Writing in Mathematics

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Writing in Mathematics

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Introduction

Adolescent literacy has become a growing concern. Of late, more and more teacher education programs have worked content area literacy classes into the list of requirements. More than that, teachers can take the learned information, say it sounds great and fall into the familiar rut of teaching concepts and preparing students for assessments. This can definitely happen in a mathematics classroom. Taking more literacy activities and placing them into the everyday classroom can enhance learning and show students that there is “life and literacy after fourth grade” (Rycik and Irvin, p. 61).

A descriptive research problem to be asked is “Does student appreciation for math increase when literacy activities are present?” Math has always been a subject that students like or don’t like. They have various reasons and usually their feelings don’t change, especially if they don’t like it. One reason students give to not liking math is that it is boring. A teacher comes in teaches, gives examples, and students need to be able to regurgitate the information in homework, quizzes, unit tests and state tests. In this study student appreciation will be looked at with detail. Appreciation will be considered closely as to how much a student likes the subject of mathematics. It will also look to see if they become more confident in their ability to successfully complete the tasks set before them and more motivated to give math a try.

Students’ levels of appreciation will be measured via surveys, interviews, observations and grades. The surveys and interviews will look at a student’s personal opinion to see if an increase in attitude, confidence and desire to do math exists. Observations will note student’s participation and interactions in the classroom and effort put forth in the literacy activities. The student’s grades will be viewed because generally when students are happier with the tasks before them, they will put forth more effort and work harder to succeed.

Literacy itself has many definitions. Readence, Bean and Baldwin, the authors of Content Area Literacy, note two definitions, though related still different. The authors define literacy as the level of reading and writing still necessary to read, comprehend and react to appropriate
instructional materials in a given subject area on page four. Then, on page 35 they redefine literacy as the ability and the willingness to use reading and writing to construct meaning from printed text, in a way which meets the requirements of a particular social context. The authors of Adolescent Literacy Research and Practice refer to literacy as the education goal of teachers that all students think, read and write critically (p.40.)

Throughout the course of this study students will participate in a variety of different literacy activities. These activities are events where students will participate in a writing assignment that is meant to connect the mathematics that they are learning to previous mathematical experiences, their personal lives, and/or the rest of the world, hence allowing the students to grow.

For the this study, I am using literacy activities, which I will define as writing activities meant to assist the students in organizing their learning and create active involvement in class related activities. Some activities to be used are math journals, tickets out the door, vocabulary developing charts and organizers, the word wall, writing assignments, and guided reading worksheets to clarify the textbook reading.

The significance of this problem is that many math classrooms remain “traditional.” Many teachers revert back to what is easiest or most familiar, lecture and practice without considering the student and their need to grow. Students also suffer from the condition of not liking mathematics. Through this research and study, I hope to find that when a teacher adds literacy activities to a classroom, that the students develop a greater appreciation for mathematics. In a study by Elizabeth Moje, she found increased student interest, increase confidence and a realization that one subject differs from another and different learning styles and methods are needed.

Review of Literature

1. Rational for Writing in Math
   a. Research in support of Literacy/Writing in Math
Literacy and writing in mathematics classrooms has been something that has been studied more in the last two or so decades than it was studied prior to that. Not only has it become more studied, but also more practiced. Many also feel that the types of writing activities have changed over time as well. As presented by Bernadette Russek (1998), it was normal or routine to use writing in the math classroom in the direct forms of note taking, summary writing and descriptions and now writing is incorporated more in the forms of journal writing, paragraph descriptions with explanations to enhance learning and aid in assessment as well as giving students the opportunity to express how they feel about the mathematics they are learning and reflect on their work (Russek, p. 41).

In 2004 Robert L. Bangert-Drowns, Marlene M. Hurley and Barbara Wilkinson prepared a meta-analysis on the effects of school based writing to learn interventions. Their research shows that there is evidence of positive effects when utilizing writing activities. They state that many educators note striking similarities between writing and learning and that engaging students in writing activities about content is engaging them in learning that content (Bangert-Drowns, p. 30). The authors also found that writing might influence learning to such a degree that it is an authentic act of personal meaning-making (Bangert-Drowns, p. 31). To be more specific, writing can support more sophisticated elaboration and organizational strategies by linking new experiences with familiar ones, synthesizing knowledge, exploring relations and building conceptual frameworks as well as the idea that it is a tool of self-reflective monitoring of comprehension allowing students to evaluate their own understandings, confusions and feeling about a topic (Bangert-Drowns, p. 32). Three of the meta-analysis’ findings are particularly useful at this time. The study found that writing to learn studies show a typically positive and small effect on school achievement (Bangert-Drowns, p. 49). It also found that students in the sixth to eighth grade did better when conventionally instructed instead of when presented with writing to learn activities (Bangert-Drowns, p. 50). They note that the writing to learn tasks do not need to be elaborate and
that shorter periods of time are better than longer periods of time and that long writing assignments had a negative effect on student learning (Bangert-Drowns, p. 52).

People have varied definitions of literacy, but in many ways they are similar. Elizabeth Moje defines literacy as more than reading, writing, speaking and listening. She feels literacy involves the practices in which those processes are imbedded; she defines reading, writing, speaking and listening as tools for engaging in and making sense of practices. She feels that people can use literacy as a way of making meaning for themselves and for other people (Moje, p. 175). For literacy and writing in math to work well in the classroom, the classroom culture needs to be reviewed. Some of the things that students and teachers use to define classroom culture are beliefs about the nature of knowledge, past schooling experiences and their role in schools and schooling, home and community experiences, and feelings and emotions about school and about themselves in general (Moje, p.175). Teachers and students in secondary classrooms are able to construct meaning about literacy and learning events based on varied beliefs and knowledges that stem from material and discursive interactions with people and text (Moje, 9. 175).

Strategy researchers have generally found significant positive differences in the reading and writing processing skills of those who use content literacy strategies in controlled settings (Moje, p. 176). According to Russek, there are many motivators for using writing strategies in the mathematics classroom. They include the consideration that writing is a valuable assessment tool, it allows individuals to express their attitudes, beliefs and mathematical ability and the ability to express ideas clearly as well as the idea that writing also opens doors of communication to students who have suffered from feelings of math anxiety or the famous “I hate math” feelings (Russek, p. 36). Overall, the finding of the student by Moje supported views of literacy that assert that literacy consists of a “set of social practices” in which people engage for “specific purposes in specific contexts of use” (Moje, p. 190).
Mathematics has been viewed as having a language of its own. Students struggle when they do not understand the mathematical language and are unable to communicate with it. Our students are routinely confronted by passages of unintelligible mathematics (Bullock, p. 740). Many use the idea that mathematics requires a special talent and that fact is often used as an excuse for not learning or even for not teaching it (Bullock, p. 740). However, students need math and will succeed if they understand the language and are comfortable communicating it.

In Elizabeth Moje’s study, “I teach students, not subjects,” the teacher, Ms. Landy defined literacy events as those events in which students read, wrote or talked about texts (Moje, p. 183). She and her students believed that the literacy events generally involved breaking down or synthesizing of complex ideas (Moje, p. 185). In Moje’s study many students were interviewed, both formally and informally and they left the class with generally positive attitudes about class and with a great deal of confidence in their abilities to learn (Moje, p.189).

James Bullock (1994) states that the study of mathematics not only allows one to read and understand the work of others, it also increases one’s own powers of thought, imagination and expression. He goes on to say that the fact that so many people view mathematics as frightening, boring or otherwise unpleasant represents a disappointing failure of our educational efforts. Bullock states that literacy in mathematics is not simply a question of how much or for whom, but looking at where we are and what we can do to improve the curricula (Bullock, p. 743). He also notes that it is an immediate cause for concern because of the widespread difficulty students experience in learning math and that if a more practical method is offered, they opt for that (Bullock, p. 735).

Student’s beliefs are very important to consider. Not just their beliefs about math and whether or not they like it, but also their beliefs about its usefulness or purpose and the role of different types of instruction. A study by Peter Kloosterman, Anne M. Raymond and Charles
Emenaker looked at student’s beliefs about mathematics over a three year time span. Their data and research indicated several important points. They found out that student’s beliefs were relatively stable over time assuming environmental factors didn’t cause a change (Kloosterman, et. al. p. 39). They found out, through conversations with the students that the students have many ideas about how well they like math, what they need it for and how strong there are at it; when beliefs are related to learning they can have a significant effect on what students do in a classroom (Kloosterman, p. 39). It is important to understand the student’s beliefs in order to try to introduce different teaching styles. Kloosterman’s study found that student’s beliefs on group work versus individual work varied based on the type of classroom the child was working in. Specifically, students will not be highly motivated in school unless they believe that they are learning something that will be valuable to them (Kloosterman, p. 40). In this study researchers looked at both the achievement of students and their beliefs. When data was gathered from students about their beliefs they mainly used an interview approach allowing them to reword questions to students who initially provided short responses (Kloosterman p. 43).

Successful literacy programs for adolescents result from creation and not imitation. James A. Rycik and Judith L. Irvin (2001) note that the process of creation needs to be guided by an awareness of the literacy needs of adolescents (p. 111). While creating a literacy program or literacy events in a classroom the what, how, who, where and when must be considered. The what is curriculum objects, instructional strategies constitute the how, students the who, and they the decision of where and when literacy should occur rounds out the questions (Rycik and Irvin, p. 111).

b. Teachers role

The teacher’s role is unique when dealing with literacy activities and writing in math classrooms. Teachers have been widely criticized for their inconsistencies in using content area
literacy activities. In the last couple decades there has been a push to include literacy activities into content areas and education programs have included required courses to educate the pre-service teacher. Teachers have many options for what direction to take in the classroom and some have strong opinions regarding content area literacy. Since many teachers have been educated on the subject they understand the benefits of it and respect what opportunities it can provide students, however, then they may choose another method of teaching.

James Rycik and Judith Irvin (2001) discuss the idea that all students should have easy and frequent access to rich and meaningful literacy opportunities. They state that many students have too few opportunities to work with adults who know how to help and thus these students may withdraw from classroom literacy events. They continue to say that in many ways the students will remain outsiders, standing at the door to literacy, but lacking either the confidence or strength to open the door (p. 7). We look on to realize that teachers need to have knowledge and confidence themselves to utilize many rich and meaningful literacy events.

