <i>me</i> do my best	1	2	3	4
n. are appropriate and beneficial for students	1	2	3	4
o. are engaging and enjoyable experiences for kids	1	2	3	4
p. identify student strengths and weaknesses	1	2	3	4
q. establish what students have learned	1	2	3	4
r. show what goes on in the minds of students	1	2	3	4
s. measure students' higher order thinking skills	1	2	3	4
t. are fair for all students	1	2	3	4

Mid-chapter quizzes...

u. predict future student performance	1	2	3	4
v. are valuable to me	1	2	3	4
w. help me succeed in class	1	2	3	4
x. help me do better on tests that I would have	1	2	3	4
y. should not “count” in my overall course grade	1	2	3	4
z. would be more <i>helpful</i> if they were ungraded	1	2	3	4
aa. interfere with the way I learn	1	2	3	4

In general,

Effects of Unrecorded Quizzes

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bb. I do quizzes but make little use of the results	1	2	3	4
cc. I ignore assessment results	1	2	3	4

Adapted from *Student Conceptions of Assessment V1* (Brown & Hirschfeld, 2007) and
Conceptions of Assessment V3 (Brown, 2002)

Appendix E

Final Survey Given to Students

Final Student Conceptions of Assessment

Please circle the number (1-4) which best represents *the extent to which you agree* with the statement given. Please respond to every statement. The words “I” “me” and “my” refer to *you*, the participant.

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

Written quizzes and tests...

f. provide students feedback about their performance	1	2	3	4
g. provide <i>me</i> with useful feedback	1	2	3	4
h. help students improve their learning	1	2	3	4
I. help <i>me</i> improve my learning	1	2	3	4
j. help me see what I still need to learn	1	2	3	4
k. positively affect the social climate of the class	1	2	3	4
l. make students do their best	1	2	3	4
m. make <i>me</i> do my best	1	2	3	4
n. are appropriate and beneficial for students	1	2	3	4
o. are engaging and enjoyable experiences for kids	1	2	3	4
t. are fair for all students	1	2	3	4

Mid-chapter quizzes...

u. predict future student performance	1	2	3	4
v. are valuable to me	1	2	3	4
w. help me succeed in class	1	2	3	4
x. help me do better on tests that I would have	1	2	3	4
y. should not “count” in my overall course grade	1	2	3	4
z. would be more <i>helpful</i> if they were ungraded	1	2	3	4
aa. interfere with the way I learn	1	2	3	4

In general,

A. I studied for the Algebra <i>quizzes</i>	1	2	3	4
B. I studied more for <i>tests and (graded) quizzes</i>				
than I have in past math classes	1	2	3	4
C. Algebra weekly quizzes changed how I prepare for tests	1	2	3	4

D. Algebra weekly quizzes improved my study habits	1	2	3	4
E. I wish my quiz scores would have “counted”	1	2	3	4
F. I felt comfortable making mistakes on quizzes	1	2	3	4
G. Taking quizzes motivated me to do my best on tests	1	2	3	4
H. In the past, I have experienced math test anxiety	1	2	3	4
I. I have generally felt less anxiety on math <i>tests</i> <i>and quizzes this year</i>	1	2	3	4
J. I want to be successful in mathematics	1	2	3	4

Please elaborate on your thoughts regarding the usefulness and value of our weekly, ungraded quizzes. You may include any thoughts related to our Friday quizzes that you would like to share. Use as much space for writing as you wish.

Adapted from *Student Conceptions of Assessment V1* (Brown & Hirschfeld, 2007) and *Conceptions of Assessment V3* (Brown, 2002)

Appendix F

Potential Initial Interview Prompts

[Researcher's notes: student will not see this printed copy, order of questions may be changed]

- 1.a) Please think of the phrase, “falling behind in class.” What does that mean to you?
- 1b.) Do you feel like you generally keep from falling behind in classes (not only math classes)?
- 1c.) [if “no”] Why do you think you fall behind? What keeps you from staying on track?
[if “yes”] If you were falling behind, what would that situation look like?

- 2a.) Please describe what *how* you would keep from falling behind in math class in a math class.
- 2b.) Imagine that you were having a difficult time staying current in this class, and felt like you were in danger of falling behind. How would you respond to that situation...what would you do?

- 3a.) Describe how you might prepare for an upcoming math test.
- 3b.) If there was an exam coming up soon, and you were knew that you weren't prepared for it, what would you do?
- 3c.) How would you know that you *were not* prepared?
- 3d.) How would you know that you *were* prepared?

Appendix G

Sample of Student Survey which has been Coded and Memoed.

[illegible]

Table 1

Distribution of Student Agreement/Disagreement with Survey Prompts as a Percentage of Total Responses

Statement	Initial (n=33)		Final (n=33)	
	Agree	Disagree	Agree	Disagree
Written quizzes and tests...				
provide feedback on performance	88	12	95	5
provide <i>me</i> with useful feedback	97	3	88	12
help students improve learning	67	33	77	23
help <i>me</i> improve learning	71	29	71	29
help me see what I need to learn	88	12	88	12
have positive effect on social climate	38	62	9	91
make students do their best	79	21	74	26
make <i>me</i> do my best	79	21	79	21
are appropriate and beneficial for students	75	25	85	15
are engaging and enjoyable for kids	11	89	11	89
are fair for all students	47	53	69	31
Mid-unit quizzes...				
predict future student performance	34	66	60	40
are valuable to me	72	28	72	28
help me succeed in class	67	36	67	36
help me do better on tests than I would have otherwise	77	23	67	33
should not count in my overall grade	68	32	79	21
would be more <i>helpful</i> if ungraded	68	32	68	32
interfere with the way I learn	6	94	9	91
In general...				
I studied for the Friday quizzes			22	78
I have studied more for tests and (graded) quizzes than in past math classes			46	54
the weekly quizzes changed how I prepare for tests			29	71
the quizzes improved my study habits			26	74
I wish my quiz scores had counted			26	74
I felt comfortable making mistakes on quizzes			80	20
quizzes motivated me to do my best on tests			60	40
in the past, I have experienced math test anxiety			60	40
I have experienced less anxiety on math tests and quizzes this year			64	36

Note. Some percentages are based on (n<33) because individual students omitted responses to certain prompts. All percentages are rounded to the nearest whole unit.