MIDDLE SCHOOL STUDENTS' PERCEPTIONS OF HOW TEACHER PRACTICES AFFECT THEIR MOTIVATION TO LEARN ALGEBRA 1

A Thesis

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by

Renee Wood Diamond

Summer 2012

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MIDDLE SCHOOL STUDENTS' PERCEPTIONS OF

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What are middle-school algebra students' perceptions of how teacher practices affect their motivation to learn Algebra 1? This study identified specific teacher practices that students perceive to be either motivational or de-motivational, revealed how students describe the effects of such practices, and identified sources of student motivation for learning mathematics.

Math reform literature encourages teacher practices that enhance motivation, which are also considered to enhance learning. Reflecting upon students' perceptions of teacher practices that are either motivating or de-motivating can result in improved teaching and learning by providing teachers with insight into the effectiveness of specific practices.

The study utilized a mixed-method methodology. The students surveyed were 147 middle-school Algebra 1 students using a five-point Likert scale, along with a set of open-ended questions requiring free responses. The survey identified sources of students' motivation, as well as measured the effects of specific teacher practices on students' motivation. Based upon the survey responses, selected students were interviewed in order to uncover underlying insight about practices that increased or decreased their motivation while learning Algebra 1.

CHAPTER I

INTRODUCTION

Background

In today's job market there is an increasing need for students to apply their understanding of mathematical and analytical skills. It seems that students' competency would progressively increase with each of the following three components: applying basic computational and procedural skills, developing conceptual understanding, and becoming adept at problem-solving. And yet, many of my own students, over the years, seem to have progressively decreasing levels of motivation when teachers proceed from one component to the next. Instructional practices, including providing feedback, support for autonomy, offering appropriate challenges, emphasizing task importance, and encouraging positive affect and supportive social relationships, influence students' motivation and affect (Schweinle, Turner, & Meyer, 2006). Examining sources of student motivation and teacher practices that influence motivation serves as a stepping stone to improving students' mathematical proficiency as well as success in higher education and careers.

Statement of the Problem

This study identified specific teacher practices that students perceive to be either motivational or de-motivational in learning Algebra 1, as well as identified sources of their motivation. The study also revealed how students describe the effects of such practices by providing written responses to open-ended questions. In this study,

motivation is defined as a desire to learn, work hard, obtain good grades, and personally succeed in classes (Burdick, Litcher, & McCoy, 1999). Multiple factors influence student motivation including gender, living arrangements (two parent or one/no parent), socioeconomic status, and classroom instruction, among others (Burdick, 1999). However, this study targeted only teacher practices that affect students' motivation in learning mathematics.

We will discuss teacher practices that may overlap with other disciplines (i.e., assessment, grouping, connecting to students on a personal level), as well as those that are specific to the mathematics classroom (i.e., explaining concepts, building upon previous knowledge, and making connections to real-world applications). For this study, teacher practices were categorized as follows: promoting participation, use of technology and visual aids, connecting to students and parent/teacher availability, grouping, instruction/teacher modeling, connecting concepts, implementing problem-solving, focusing on computational skills, and assessment/effort.

Purpose of the Study

Many mathematics teachers face the dilemma of students who repeatedly require prompts to begin a task, want their hand held through problem-solving situations, want to pack up ten minutes prior to the end of class, and who are convinced that they will never need to know nor apply the mathematics that the teacher presents. It is easy for teachers to dismiss students' lack of motivation by blaming the students' personal problems, their apathy for learning in general, or simply their personalities rather than looking inward and reflecting on the influence of teaching practices. Research suggests that

students' motivations toward mathematics are influenced greatly by teacher actions (Middleton & Spanias, 1999); this is why it may be beneficial for teachers to consider how their practices affect their students' motivation.

The effects on motivation are multi-faceted and involve elements that are often out of the teacher's control. Some of these elements may include students' preconceived value for mathematics and/or education, fatigue, health conditions, peer pressure, or lack of devotion due to other commitments; however, to neglect the role that teacher practices and behaviors have on students' motivation would be a disservice to students. Several factors contribute to shaping a student's motivation. These may include grades, rewards, and the classroom environment. Teachers have considerable control over the features of the learning environment that can increase or diminish a student's level of motivation. Investigating motivational triggers within the students' learning environment can assist teachers in adapting their practices so as to promote increased levels of motivation.