Rycik and Irvin present the idea that literacy in the classroom will change the environment of the classroom. They suggest not focusing on specific instructional strategies, but consider the next four ideas. Making explicit connections between curriculum and student lives, providing rubrics that show students how to evaluate their own learning, using discussion and writing to help students extend or clarify ideas and collaborate with students so they share and challenge one another (p. 61).

In addition to the idea that literacy will change the environment of the classroom, teachers need to be well aware of the students. Mary Roe (1997) notes that teachers need to listen to all messages about literacy from their students (p. 15). Using literacy events can be successful when the teacher is paying attention to the students to see how they are responding to the activity and make adjustments when necessary. A teacher cannot just pay attention to the messages from the
students that are most closely linked to the teacher’s literacy agenda if they want to affect student’s literacy engagement (Roe p. 15). Roe also discusses more aspects of the teacher’s role. She states that teachers must remain critical of their instructional choices; they must be able to distinguish between appropriate and inappropriate instruction allowing them to determine the topic’s worth (Roe p. 15). Strategy instruction or the building of a skill does not depend on finding the right program or imposing a pre-determined sequence of lessons, but rather requires monitoring students as they read and write so instructional needs can be detected and accommodated (Roe p. 15).

One important responsibility of teachers is to motivate students. Barbara L. McCombs and Mary Lee Barton (1998) discuss a survey where students indicated what motivates them to learn. In a summary, McCombs and Barton state that students would be more motivated to learn if school was a place they could experience success (the need for mastery), curiosity (the need for understanding), originality (the need for creativity) and relationships (the need for positive involvement with others) (p. 73). They go on to say that when students feel a sense of belonging, feel competent, respected and trusted to make choices, it contributes to healthful development, motivation for learning and strong character. Meeting these needs is essential not only for eliciting motivation to learn but also for promoting a sense of personal responsibility (p. 73).

Elizabeth Moje states that differences in teacher’s knowledge and beliefs about pedagogy stem from a complex interaction of their experiences, beliefs, and values about life and learning, as well as their beliefs about knowledge of content and how to teach content (p. 176). Teachers need to find a way to be effective at meeting student’s needs and teachers who resist literacy strategies desire to be effective at transmitting content; thus, the literacy strategies seem burdensome and time consuming (Moje, 177).

Elizabeth Moje studied a classroom facilitated by Ms. Landy in the early nineties. Ms. Landy is quoted to say that she was committed to student success and believed that she needed to
“reach out” or build a rapport” with students to help them be successful learners (Moje, p.180). Moje determined that Landy was committed to caring for people and that she demonstrated that by getting to know the students as individuals, but also by using literacy strategies that she believed would help them learn more effectively (p.181). In essences, literacy was practiced in Ms. Landy’s classroom as a tool for organizing thinking and learning in the context of a relationship built between the teacher and her students. Therefore the students were willing to participate in the literacy events because they believed that the teacher used the activities to help them learn (Moje, p. 181). Ms. Landy communicated with the researcher that she believed that teaching was her calling, that she enjoyed working with people, and wanted students to feel good about themselves and be successful (Moje, p. 185). Landy, when she started teaching, taught traditionally. She stated in an interview that she taught her subject, and all the facts, but eventually realized she needed to teach students, not subjects. She changed her teaching philosophy toward helping the students learn (Moje, p. 186).

There are many things that Ms. Landy did that benefited her students. She made decisions based on philosophy of her subject area, pedagogical content knowledge and her knowledge of and beliefs about learner’s needs. She then created her curriculum that supported the use of organizational literacy activities (Moje, p. 184). Ms. Landy’s perspectives also kept her motivated to focus on what she believed were her student’s needs and her commitment to her students’ success prompted her to look beyond subject area concepts to find ways that would help students become better learners (Moje, p. 185). She engaged students in activities where they were involved in making meaning about the material (Moje, 183). She believed that she was able to appear spontaneous and to concentrate on students’ understandings and interests because she was so organized; she modeled organization and expected it (Moje, 184). Ms. Landy believed that it was crucial to connect with students and to find that special creativity within each student (Moje, p. 186). Overall Ms. Landy moved from a subject centered to a student centered classroom.
orientation with her focus on the students instead of the subject, thus requiring her to use whatever strategies she deemed necessary to make the students successful learners.

James Bullock (1994) discusses that many have come to perceive mathematics as a collection of specialized skills rather than as a way of thinking and communicating. This leads our students to conclude that mathematics is either worthless or impossible to master (p. 740). In many cases students are presented procedures and processes and are expected to repeat them. Bullock states that this type of teaching creates an air of training as opposed to education. To avoid this, he says that the teacher must obtain practice in expressing mathematical language and words must be given a context if the teacher is going to enrich the students with their meanings (p.740).

Importantly, content teachers need to be a part of the effort to improve student literacy. It is notable to say that teachers need to explore how literacy can enhance their teaching of any content area, even mathematics. We can use literacy to motivate students to want to learn. The skills they learn can be utilized in many classrooms and many real life situations.

c. Students’ role (Benefits and feelings)

The student role in the literacy classroom is an important aspect to review, especially regarding the benefits to the students and the feelings of the students both during the activities and after the activity. As mentioned in the teacher’s role, the students must be taken into account when deciding about literacy activities. Students play a major role in a classroom, they are the ones doing the learning and teachers must teach them the way the students learn best. Students should be decision makers in the classroom. They should be given the opportunity to make decisions or judgments about their work allowing them to gain a sense of ownership to their work (Wilcox p. 98).

Elizabeth Moje’s study sheds some light on the thoughts of students about literacy activities in their classroom with Ms. Landy. Students in Ms. Landy’s class participated in the
literacy events in part because of their relationship with the teacher and attributed their success to her enthusiastic and motivating teaching which kept them involved and motivated (Moje, p. 188). The literacy activities from Ms. Landy’s classroom left the students believing that writing served two purposes. One being for retention of information for later reference and the other enabling the students to organize and highlight key ideas from a large mass of information (Moje, p. 184). The students also felt that classroom conversation helped them think through the different rules, processes and concepts they learned. The students were willing to participate because they believed the teacher used the activities to help them learn and be successful, as well as feeling that the inclusion of the literacy events was evidence of Ms. Landy’s teaching effectiveness as well as her caring for them as learners (Moje, p. 181). Many students were interviewed throughout the course of the study and some of them suggested that their subject was organized and logical, thus requiring organizational literacy practices and one student stated that she believed that the organizational strategies helped her understand more fully (Moje, p. 184). One student, Lew, stated that he appreciated teachers who were positive and motivating, he valued his teachers teaching of literacy strategies that helped him organize and understand course material. He also said that he would have been flunking if he did not have the positive teacher that he had (Moje, pg. 187). Another student, Noreen, stated that using literacy strategies helps because it helps her when she writes things down. The process of the strategy helps because she knows exactly what she is supposed to know (Moje, p. 187). It was noted that several of Ms. Landy’s students would return after some time in college to tell her how much they appreciated her teaching and how successful they had been believing that her strategies helped (Moje, p. 188).

Students have many opportunities to be valued members of a classroom. They can do many things to keep developing their ideas. This includes students evaluating students, using drawing, prepared presentations, and a checklist to assess one’s own work (Wilcox p. 99). Journaling and
questioning techniques can also encourage students' reflective thinking allowing them a greater
ownership to their work and education.

II. Literacy Activities

There are many types of literacy activities that can be incorporated into a lesson plan. One
type of literacy activity to consider is note-taking strategies or graphic organizers. Another to
consider is journaling. Journaling includes keeping a separate notebook for the purpose of free
writing and reflection, it can include responses to specific prompts or responses to mathematics
questions with explanations for finding the solution. Tickets out the door or in the door, which are
similar to journaling can also be considered a writing or literacy activity as a student communicates
in writing to the teacher what they know or do not know. Writing projects can also be a useful
literacy activity. Some to consider are the Hanging Cube Project, RAFTs or Foldables. These
projects can typically be done near to or at the end of a topic to review it, summarize it, or provide
the final assessment.

The Frayer Model has been considered a valuable note-taking strategy as well as a graphic
organizer. Its main use is for vocabulary building. The Adolescent Literacy website notes that
these strategies have several benefits including promoting critical thinking and gives students the
opportunity to draw upon prior knowledge and connect it to new concepts. This strategy can be
used at many different times. It can be used during the introduction of topic, or during or after a
lesson to review the topic.

Good note-taking strategies can reinforce students' understanding of required content area
material. According to Beverly and Troy Strayer (2007) when using good strategies that present
key information and concepts in a way that students can interact with and connect to, the students'
retention will increase, confidences soar and they will have a deeper understanding of the content
they learned (p. 46). A strategy promoted by the Strayers is Movie Frame notes. The students
would have notes similar to two column notes, but the one side would be movie clip boxes and the other side would be lines to clarify the information. With this type of note taking the students have an opportunity to complete either column first and then fill in the other. In math, however, the movie clips could contain pictures or mathematics problems as they pass through the many steps to complete.

Journal writing is an area that can develop a student’s writing ability and is feasible in a mathematics classroom. As Joan Countryman (1992) notes early on, students will ask, what does writing have to do with math (p. 27). She goes on to say that she tells the students that a journal allows them to chart their journey through math, keep track of where they have been and where they are going, where their successes were and where their struggles lay. Her list of benefits includes: increases confidence, increases participation, encourages independence, to monitor progress and to enhance communication between student and teacher (p. 42-43). Readence, Bean and Baldwin note a couple things about journal writing. First, that journal writing can communicate a student’s feelings and emotions and provide the teacher with a sense of how the lessons are progressing for individual students on various days. Second, in busy classrooms, they can serve as an important need to communicate attitudes and interests beyond the endless facts and concepts (p. 240).

Journal writing can take on a couple different forms. It can be in the form of free writing. Countryman suggests giving students five to ten minutes of time to write about anything in math. She also promotes the use of journal prompts or sentence stems. A couple of free writing prompts she offers are the trouble with math is, math is like, teachers usually say, prime numbers are, to study for a math test I usually (p. 19). According to Countryman, journal writing is an informal writing, and at times is a student’s personal sharing or in a conversational tone. She recommends that spelling, punctuation, grammar and writing structure not be fixed when reviewing the students work (p.31). Readence, Bean and Baldwin note that the journal writing should become a regular
part of teaching and that students should write on a daily basis. They offer the idea that journals are an excellent way to introduce a topic and explore prior knowledge as well as to recap the previous day’s lesson (p. 241). Both Countryman and Readence, Bean and Baldwin agree that the teacher should keep her own journal and write when the students do and that the teacher should share her writing. They also agree that teachers should look at the students journal entries and respond to their thoughts informally. Readence suggests collecting periodically a few times a semester to review the students’ ideas (p. 241). Countryman mentioned that she would collect them once a week (p. 40).

The ticket out the door or a similar ticket in the door can be very similar to journal writing, but still different. It is often a more specific question or has a leading prompt that requires a quick response. Possible prompts to use are three things learned today, I have a question about, the part that confused me the most was, what are the steps for, give an example of or how are two things learned similar or different. These prompts can be used for in the door or out the door with slight rewording.

Another type of writing project to consider is RAFTing. RAFT stands for role, audience, format and topic. Students are allowed to pick what perspective they write from and to what audience they write to as well as what type of writing they want to do. The Strayer’s main objective for this project is for students to demonstrate in detail what they know about a certain topic. They feel that these assignments will help students practice what they have learned in a creative, choice based format allowing them to organize the information they gathered, elaborate on it and create a coherent piece of writing that demonstrates understanding (p. 58). The Strayers say that this type of project can be used as a formative assessment during a unit of study or as a summative assessment at the end of the unit.
Dinah Zike presents a whole book entitled *Teaching Mathematics with Foldables* to go along with the Glencoe Mathematics textbooks. Foldables can be used as a culminating project as well as part of any lesson. They are 3-D, interactive graphic organizers, hands on manipulatives that are student made. Students can use notebook paper, construction paper or computer paper to make them. Zike provides a list of reasons why teachers should consider using her foldables in her introduction on page vi. Foldables replace teacher generated writing and photocopied pages with student generated pages that can be used as study guides. Foldables immerse students in previously learned vocabulary and concepts; allow students to quickly organize, display and arrange information.

The Hanging Cube project allows students to explain in words and show in symbols and numbers how to do certain types of problems. It is a project based on a foldable design entitled the Standing Cube on page 20 of Dinah Zike’s book. It allows students to show similarities and differences in topics that have four categories.

III. Connections to the Standards

The New York State Standards provide direction and guidance to teachers. The communication strand is particularly important at this time while planning to incorporate literacy activities into everyday teaching. One part of the strand states that students will organize and consolidate their mathematical thinking through communication. More specifically, they will present work with an organized thought process that is correct, complete, coherent and clear as well as be able to explain why they chose that strategy. The Hanging Cube project on equations will give students an opportunity show both the solved equations as well as written explanations explaining how they solved the problems and how the problems are similar and different from one another. Another key portion of the communication strand category is that students will use the language of mathematics to express mathematical ideas precisely. This goes on to say that students will be able to increase their use of mathematical vocabulary and language when communicating.
with others. They will also be able to use appropriate vocabulary when describing objects, relationships, mathematical solutions and rationale. The RAFTs will offer opportunities for the students to communicate in a method they are comfortable with and discuss the mathematic topic at hand carefully and in detail using mathematical terms and vocabulary. The Frayer Model for note taking offers students a useful graphic organizer to develop vocabulary. In addition, the standards also would note that students should be able to organize mathematical ideas through manipulation of objects, numerical tables, drawings, pictures, charts, graphs, tables, diagrams, models and symbols in written and verbal form. Many of the activities will give the student opportunities to communicate, especially the journaling and the foldables. The book on foldable includes many options for use and any one of the above ways to communicate can be used. One type is a venn diagram which can be used for least common multiple and greatest common factor. It is key that students can communicate in both the verbal and written form. In a classroom, only one person or a few students can talk at the same time, but if a writing assignment is given, they can all communicate all at once. Then, reviewing the writing pieces a teacher can see where any holes exist.

Development, Measures, Methods and Procedures

In response to my desire to incorporate non-traditional teaching strategies in my classroom I will look at one; writing in mathematics. I learned in a very traditional manner, especially in mathematics classes and would like to offer my students different strategies. I believe also that students will perform better in mathematics if they enjoy the subject. Throughout this study, several writing/literacy activities will be incorporated into the lesson plans. Students will answer various surveys/questionnaires to reflect on math and on writing in mathematics. The hypothesis that I am testing is that student appreciation for math will increase when literacy activities are present.
This study was conducted in a class with seven sixth grade students. The title of the class is AIS math. Academic Intervention Services (AIS) is mandated by the state of New York for students who have not met the state standards at the previous grade level. Our district bases their AIS class list off of the previous years New York State Math Assessment and teacher recommendation. If a student scores a level one or level two, they must be enrolled in AIS. If they have scored a level three, but have struggled in math, teachers recommend that those students are also placed in AIS. In our district, the students who must receive services must receive it at least one day a week. In light of that information, my class of seven meets together one day a week and each student is also in another AIS math class with other students in smaller groups. The reason for this is that the students AIS period also conflicts with band, chorus, and other subject’s AIS classes. Another unique aspect to this class is that no grade is assigned, so no homework is given. All assignments and tasks are completed in class. If necessary, students will be taken from homeroom or lunch to complete an important task or for continued work with a topic if they are struggling. Of the seven students, six of them returned their consent forms allowing them to participate in the study. Of the six students, three are female and three are male.

Since I meet with the students twice a week, the study will be carried out over a five week time period. The students are preparing to take their sixth grade state mathematics assessment in the first week of May, so the months of March and April are geared towards review of sixth grade topics that have been frequently tested on in the past. Those topics include equations, measures of central tendency, range, proportions and similar triangles, circles and volume of rectangular prisms.

This study is using several surveys to review student feeling about and appreciation of mathematics. These surveys can be found in the appendix. To begin, the students will take a portion of the Mathematics Attitude Inventory. The survey will produce a scale score for each of the following subtitles: Self-Concept in Mathematics, Enjoyment in Mathematics, and Motivation in Mathematics. They will also retake this survey at the very end of the study. With the hypothesis
of student appreciation increasing, I expect that the scale scores will rise when the students take the survey at the end of the project.

The students will also complete a short survey which will allow them to reflect on the writing/literacy activities that we use or complete in class. This survey will be the same for each activity. Since these students are students who struggle with math, they will have differing opinions on their feeling about writing in math. Some students who struggle with math are good communicators, but some students struggle in all academic areas. Our district tracks sixth graders on reading level. One student is high, four are medium, and one is low. A student’s reading level affects their ability in other subjects as well and thus may affect their writing ability. I think that some of the students may not like the writing activities, but others will enjoy them because they are able to use some of their other talents.

In addition to those surveys, there will also be a closing survey that the students will take at the very end of the time period of the project. The survey, which consists of eight questions gives students the opportunity to answer questions with scaled responses as well as questions that need to be answered in complete sentences. The goal of the closing survey is to get a general overview of the student’s feeling about mathematics and writing in mathematics.

Student’s opinions will be taken into consideration, but so will teacher observation. I will observe the students during my class sessions as well as in their regular math classroom. Since I want to see if they appreciate or like mathematics more with the inclusion of writing activities, I would like to see if it changes their regular math class participation. During our AIS class times we are in small groups and the students have more opportunity to participate. Seeing the students in the regular math class shows their amount of participation in a class size of approximately twenty students. When checking to see if the students participation rates are increasing, I am going to note
the number of questions asked by teacher, how many times did the student volunteer and how many correct responses the student gave.

Student's grades will also be reviewed. Since this study took up half the third marking period, I am going to compare the students first and second marking period grades to the third marking period. Since the topics we covered in AIS class are not corresponding to what is learned in the regular math classroom, I do not anticipate a huge grade change. However, I feel that since the writing activities should cause students to like or enjoy mathematics more, they will work to perform better in math class, which may cause their average to rise.
Lesson Plan Calendar

Unit: Review of Sixth Grade New State Mathematics Assessment

<table>
<thead>
<tr>
<th>Day 1 (Smaller student groups)</th>
<th>Day 2 (all students together)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Review Equations</strong>&lt;br&gt; Ticket in the door – write down anything you can think about EQUATIONS&lt;br&gt; Ticket out the door – solve two of the four equations with written explanation</td>
<td>Journal Entry: How do expressions and equations differ?&lt;br&gt; Equations Project – Hanging Cube</td>
</tr>
<tr>
<td>Finish equations project if necessary&lt;br&gt; Ticket in the door – solve 3 of the 4 equations&lt;br&gt; Review parts of a circle – use movie frame notes for picture and definition (radius, diameter, chord, and central angle)</td>
<td>Journal Entry: Define in your own words area and perimeter&lt;br&gt; Circles: Area and Circumference</td>
</tr>
<tr>
<td>Circles RAFT Day 1&lt;br&gt; Introduce the project&lt;br&gt; Explain all the parts and brainstorm RAFT parts and beginning work for project</td>
<td>Journal Entry: Write about any topic that you are struggling with in your regular math class&lt;br&gt; Circles RAFT Day 2&lt;br&gt; Project work day&lt;br&gt; Finish during homeroom or afterschool if necessary</td>
</tr>
<tr>
<td>Volume of Rectangular Prisms&lt;br&gt; Visual with the unit blocks&lt;br&gt; Identify the formula&lt;br&gt; Use the formula: Movie frame notes</td>
<td>Journal Entry: Write down anything you can remember about Proportions&lt;br&gt; Identifying and Solving proportions&lt;br&gt; Frayer Model notes page to define and identify proportions&lt;br&gt; Solving two different ways: cross multiplication and equivalent fractions&lt;br&gt; Journal entry: what did you find easy about proportions and what was difficult or confusing</td>
</tr>
<tr>
<td>Similar Figures: More with proportions&lt;br&gt; Ticket out the door: Create one fraction, give to teacher, teacher creates a proportion with a variable, student solves proportion for variable and explains how they solved it.</td>
<td>Journal Entry: Explain which method of solving proportions you prefer and why.&lt;br&gt; Mean/Median/Mode/Range Review and Project&lt;br&gt; Project: Layered-Look Book&lt;br&gt; Finish during homeroom, if necessary</td>
</tr>
</tbody>
</table>
Unit: Review for NYS Math Assessment

Lesson 1: Equations (1 day)

Objective: Review opposite operations and the steps to solve equations

New York State Standards:
- 6.CM.1 - Provide an organized thought process that is correct, complete, coherent and clear.
- 6.CM.9 - Increase their use of mathematical vocabulary and language when communicating with others.
- 6.CM.10 - Use appropriate vocabulary when describing objects, relationships, mathematics solutions and rationale.
- 5.A.5 - Solve and explain simple one step equations using inverse operations involving whole numbers.

Opening: Ticket in the door question – Students will grab the half sheet of paper that says ticket in the door and copy the question off the board. Question is: Write down anything you can think of about EQUATIONS. After a couple of minutes of brainstorming the students will begin to share their thoughts which will hopefully lead into the lesson. Collect the ticket in the door pages.

Lesson:
- Distribute the worksheet to the class.
- The top box is for opposite operations. Discuss opposite operations; they undo each other. Fill in the box.
- The bottom box is broken into mini boxes where the students can write and solve the equations. The boxes are empty so the students have to write in the equation we are solving so they do not work ahead.
- The plan is to solve eight equations, two of each operation, with varying degrees of participation from students.

Guided practice:
- For the first four problems, the students will identify the operation that exists in the equation.
- The second four the students will tell both what problem exists and which one they will need to solve.
- I may also prompt them to state which number they need to operate with, depending on how well they are doing.

Independent Practice: Give the students four problems, one of each operation to solve on the back of the page. I will move around while the students work and assist them when necessary. I may ask the students to verbalize the process while I assist them.

Closing: Ticket out the door – Solve two of the four equations with written explanations. A ticket out the door page will be distributed to the students which will have four boxes, an equation in each. When they complete two problems and write out the explanation, they may turn the ticket into me and relax until the final bell.
### EQUATIONS

#### Opposite Operations:

<table>
<thead>
<tr>
<th>Addition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subtraction</td>
</tr>
<tr>
<td>Multiplication</td>
</tr>
<tr>
<td>Division</td>
</tr>
</tbody>
</table>

#### Examples:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>
TICKET IN THE DOOR

DATE:______________

Name:____________________

QUESTION:

TICKET IN THE DOOR

DATE:______________

Name:____________________

QUESTION:
TICKET OUT THE DOOR

Name: _______________________

EQUATIONS:

1. Solve two of the equations.
2. Explain in complete sentences how you solved each equation.

<table>
<thead>
<tr>
<th>$x + 27 = 55$</th>
<th>$x - 43 = 65$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$8x = 128$</td>
<td>$\frac{x}{9} = 14$</td>
</tr>
</tbody>
</table>
Unit: Review for NYS Math Assessment

Lesson 2: Equations Project (1.5 days)

Objective: To become confident in solving one step equations. To become confident in using opposite operations and to identify which operation to use when. To communicate in words the steps to solving the equations and explain how the four different equations are different.

New York State Standards:
- 6.CN.2 – Explore and connect the relationship between mathematical ideas.
- 6.CM.1 – Provide an organized thought process that is correct, complete, coherent and clear.
- 6.CM.2 – Explain a rationale for strategy selection.
- 6.CM.4 – Share organized mathematical ideas through the manipulation of objects, numerical tables, drawings, pictures, charts, graphs, tables, models and symbols in written and verbal form.
- 6.CM.9 – Increase their use of mathematical vocabulary and language when communicating with others.
- 6.CM.10 – Use appropriate vocabulary when describing objects, relationships, mathematics solutions and rationale.
- 5.A.5 – Solve and explain simple one step equations using inverse operations involving whole numbers.

Opening: Journal Entry, students will grab their journals from the table at the side of the room. Students will write in today’s date and then copy down the question. Question: How do expressions and equations differ? They need to write in complete sentences. They will have about five minutes, exact time will depend on their usefulness of the time. Have one student collect the journals and place back on the side table.

Lesson/Project:
- While a student collects the journals, I will hand out the paper describing today’s project.
- We will read the page together and I will answer any questions the students have.
- Next, I will distribute the cube pages and list of equations. The hanging cube page is a horizontal page with two word boxes in which the students can write.
- The students will have another opportunity to answer questions.
- Then the students will begin working on their project.
- I will move around as they work and check their work for the correct stages when they ask for help.

Closing: We will review the parts of the project. I will look over each students' progress, offer praise and make suggestions for the next session when we will finish the project.
The Hanging Cube

Equation Project

Goals: To review the processes for solving one step equations. To practice solving equations and to communicate how to solve equations. To compare and contrast the solving of the four different types of equations.

Materials: Scrap paper, list of equations page, two sheets of “cube paper,” tape, ribbon

Task:
- Choose four equations from the page of equations. You will need to have one of each of the four operations represented.
- Solve the four problems on scrap paper and have your work checked to ensure you used the concept of opposite operations correctly as taught in class. When you have a star sticker, you may move on.
- Take the two sheets of cube paper, and fold in half carefully.
- Write one of each of the four equations in the top part of each page. The top part is the blank part.
- Write an explanation in paragraph form about how you solved that equation and discuss the similarities and differences of that equation to the other three. You will do this part in the line box portion of the page. (You may wish to do this on scrap paper first to have it spell checked.)
- Tape the two pieces of paper together and fold so it forms a cube.
- Hole punch and add ribbon to hang.
- If you have time and so desire, decorate your cube with color and creativity.

Questions? Make sure you ask!

You have class today and part of the next class to complete this assignment. If more time is needed you will have to finish during homeroom or afterschool.
Equations Activity
Potential Equations

****Make sure you pick four****

******Make sure they each use a different operation******

\[ x - 65 = 21 \]
\[ 4x = 112 \]
\[ x + 23 = 47 \]
\[ x - 77 = 47 \]
\[ 9x = 144 \]
\[ x - 48 = 51 \]
\[ x + 42 = 91 \]
\[ x - 56 = 113 \]
\[ x + 53 = 112 \]
\[ \frac{x}{8} = 13 \]
\[ 6x = 132 \]
\[ \frac{x}{7} = 15 \]
\[ \frac{x}{5} = 19 \]
\[ x + 39 = 73 \]
\[ 7x = 98 \]
\[ \frac{x}{9} = 12 \]
Unit: Review for NYS Math Assessment

Lesson 3: Parts of a Circle (.5 day) & finish Equations project from Lesson 2

Objective: To familiarize students with the parts of the circle both pictorially and by definition. To distinguish the difference between radius and diameter and to identify the relationship that they share.

New York State Standards:
- 6.CM.9 - Increase their use of mathematical vocabulary and language when communicating with others.
- 6.CM.10 - Use appropriate vocabulary when describing objects, relationships, mathematics solutions and rationale.
- 6.G.5 - Identify radius, diameter, chords and central angle of a circle.
- 6.G.6 - Understand the relationship between the diameter and radius of a circle.

Opening: Ticket in the Door page. Students will pick up the question sheet from the side table and solve three of the four equations on the page. After three or four minutes I will give the students an opportunity to compare their work with a neighbor’s work. If they are struggling, they can discuss how to solve the problems. This will prepare them to be mathematically ready to finish their hanging cube if they needed more time. If they didn’t need more time, it reviews the topic to see if they remembered how to solve the one step equations.

Lesson:
- Hand out Movie frame notes page (can be found in the appendix).
- Explain the general idea of the movie frame notes. It can be used to add pictures to definitions or to show the progress through multi-step problems.
- Have the students write the word circle in capital letters.
- Draw a circle in the first movie frame and add the center point.
- Ask the students if they know any part of a circle.
- If no, draw a radius, see if they know the name.
- If yes, see if they know the definition. Use definition: a line segment which goes from the center of the circle to the outer edge.
- Ask if they know any other parts, the goal is to move on to diameter. Depending on the students, may introduce either the picture or the word and prompt the student from there. This will be in the second movie frame. Make sure the students get the definition down, use: line segment that goes from one point on the edge of the circle to a point on the opposite edge while passing through the center point.
- Once both diameter and radius are noted, ask the question: how many radii are in a diameter?
- Verbally quiz the students given one length, what is the other length.
- Next draw a circle and a chord in the third movie frame box. Define chord, use: line segment that starts at one point on the circle ends at another point on the circle.
- Then ask the question: is a diameter a chord?
- Draw a new circle in the fourth movie frame, draw two radii in the circle and shade the region they contain.
• Ask the students if they know what the shaded region is. Then define the central angle.
• Then quiz the students a second time, verbally, about the diameter and radius relationship
• As time allows and as students need it, offer time to finish their Hanging Cube Project.

Guided review: Have the students draw a circle on the back of their notes page and then have them draw the part of the circle that I announce. I will have them do all four that we discussed.

Closing: In partners, the students will quiz each other on the parts of the circle and on radius and diameter. This will last about three or four minutes. I will step in when needed to prompt good questioning techniques.
TICKET IN THE DOOR

Name: _____________________________

EQUATIONS: Solve three of the equations.

<table>
<thead>
<tr>
<th>Equation 1</th>
<th>Equation 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>$x + 13 = 26$</td>
<td>$x - 29 = 57$</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>$6x = 114$</td>
<td>$\frac{x}{3} = 12$</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TICKET IN THE DOOR

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EQUATIONS: Solve three of the equations.

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<td></td>
</tr>
</tbody>
</table>
Unit: Review for NYS Math Assessment

Lesson 4: Circles RAFT project (2 days)

Objectives: To create a project that will allow the students to demonstrate in detail what they know about circles. Give the students an opportunity to create by tapping into their own interests and learning preferences. To have the students communicate their mathematical learning in a form of writing.

New York State Standards:
- 6.PS.3 – Interpret information correctly, identify the problem and generate possible strategies and solutions.
- 6.CM.4 – Share organized mathematical ideas through the manipulation of objects, numerical tables, drawings, pictures, charts, graphs, tables, models and symbols in written and verbal form.
- 6.CM.9 – Increase their use of mathematical vocabulary and language when communicating with others.
- 6.CM.10 – Use appropriate vocabulary when describing objects, relationships, mathematics solutions and rationale.
- 6.G.5 – Identify radius, diameter, chords and central angle of a circle.
- 6.G.6 – Understand the relationship between the diameter and radius of a circle.
- 6.G.7 – Determine the area and circumference of a circle using the appropriate formula.

Day 1

Opening:
- Draw a circle on the board
- Have students come up and draw in the parts of the circle (radius, diameter, chord and central angle).
- Break the students into two groups and give the radius a measure of 4 inches and ask one group to find the circumference of the circle and one group to find the area of the circle.
- A representative from each group will place their solution on board when they get teacher approval.

Lesson/Project:
- The lesson will follow the Circle Project Plan sheet that all the students will receive.
- We will read through the plan together and then begin to go through the steps that are outlined for them.
- I will take my time explaining the project and offer students many opportunities for the students to ask questions.
- The practice RAFT brainstorming session is important and cannot be skipped. It will allow the students to see the process of beginning the project.
- I hope to conference with each student at least once during the course of their brainstorming time and while they begin their rough drafts.
- I will stress the time line, that we have two classes to complete this project in class and it may have to be finished after school or during homeroom.
- I will remind the students that if they work hard they could finish it during class time.
Closing: At least half the students will explain to the class what their plan is for the RAFT. They will note the role, audience, format and topic as well as share something neat that they plan to incorporate.

Day 2

Opening: Journal Entry – Write about any topic that you are struggling with in your regular math class. Give students about five minutes. Have a student collect them and place on the side table. (I will review these while the students are working on their project and talk to them about their struggles if I deem it necessary depending on the student and the topic.)

Lesson/Project:
- Students will continue to work on their projects as outlined on the Circle Project Plan worksheet.
- Conferences will be very important during this class session to keep the students on task and progressing through the many steps of the project.
- I will continue to remind the students of their time line so they can finish the project in a reasonable amount of time.

Closing: I will take the time in the last ten to fifteen minutes of the class to conference with each student about their project. We will discuss their plan, their goals and objectives as well as what their final project will look like and when I can expect it to be done.
Circle Project

RAFT
(Role, Audience, Format, Topic)

Goal: To design a creative writing piece that reviews information about circles.

Provided Materials: FYI Sheet, Brainstorming Sheet, Checklist Sheet

Our Process (Cross of each step as it is completed):

1. Review the RAFT FYI page as a class.
2. Review the RAFT brainstorming sheet as a class.
3. Do a quick practice brainstorming session as a whole class to review the process of starting a RAFT project.
5. Conference with Mrs. Kyle at least once while completing the page.
6. When given the okay, start the rough draft.
7. Conference with Mrs. Kyle at least once while completing the rough draft.
8. Utilize the RAFT checklist to check your progress at least once while working on the rough draft.
9. Make sure Mrs. Kyle sees the completed RAFT checklist in second conference for the rough draft step.
10. When given the okay, move on to the final copy.
11. Depending on type of piece you choose, it may be appropriate to use artwork in your writing piece.
RAFT

FYI PAGE

R – Role of the writer: WHO YOU ARE, THE WRITER? You may choose any perspective you wish to write from. You may be yourself or take on another persona in form of a rapper, animal, soldier, reporter, mathematician, young child, or a part of a circle. You may choose something that is not on this list as well.

A – Audience: WHO WILL READ YOUR WRITING? You also get to choose your audience. You may choose to write to a friend, in a diary, to another adult or a younger student, the readers of a magazine or newspaper or to a fictional or historical person of your choice. You may also choose something that is not on this list. Once you choose your audience you will have to make sure that your writing is appropriate for your audience. You will want to consider the tone you write in or the style you use to present your information to its audience.

F – Format: HOW WILL YOU PRESENT YOUR IDEAS AND INFORMATION? WHAT’S YOUR PURPOSE? You will get to choose what you want your writing piece to look like. It will not have to look like a traditional writing piece. It can take on the form that you are familiar with or would like to try writing in. The format may be a poem, speech, play, song, diary entry, comic strip, letter, advertisement, game, children’s book, directions for “How To”, email, fairy tale, greeting card, newspaper or magazine article, rap, or test. You may also choose something that is not on this list.

T – Topic: WHAT IS THE WRITING ABOUT? This is the subject of your writing piece. For this project your writing piece must relate to circles. We have discussed parts of a circle (diameter, radius, chord, central angle), area and circumference of a circle. Your piece may include all those elements, or just some of them.
RAFT BRAINSTORMING PAGE

Fill in this table to start brainstorming. What will you use for each of the parts?

<table>
<thead>
<tr>
<th>ROLE</th>
<th>AUDIENCE</th>
<th>FORMAT</th>
<th>TOPIC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continue to brainstorm in the following chart. Give additional information and reasoning. (from Strategies for Differentiating in the Content Areas by Beverly Strayer and Troy Strayer)

Give life to your characters (role and audience). Explain what your format is going to look like. Write in as much information about your topic; this may be pictures, definitions, or examples. Feel free to use math notes and book to get some of your topics information.

<table>
<thead>
<tr>
<th>ROLE</th>
<th>AUDIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FORMAT</th>
<th>TOPIC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RAFT CHECKLIST
Name: ___________________________  Date:  ________________

RAFT Activity: ____________________________________________

Accuracy

_____ I have carefully checked the information presented in my activity. It is correct and backed up by research, if needed.

_____ I need to check the following parts: ____________________________

____________________________________________________________________

Perspective

_____ I stayed in the chosen role throughout my writing.

_____ These are the places where I could make my voice sound more like that person or thing: ____________________________

____________________________________________________________________

Focus

_____ I stuck to the activity described in the directions and developed it fully.

_____ I did some parts differently. (Explain.)

____________________________________________________________________
RAFT CHECKLIST p. 2

Mechanics

_____ I have checked punctuation, spelling and grammar.

_____ I still need to check the following mechanics:_____________________

Neatness

_____ The overall quality of this writing piece is the best work I can do.

_____ I could still improve the following:___________________________


Changes made:

________________________________________

________________________________________

________________________________________

________________________________________
Unit: Review for NYS Math Assessment

Lesson 5: Volume of Rectangular Prisms (1 day)

Objectives: To use the formula for volume of a rectangular prism correctly. To use movie frame notes to visually see the changes in the steps and see the proper mathematical terminology for the steps as the problem progresses.

New York State Standards:
- 6.CM.1 - Provide an organized thought process that is correct, complete, coherent and clear.
- 6.CM.9 - Increase their use of mathematical vocabulary and language when communicating with others.
- 6.CM.10 - Use appropriate vocabulary when describing objects, relationships, mathematics solutions and rationale.
- 6.A.6 - Evaluate formulas for given input values (circumference, area, volume, distance, temperature, interest, etc.).
- 6.G.4 - Determine the volume of rectangular prisms by counting cubes.

Opening: In pairs students will work to create a rectangular prism from unit blocks with dimensions of their choice.

Lesson:
- I will hold up one unit block and ask them how many blocks do I have. I will tell them that the volume of the block is one.
- I will tell them that volume is the capacity of what something can hold, for example how many unit blocks it can hold.
- They will find the volume of their rectangular prism and write it down secretly.
- The students will get up and check out all the other rectangular prisms and find the volume of those. They can write them down on scrap paper.
- I will call on students to tell me what the volume of a particular rectangular prism is and the creator will have to confirm or deny that number. We will do this for each box.
- Then I will put the formula up on the board.
- I will ask the students if they recognize it and if they can tell me anything about it. I will be looking to see if they know that it is a formula and what the letters stand for.
- We will then discuss the formula in relation to finding the volume of the prisms that the students created.
- Once the volume is found for all three we will move onto the movie frame notes page for the remainder of class. The purpose of using the movie frame notes is to show that the progress and changes throughout the course of solving a volume of a rectangular prism problem. (A copy of the movie frame notes can be found in the appendix.)
- At the top of the page the students will draw a rectangular prism and label with the dimensions that I have on the board.
- The first movie frame with contain the formula alone. On the lines we will write words: Volume of a Rectangular Prism formula.
• In the second movie frame we will rewrite the formula and show the substitution. On the lines we write: Substitute the numbers from the problem/picture for the variables.

• In the third movie frame the students will rewrite the substitution step and then go on to show their multiplication steps. On the lines they will write: multiply the numbers. I will verbally note to them that multiplication is commutative and they can multiply in any order. I will also note that since there is only multiplication, order of operations does not need to be taken into consideration at this time.

• In the last movie frame the students will rewrite the answer and then put the proper label. On the lines they will write: label and since it is volume we need units cubed. I will note verbally that cubed and exponent of three means. If they seem to not understand I will have them write the fact down as well for repletion.

Guided practice:

• The students will try another volume of a rectangular prism problem with their notes handy on a separate piece of paper. They will need to contribute to the conversation as I work through the problem. If necessary, I will have each student assist with one part of the problem.

• For the second and third problems, I will only have them do it on the board. They will take turns coming up to the board and doing one step.

Independent Practice: The students will solve one problem on the back of their movie notes page and I will direct them to show all their work. I will check each student's work and note correct answer with a star sticker.

Closing: Ticket out the door. The students will get a half sheet of paper and put their name on it. They will create a rectangular prism and label the dimensions. The whole class will trade papers so that no one has their original shape. Students will put their name on the paper also and then solve the problem. They will then return the paper to its creator and the creator will check the work. If it needs correcting the students will conference about it to come to a correct solution.
TICKET OUT THE DOOR

Creators Name: _________________________

Solvers Name: _________________________

Draw a rectangular prism and then label it with the proper dimensions.

Answer: ____________

TICKET OUT THE DOOR

Creators Name: _________________________

Solvers Name: _________________________

Draw a rectangular prism and then label it with the proper dimensions.

Answer: ____________
Lesson 6: Solving Proportions

Objectives: To familiarize students with the solving of proportions. To offer the students two different methods to solve proportions, using equivalent fractions and using cross multiplication. To prepare the students to use proportions to find the missing length in problems with similar figures.

New York State Standards:
- 6.CM.9 – Increase their use of mathematical vocabulary and language when communicating with others.
- 6.CM.10 – Use appropriate vocabulary when describing objects, relationships, mathematics solutions and rationale.
- 6.N.7 – Understand equivalent ratios as a proportion.
- 6.N.9 – Solve proportions using equivalent fractions.
- 6.N.10 – Verify the proportionality using the product of the means equals the product of the extremes.

Opening: Journal Entry – Write down anything you can remember about proportions. This can be a list or in paragraph form. Students will retrieve their journals from the side table and write down the date and the question from the board. Students will have about five minutes. I will have the students draw a dark line under their work in the journal and then they will put their classmates thoughts and ideas under the dark line. We will go around the room and each student will share something that they have written down about proportions. (This brainstorming journal entry session will prepare the students for the completion of the Frayer Model notes that will be part of the lesson.)

Lesson:
- Hand out Frayer Model worksheet (can be found in the appendix).
- Complete the Frayer Model notes on proportions with students facilitating the information for each part.
- Use questioning to direct students in the right direction. Possible questions to use include: What does a proportion look like? Where have we seen them before? Do they look like something familiar? What do you do with proportions? When do we use proportions?

Guided practice:
- Distribute worksheet with several examples on it.
- We will solve the examples together, with varying levels of student participation.
- We will solve the first two problems using both methods and then use one or the other on the next few problems.
- I will reference the hints that their classroom teacher uses.
- We will do several problems together until I feel comfortable with the students trying them on their own.

Independent Practice: The students will try a few problems on their own. There may be problems left on the worksheet for the independent practice, but if necessary have the students put a few
more problems on the back of their worksheet. I will move around the room as the students work. If there is time, the students can show their solutions on the board.

Closing: We will return to the journals and the students will write about proportions and discuss what they found easy and what they found difficult or confusing. They will turn them in to me when done.
PROPORTIONS

Solve each proportion for the missing variable.

**Remember proportions are two equivalent ratios and a fraction is a way of writing ratios.

1. \( \frac{x}{5} = \frac{12}{15} \)

2. \( \frac{9}{18} = \frac{x}{6} \)

3. \( \frac{x}{2} = \frac{6}{3} \)

4. \( \frac{12}{3} = \frac{x}{1} \)

5. \( \frac{2}{x} = \frac{6}{18} \)

6. \( \frac{8}{12} = \frac{x}{3} \)

7. \( \frac{x}{21} = \frac{3}{9} \)

8. \( \frac{4}{x} = \frac{8}{20} \)

9. \( \frac{10}{x} = \frac{5}{1} \)

10. \( \frac{9}{24} = \frac{x}{24} \)
Unit: Review for NYS Math Assessment

Lesson 7: Mean/Median/Mode/Range (1 day)

Objectives: To review mean, median, mode and range. To allow the students to show how to find each piece of information for a set of their own data and explain in words how they found it.

New York State Standards:
- 6.CM.2 – Explain a rationale for strategy selection.
- 6.CM.4 – Share organized mathematical ideas through the manipulation of objects, numerical tables, drawings, pictures, charts, graphs, tables, models and symbols in written and verbal form.
- 6.CM.9 – Increase their use of mathematical vocabulary and language when communicating with others.
- 6.CM.10 – Use appropriate vocabulary when describing objects, relationships, mathematics solutions and rationale.
- 6.N.9 – Solve proportions using equivalent fractions.
- 6.S.5 – Determine the mean, median and mode of a given set of data.
- 6.S.6 – Determine the range for a given set of data.

Opening: Journal Entry: Explain which method of solving proportions you prefer and why?
Students will pick up their journals from the side table and write in today’s date and the question. They will have approximately five minutes to answer the question. When they are complete, they will raise their hand and I will collect them.

Lesson/Project: Introduce project via the handout with all the steps outlined. It is a foldable from Dinah Zink’s book. It is the layered-look book which will allow the names of each measure to be shown and when the flip is done, the student can see how to find it and how they found it with their own data. The grid sheet that the students are using during the project is meant to organize their work and information. If a lack of paper resources, the grids can be made on scrap paper or notebook paper. Time during tomorrow’s homeroom may be needed to finish.

Closing: Take the last couple of minutes to review the project and see where each student is. The students may need to finish during homeroom if needed.
Mean Median Mode Range

Foldable Project

Goal: Complete a study resource that contains both an example of each of the four measures and an explanation in words on how to find it.

Step 1: Use the Mean/Median/Mode/Range Grid and write out the definitions or step to find each of the four measures to the best of your memory. You may cross off the words data set at the top.

Step 2: Class discussion on how to find each. Make additions or changes if you need to.

Step 3: Using another Mean/Median/Mode/Range grid and find each of the four measures for the data set 20, 24, 30, 22, 24, 36, 26 as a whole class. Please write down the data set on the line provided.

Step 4: Using another Mean/Median/Mode/Range grid, create your own data set of seven data pieces. Have the data set approved by Mrs. Kyle. Then find each of the four measures. When the four answers are found, have Mrs. Kyle check them over.

Step 5: THE FOLDABLE! They are pre-folded, you will first label the flaps (be careful, they are labeled in this order due to side of the area under the flap)

Data Set:
Mode
Median
Range
Mean
Summary

Step 6: Complete the foldable study resource

a. Put your data set on the first fold
b. Above the word Mode you will write what the mode of your set is as well as, how you found the mode in words
   c. Complete for each measure.
   d. For summary, please list all four pieces of information in a creative fashion

Step 7: Add any other creative designs you wish, if time allows.
Mean Median Mode Range Grid

Data Set: ____________________________________________

<table>
<thead>
<tr>
<th>MEAN</th>
<th>MEDIAN</th>
<th>MODE</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Analysis of Data and Interpretation of Results

Overview

The goal of this study was to introduce writing activities into the curriculum and see if that increases student appreciation for mathematics. Student appreciation was reviewed in three ways: observations, questionnaires and review of student's grades. Overall, the students appeared to enjoy or appreciate the activities. There were minimal complaints about the work, they completed everything asked of them even if it meant some extra time.

Observations

Students were observed both in our AIS Math setting but also in their regular math classrooms. Students were observed in their regular math classroom twice. I chose to observe them in the larger class setting to see how they interact in a class with twenty students as opposed to a small group of three to seven students. The first time I went was during the first week of the introduction of writing activities. They had taken their introductory survey and been to one class with a lesson that incorporated writing activities. The second time I observed the students in their math classroom was during the last week of the study. I was looking to see if there was an increase in participation in the regular classroom. When in the classroom I noted the number to teacher questions, the number of times the student raised his/her hand to participate and how many times they participated correctly. This data can be viewed in the following chart.

<table>
<thead>
<tr>
<th>Student #</th>
<th>Number of Questions</th>
<th>Times volunteering</th>
<th>Questions answered</th>
<th>Number of Questions</th>
<th>Times volunteering</th>
<th>Questions answered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student #1</td>
<td>18</td>
<td>3</td>
<td>1</td>
<td>16</td>
<td>4</td>
<td>1*</td>
</tr>
<tr>
<td>Student #2</td>
<td>21</td>
<td>7</td>
<td>4**</td>
<td>25</td>
<td>20</td>
<td>11</td>
</tr>
<tr>
<td>Student #3</td>
<td>19</td>
<td>5</td>
<td>2</td>
<td>22</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Student #4</td>
<td>18</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Student #5</td>
<td>20</td>
<td>0</td>
<td>2***</td>
<td>21</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Student #6</td>
<td>13</td>
<td>1</td>
<td>1</td>
<td>25</td>
<td>7</td>
<td>3</td>
</tr>
</tbody>
</table>

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This table showed some things that I would expect and some things that surprised me in a way. I do want to note that these sixth grade students do not all have the same math teacher. Four of the students have one teacher and two of the students have a different one. The second teacher of the two, I believe, uses more questioning in her lessons. I also want to note that the lessons I attended varied. At times the classes were going over homework, or presenting a new topic or introducing a project. Different lessons provide differing amounts of questions to be asked. A couple numbers I wish to note on from the chart:

- For student #1, there is one asterisk in the last column. This one question that was answered was an answer that another student shouted out and she quickly volunteered and was picked to share the answer.

- For student #2, there are two asterisks in the third column. That particular day he did not have his homework completed for the teacher and got in trouble at the start of class. In working with him, he tends to be more quite and participate less after a confrontation with a teacher. This particular day he did participate quite a bit in comparison to his peers, but for him, it was a low number of participation occurrences. You can see that during the second observation, his participation level was back up which is more like him. This student is by far the most likely out of the six to participate in math class.

- Student #4, I will consider my least likely of the six to participate. It did not surprise me that he did not participate in the regular math classroom. He was called on once in one of the class sessions and did not produce and answer for his teacher.

- For student #5, there are three asterisks in the third column. This student was late to class due to a visit with the principal and was unprepared. She did not volunteer to participate during this class session, but was called on twice to answer questions and was successful both times.
I also observed the students in my AIS math classes. In my classes they are in much smaller groups. When they are all together, there are seven students total. I also meet with them all in smaller groups another day of the week. Those group sizes range from three to five students, with some additional students who are not in the larger group. I made notations of participation four times during the study. Twice I took down my observations during the smaller groups and twice when all the students were together. During weeks one and two I watched the smaller groups and during weeks four and five I noted participation for the larger group. The data can be viewed in the following chart. Since the first two observations were done in the smaller groups, the number of questions varied during weeks one and two. This chart, though it should be similar to the last one is grouped by student and observation. I want to note before you view the chart that you know a bit about my philosophy. Early in my teaching career a principal gave the whole staff an article titled “Don’t say anything a student can say.” Since then I have believed in having students participate a great deal and I provide a large number of questions for them to answer. I believe that the more they participate, the better they will do with the material.
PARTICIPATION IN AIS MATHEMATICS CLASS

<table>
<thead>
<tr>
<th></th>
<th>Number of questions</th>
<th>Times volunteered</th>
<th>%</th>
<th>Number of questions</th>
<th>Times volunteered</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student #1</td>
<td>Observation 1</td>
<td>35</td>
<td>9</td>
<td>26%</td>
<td>Observation 1</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>26</td>
<td>12</td>
<td>46%</td>
<td>2</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>37</td>
<td>9</td>
<td>24%</td>
<td>3</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>24</td>
<td>11</td>
<td>45%</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Student #2</td>
<td>Observation 1</td>
<td>34</td>
<td>16</td>
<td>47%</td>
<td>Observation 1</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>27</td>
<td>18</td>
<td>67%</td>
<td>2</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>37</td>
<td>17</td>
<td>46%</td>
<td>3</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>24</td>
<td>13</td>
<td>54%</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Student #3</td>
<td>Observation 1</td>
<td>34</td>
<td>11</td>
<td>32%</td>
<td>Observation 1</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>27</td>
<td>8</td>
<td>29%</td>
<td>2</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>37</td>
<td>Absent</td>
<td>NA</td>
<td>3</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>24</td>
<td>6</td>
<td>25%</td>
<td>4</td>
<td>24</td>
</tr>
</tbody>
</table>

Surprisingly, this table did not specifically show that writing activities increase student participation. I believe that because I taught a lot of topics that did not connect to one another, that may have an effect on student confidence with the material. All the topics were review for them and some of them they have seen more than once. Equations and the measures of central tendency were reviewed in class for their midterm exam in January. I will discuss some of the visible trends.

- Only one student, student #6, showed consistent increase throughout the study. This student missed a large chunk of school in February and was behind for quite a bit. As we began the study he was still catching up on his work and I think that the extra time with math was helping him to succeed in math.

- One student, student #3 decreased throughout the study. This student is quite shy. You can see from both charts that she doesn't participate a huge amount, but I have found that
she is very willing to participate when she is confident with the material. A few of her participation numbers may have been not from raising her hand but from being called on.

- I would like to say that student #4 has an increasing trend. This student will rarely participate, but if we removed observation number two he would be increasing from beginning to end. Our class is the last period of the day and sometimes he is very withdrawn from the learning atmosphere by that point in the day. I am pleased to see that he showed some increase in participation.

- The other three students have more random percentages of participation. Observations one and two were in the smaller group settings so the students would have a greater chance to participate than in the whole group setting for observations three and four. Therefore, student #1, student #2 and student #5 both increased from observation one to observation two as well and increased from observation three to observation four. This shows that they may have been becoming more confident, but during the larger group they may have been a bit hesitant to participate. I believe that this also shows an increasing trend.

Overall, I would say that the observations do not show a very obvious increase in participation, thus showing more interest or appreciation for mathematics. I thought that that may be the case for the observation portion of the study. After looking more closely at the setting where the observation took place, I believe that the trends look to be increasing; just class size may affect a student’s desire to participate.

Questionnaires

Several questionnaires were distributed throughout the course of this study. The first questionnaire the students took was taken from the Mathematics Attitude Inventory survey. The original survey contains forty-eight questions that give scale scores to six different attitudes about math. I shortened the survey to seventeen questions that would only assess three of the attitudes. The three attitudes I chose to assess were Self-Concept in Mathematics, Enjoyment of Mathematics, and Motivation in Mathematics. This survey was taken at the very beginning of the
study as well as at the end of the study in order to assess an increase in attitude about mathematics. The students also answered a questionnaire about each type of writing activity we did. This was done several times throughout the study. Finally, at the close of the study, I had the students complete a closing questionnaire which consisted of eight questions. This was to capture an overall picture from the students about their feelings about writing in mathematics.

The attitude survey gives the assessor scaled scores for each of the categories. For the self-concept the minimum scaled score is six and the maximum scaled score is twenty four. The minimum and maximum scores for enjoyment of mathematics is seven and twenty eight and for motivation is four and sixteen. The lower scores are more positive than the higher scores. For example a score closer to four in the motivation category shows that a student is motivated to do mathematics. A score closer to sixteen shows a student who is not as motivated in mathematics.

I feel that all three parts of the survey are important to the project. Self-concept views how a student feels that they are doing in mathematics. I believe that it is important to see if the students feel they are doing better in mathematics. Enjoyment is important because I am looking to see if their appreciation, or the amount that they like math, has increased. I want to see if over the course of the study if they enjoy math more at the end or at the beginning. Motivation has been included because I wanted to see that if the students are enjoying math more with the inclusion of the writing activities, are they more motivated to work harder in mathematics. The student’s scaled scores are summarized in the three charts below.
The self-concept in mathematics chart shows that four students have a higher self-concept at the end of the study and one had no change. It would appear that a majority of the students feel better about their ability to do well in mathematics. Student #4, which is the student from above with the least amount of participation in both AIS math and his regular math class, had the greatest change. I suspect that is because writing in math showed him that math does not have to be just solving computational math problems. This project showed him that we can do projects in math, which interested him more. Therefore, he now believes that he is more capable at succeeding in mathematics. Student #1 had the second greatest change and I believe that writing in math may have challenged her in a different way, had her looking at mathematics differently, thus feeling more confident in her ability to do well. This particular student is repeating the sixth grade, however, it is her first time in sixth grade in our district.
The bar graph on enjoyment of mathematics was going to be a key point of this study to show an increase in appreciation in mathematics. As you can see, from the beginning to the end, only two students showed an increased enjoyment of mathematics (represented by a decrease in scale score on the graph) and one student stayed the same. However, all the students scaled scores only changed from zero to three points. Student #1, as noted above, may be really enjoying the writing activities because it is presenting material in a different way and she is potentially not as bored. Student number four actually scored the highest score for enjoyment of mathematics, which shows that he hates it (something he states regularly). He has always succeeded in ELA, but scored low in mathematics. I believe his strengths may be more writing and reading based and thus he enjoyed the writing in math class. Student #6 stayed the same. That surprised me because his participation levels were increasing in AIS math class. I believed that there would be a link between participating more and enjoying math more. This student is very hardworking and enjoys pleasing his teachers.
Motivation in mathematics is the third part of the questionnaire reviewed. We can see from the chart, three of the students showed no change in their motivation to do mathematics and one student, student #3, showed positive change. The student with the positive change is my shy student, who usually sits back and doesn’t have a lot to say in the classroom. She, however, was the only student in the study who stayed afterschool to make up work from an absence as well as complete a summary. That showed motivation to complete the tasks that were in front of her. I am surprised that the writing activities did not increase more student’s motivation, but am pleased with the fact that they show no change as opposed to a negative change. The two students with negative change had a scale score difference of just one point, which is a very small change.

Another questionnaire the students had was the Activity Questionnaire (can be found in the appendix). They took this questionnaire at the conclusion of a writing activity. There were seven types of writing activities and we completed the questionnaire after five activities. It was short, four questions, and to the point. At times these questionnaires were completed during home room, so if a student was absent or late to school, they did not complete the task.
The hanging cube project reviewed equations and allowed the students to communicate in writing how to solve them as well as compare and contrast the four types of problems. Only five of the six students completed the activity. Four students stated that they enjoyed the activity while one student (#4) stated he did not enjoy the activity. Student #4 picked no and explained further that he did not enjoy it because he was learning. Three of the students (#1, #2, and #3) who picked yes, stated that the project was fun. The students were also asked how much they felt the project helped them learn. Student #4 selected none, student #1 and student #3 selected quite a bit and student #2 and student #6 selected an extreme amount. The last question was in regards to making the project better and student #1 thought if the project was a bit hard it would have been better.

The movie frame notes offered the students two options for note taking. They could match up definitions with pictures or show the progress and steps through a multi-step problem. All six students responded to this survey and their results are collected in the following chart.

<table>
<thead>
<tr>
<th>Student #</th>
<th>Enjoy?</th>
<th>Amount Helped?</th>
<th>What could make it better?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td>Quite a bit</td>
<td>Colored pencils</td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
<td>Quite a bit</td>
<td>If I got to make the movie frames myself</td>
</tr>
<tr>
<td>3</td>
<td>Yes</td>
<td>Quite a bit</td>
<td>If color were involved</td>
</tr>
<tr>
<td>4</td>
<td>No</td>
<td>Some</td>
<td>Nothing</td>
</tr>
<tr>
<td>5</td>
<td>Yes</td>
<td>Some</td>
<td>Not sure</td>
</tr>
<tr>
<td>6</td>
<td>Yes</td>
<td>Quite a bit</td>
<td>NA</td>
</tr>
</tbody>
</table>

In response to student #4’s no, he again did not enjoy the activity because he was learning. Student #2, student #5 and student #6 enjoyed the activity because they enjoyed the drawing aspect when we did the circle notes. I would anticipate including color and colored pencils in the future. Those were very thoughtful comments.

Five of the six students were available to reflect on the RAFT project. They all enjoyed the activity and most noted that it was because they got to pick what they were (unique role). Three students (#1, #2, #3) all felt that the activity helped them quite a bit while student #6 said some and student #4 said none.
The activity questionnaire for the Mean, Median, Mode and Range Foldable was only completed by four students. All four students enjoyed this writing activity. Student #1 liked foldable layers and flipping up a layer to see her work. Student #2 liked the project because it wasn’t work on the board. Student #3 said that it was fun and student #4 said because he was able to do it. Two students said the activity helped them an extreme amount, one said some and the last said none. Student #1 noted that the activity could have been better if there had been more time to complete it.

The last activity questionnaire the students completed was on journal entries. All six students completed the questionnaire and five of the students did not enjoy the activity and only one did. Some of their reasons for why they did not like journals don’t make a lot of sense but it did show that the students are aware of other alternatives for learning. Their responses to two of the questions are summarized in the following chart.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NO</td>
<td>Because there are boards</td>
<td>Some</td>
</tr>
<tr>
<td>2</td>
<td>No</td>
<td>Because we would be writing</td>
<td>Some</td>
</tr>
<tr>
<td>3</td>
<td>Yes</td>
<td>Because she was able to look back and learn more</td>
<td>Quite a bit</td>
</tr>
<tr>
<td>4</td>
<td>No</td>
<td>I hate math</td>
<td>Some</td>
</tr>
<tr>
<td>5</td>
<td>No</td>
<td>Cause I already have one in ELA</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>No</td>
<td>Because you can use the paper in your binder</td>
<td>None</td>
</tr>
</tbody>
</table>

The final questionnaire the students completed was the Closing Survey (can be found in the appendix). It contained eight questions and was completed by all six students. The first four questions where multiple choice and the other four were short answer. The goal of the survey was to get the students overall opinion of writing in math and to see how they felt about themselves during the survey. I will summarize each student’s results and compare them to the other results above.

Student #1 felt that her overall appreciation for math changed some because the writing activities helped. She believes that her math average has risen since the inclusion of the writing
activities. She disagrees that she is more motivated to do her math assignments. However, her attitude survey showed no change in motivation. Student #1 also noted no change in her confidence in mathematics. This differs a lot from the attitude survey because she has a very positive change in her self-concept in the field of mathematics. She most enjoyed the hanging cube and felt the foldable for mean, median, mode and range helped her learn the most. Overall, she summarized her feelings about writing in math as: “It was tiring sometimes and it was fun after that.”

Student #2 noted that his overall appreciation for math changed little during the course of the study. He strongly agreed that his average rose during this time frame and said that there was no change in his motivation to do his math assignments. However, student #2 felt he was more confident with math. His attitude survey showed no change for both motivation and self concept. He is rather consistent with knowing his relationship with mathematics. He enjoyed the movie frame notes the most and also felt they helped him the most to learn. He did not enjoy the hanging cube because he was bored, which contradicted his response earlier that it was fun. Student #2 summarized his feelings with this statement: “I think it is better because we do not have to do a problem.”

After completing writing activities student #3 felt that her appreciation for mathematics changed a little, because it was fun. She felt that her math average would not have changed nor had her motivation to do math assignments changed. She would agree that she is more confident with mathematics. Her results in the attitude survey match her results for self-concept, that she is more confident. However, her attitude survey results show a slight positive change in regards to motivation. The mean, median, mode and range foldable was her favorite and she felt that it helped her learn the most. She also did not prefer the hanging cube. Student #3 summarized her feelings about writing in mathematics in a few sentences: “I like math. Sometimes I don’t like math. Math is sometimes easy for me.”
Student #4 has shown an attitude of dislike for math throughout the entire study as well as throughout the entire school year. He said that his appreciation of math changed none, because he hates it so much. He would agree that his math average has risen. He feels that there has been no change in his motivation to do mathematics, but does feel that he is a bit more confident. He is consistent with his attitude survey in regards to both his motivation and self-concept. He remained the same in motivation and his self-concept showed a positive change. Student #4 claims to have not enjoyed any of the activities and found none of them helpful. His overall feelings about math are captured in this statement: “Math stinks so bad that I wish it was never invented. Whoever invented math should be dragged into the streets and beaten.” This student continues with his negative attitude towards math consistently.

In the closing survey, student #5 answered the questions vaguely. She felt that her appreciation of mathematics changed a little. She does not feel that there has been a change in her math grade nor a change in her confidence. She does state that she is more motivated to do her math assignments. She most enjoyed the mean, median, mode and range project.

After completing the activities, student #6 felt that his appreciation for math changed a little because he started doing better in math class. He agreed that his average rose, his motivation increased, and his confidence increased. This does differ from his attitude summary because his self-concept remained the same while enjoyment of mathematics and motivation both suffered negative changes. Student #6 most enjoyed the hanging cube project. He felt that the movie frame notes helped him to learn the most, especially because it helped him become better with radius of a circle, however he would rather not see this activity again because it was a lot of writing. He summarizes his feeling about writing in math this in sentence: “I don’t really like writing in mathematics.”

Overall, I felt that the questionnaires offered a lot of insight about the students feelings about mathematics and about writing in mathematics. At times one survey would contradict another, but they are young students still finding their way and still defining their true feeling about

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math. In general, I believe that I would take the students verbal responses over the prepare survey about attitudes. I feel that for some of the students the attitude surveys were right on track, but responses in student voice carry so much more weight, especially when we are talking about their feelings.

Review of Student Grades

Student’s grades are also being reviewed as part of this study. The purpose of including them is to see if student’s grades increased along with their appreciation for mathematics. The thought was that if they liked math more, they would be more motivated to succeed, thus performing better and receiving higher grades. The grades we are going to compare in the following chart are first, second and third marking period. Their classroom teachers, thankfully, were willing to share the information. The information is summarized in the following bar graph.

You can see that all of the student’s average increase from the second marking period to the third marking period. Four of the students believe that there was an increase in their math grade, so they were on the ball with that. The other two students believed that there was no change. I believe that does not just have to do with my study, but with many other things as well. The main topic in the second marking period was fractions and the main topic in the third marking
period was geometry. Also the amount of time a student spends in AIS increased each marking period. My goal is not to just teach them mathematics, but to enjoy math and desire to succeed. I am, however, pleased to see their grades rising.

Discussion, Summary and Reflections

The purpose of this study was to see if implementing writing activities into the mathematics curriculum would increase student appreciation. I was looking to see that if the students liked mathematics more, if then their class participation would increase as well as their math averages. I am glad I started researching this topic with such a small group of students because my results for each student varied.

Student #4 proved to be a challenge. I couldn't find an activity that could help him change his verbal opinion about mathematics, but the attitude survey did show some positive change in self-concept and enjoyment of mathematics and his math average did rise. Therefore I have hope that with time and positive experiences in math, we can motivate this young mind to appreciate mathematics just a bit more.

Student #1 is a student I have always had a watchful eye for. She is repeating sixth grade and has always seemed more capable than she leads teachers to believe. Her participation in class had a positive trend and she had positive changes in the attitude survey. She also tended to have more useful comments for me in the hand written surveys. I believe that she enjoyed this unit that included writing in math and will continue to work well if her classroom teacher and I find ways to present the material to her in new ways.

Student #6's attitude survey gave way to a more negative change over time than a positive change, but he has always been eager to participate. I believe he did fine with the inclusion of writing activities, but he did share that he really did not like them.
Student #2 has always been my most eager student. His first AIS placement was based on his state test score from fifth grade, but overtime I found that he was much higher functioning than his peers so I switched him to another group and he has grown tremendously with the new group. This student is from a Spanish speaking family, where Spanish is spoken in the home so he does at times struggle with language. He did very well with the writing activities, completing everything asked of him and he believed that it was helpful. His average rose as did his overall appreciation.

Student #5 was probably the student who put forth the least amount of effort. It was usually her activity questionnaire that was missing because she has developed an unhealthy habit of arriving to school late and most of the surveys were completed during homeroom. I do think that she enjoys mathematics as her attitude survey scores show that she has the best scores for liking math out of the whole group, but she didn’t put forth a lot of extra effort with the writing activities.

Student #3 worked very hard through the course of the study and I feel that she truly enjoyed the writing activities. She felt that her appreciation did increase and it was because the activities were fun. She was the student that noted the most that the activities were fun and I felt that she had a bit of an increase in the participation trends.

Overall, I was pleased with the outcome of the project. While I do not feel that I have clear cut data that states for sure that the inclusion of writing activities increase appreciation for mathematics, I do feel that the information I gained from the students gave me a good feeling that they do in fact appreciate mathematics more than they did before. I did note earlier that I felt that using student’s verbal or written responses were more valuable than the attitude survey because the students were conveying in their own words how they truly felt instead of interpreting the words of another person.

The 2004 study by Bangert-Drown, Hurley and Wilkinson found that typically show a small, but positive effect. Generally, I feel that the students benefited from the activities done
during the study. Many of the students did show an increase in some of the given areas. The study by Russek noted how valuable the writing events can be because the students are able to express their attitudes and mathematical ability. Many opportunities arose during the study allowed the students how to communicate both math, but their feelings, especially the journal entries. The questionnaires also gave students time to share their feelings about what they were doing. I found it extremely valuable to have the students use the checklist in the RAFT because it gave the student a chance to evaluate their own work as Wilcox noted. It gave them more ownership of their work and education. I feel that writing in math enhances the learning of the students which is something that Bullock was concerned about.

I believe I will continue to investigate writing in mathematics because I can see areas where the students benefited. I will want to work more with these students including writing into their daily plans, but will not do it with such concentration as the last five weeks has been. I would like to incorporate writing activities in classes of larger size and more academic diversity. I worked with only kids in AIS math, but would love to take some of the ideas into another teacher's classroom and collaboratively include them. I think it would be beneficial to see how students, who are not in AIS because they haven't met a state benchmark would respond to the writing activities.

I tried using activities in math classes before. For example, last summer I taught a summer school class of ten eleventh grade students who needed an additional math credit for graduation. Each of these students had passed the Math A Regents exam and had started to prepare for the Math B exam. They had failed the course they were enrolled in and needed credit. Some were going onto taking the last half of Math B, but some were going on to Financial Math for their final credits. During that course I incorporated several project based assignments that allowed the students to learn and practice the material while being creative. Several of the activities included writing. The students really enjoyed the projects and they gave me none of the typical summer
school trouble. I look forward to doing similar activities with future summer school classes as well.

I enjoyed this topic and look forward to finding out more. My next plan is to try to work with a larger group of students with a wider array of mathematical abilities. I would like to see how they respond to the surveys and questionnaires. Since I found that I weighted information that came verbally or written by the students more heavily, I might implement interviewing techniques as well.
References


Countryman, Joan. Writing to Learn Mathematics: Strategies that work. Portsmouth, New Hampshire. 1992


Strayer, Beverly and Strayer, Troy. Strategies for Differentiating in the Content Areas. New York, New York: Scholastic. 2007

Appendix
Mathematics Survey

On the line next to each problem place one for the following numbers:
4-Strongly Agree
3-Agree
2-Disagree
1-Strongly Disagree

1. Mathematics is something I enjoy very much.
2. I don't do very well in mathematics.
3. Doing mathematics problems is fun.
4. I would like to do some outside reading in mathematics.
5. Mathematics is easy for me.
6. When I hear the word mathematics, I have a feeling of dislike.
7. I would like to spend less time in school doing mathematics.
9. I usually understand what we are talking about in mathematics class.
10. No matter how hard I try, I cannot understand mathematics.
11. I would like a job which doesn't use any mathematics.
12. I enjoy talking to other people about mathematics.
13. I am good at doing mathematics problems.
14. Sometimes I do more mathematics problems than are given in class.
15. I remember most of the things I learn in mathematics.
16. I have a good feeling toward mathematics.
17. I have a real desire to learn mathematics.
Activity Questionnaire

If a multiple choice question, pick your best answer. Please answer all other questions in complete sentences.

1. What activity are you assessing?

2. Did you enjoy the activity? Why?
   - Yes
   - No

3. How much do you feel the activity helped you learn the math topic that was taught?
   - None
   - Some
   - Quite a Bit
   - An extreme amount

4. What could have made the activity better?
Closing Survey

If a multiple choice question, pick your best answer. Please answer all other questions in complete sentences.

1. Thought it has only been a short time, after completing the writing activities would you say your appreciation (the amount you like) for math has changed? Why?
   \[
   \begin{array}{ccccc}
   \text{None} & \text{Little} & \text{Some} & \text{Substantial} \\
   \end{array}
   \]

2. Would you say that your math average has risen since the inclusion of the writing activities?
   \[
   \begin{array}{ccccc}
   \text{Strongly agree} & \text{Agree} & \text{No change} & \text{Disagree} & \text{Strongly disagree} \\
   \end{array}
   \]

3. Would you say you are more motivated to do your math assignments?
   \[
   \begin{array}{ccccc}
   \text{Strongly agree} & \text{Agree} & \text{No change} & \text{Disagree} & \text{Strongly disagree} \\
   \end{array}
   \]

4. Would you say you are more confident with mathematics?
   \[
   \begin{array}{ccccc}
   \text{Strongly agree} & \text{Agree} & \text{No change} & \text{Disagree} & \text{Strongly disagree} \\
   \end{array}
   \]

5. What activity did you enjoy the most? Why?

6. What activity did you feel helped you to learn the material being taught? Why?

7. What activity would it please you not to see again? Why?

8. In several sentences, summarize your overall feelings about writing in mathematics.
## Frayer Model

<table>
<thead>
<tr>
<th>Essential Characteristics</th>
<th>Non-Essential Characteristics</th>
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<tbody>
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<table>
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<tr>
<th>Examples</th>
<th>Non-examples</th>
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Movie Frame Notes

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