Lack of student motivation for learning mathematics is not uncommon in the classroom and transfers to the fields of science and engineering. A recent national study examining trends in undergraduate education reveals a steady decline in student interest in the physical sciences and mathematics over the last thirty years (Astin, Parrott, Korn, & Sax, as cited in Chang, 2002). This decline in student interest may be due to the mathematics requirements within these fields, and may, in turn, be related to teacher practices within mathematics classrooms. The decline in student interest within mathematics classrooms is most pronounced when shifting from routine procedural practice to

more in-depth conceptual understanding and problem-solving exercises. For example, Eggleton and Jiang observed that "Chinese students are expected to work harder in their classes whereas American students will simply move to a less demanding class so that they don't have to work hard" (as cited in Chang, 1996, p. 7). However, motivational research promotes activities that are challenging and relevant as a way to increase student motivation. This discrepancy demands further attention as it relates to students' perceptions of teacher practices that affect their motivation in learning mathematics.

The dramatic decline in students' desire to learn mathematics typically begins as they enter the middle grades, and continues to decrease through high school (Middleton & Spanias, 1999). As the National Research Council (1989) noted, "Mathematics is the worst curricular villain in driving students to failure in school. When mathematics acts as a filter, it not only filters students out of careers, but frequently out of school itself" (p. 7).

An essential component of mathematics instruction is the means by which students can be motivated (Holmes, 1990). Holmes declares,

> In the absence of such motivation, learning is reduced to a sequence of activities imposed by an agent external to the student, thereby leaving the student with a clear option of rejecting either the agent or the activities . . . facilitating self-motivation among students is, after all, one of our primary objectives in teaching mathematics. (p. 107)

Today's students enter a globalized economy in which technology plays a vital role (Pearlman, 2006). To compete successfully, today's students must have a high degree of comprehension in mathematics (Mathematics Framework for California Public Schools [MF], 2006). More than ever before, students must be educated to higher levels in order

to compete in this increasingly technological job market, which requires skills such as mathematical reasoning, problem-solving, and critical thinking. Addressing student motivation may be a first step in better assisting students to develop such skills. Teachers who reflect upon instructional practices that affect motivation naturally create an opportunity to make improvements in such practices. This is of particular importance since today's students appear to have decreased motivation when asked to make the leap from routine procedural practice to more in-depth reasoning and problem-solving.

Reform literature promotes practices presumed to enhance motivation. Because high motivation is considered a means to enhance learning, it is, therefore, a responsibility of mathematics educators to examine the factors that affect students' motivation (Givvin, Kazemi, Salmon, & Stipek, 1998). One way to reveal such factors is to probe the students on their perceptions of motivation, which may provide powerful insight into how they are affected by what they see, hear, and do in the classroom. Certainly, one could gather and interpret observational data on student behavior, as well as results of achievement assessments; however, this would surely miss critical factors that contribute to student motivation. Moreover, identifying motivational factors as seen by the students themselves, rather than simply observing behavior and trends in test scores, is likely to be far more insightful. By examining students' perceptions of the instructional and classroom learning environment, improvement of teaching and learning can emerge (Knight & Waxman, 1991; Walberg, 1976; Waxman & Eash, as cited in Huang, 1996).

Both motivational literature and mathematics education literature indicate that instructional practices that are effective in enhancing students' conceptual learning are

also motivating instructional practices (Kazemi & Stipek, 1998). Some of the practices recommended for reform mathematics instruction are related to the affective climate and include emphasizing effort and learning versus performance, improving self-confidence, encouraging autonomy and risk-taking, and providing substantial constructive feedback on students' papers (Kazemi & Stipek). However, there are no examples in the literature of practices specifically associated with teaching algebra concepts.

Instructional practices that aim to meet objectives related to both motivation and learning are valuable (Kazemi & Stipek, 1998). Teachers who have insight into students' motivational constructs are better able to fine-tune their instruction to meet the motivational needs of their students (Middleton & Spanias, 1999). The largest step in the mathematics curriculum occurs between grade 7 and algebra (MF, 2006). Thus, in an effort to maximize students' effort and interest in the field of mathematics, it is important for middle-school mathematics educators, in particular, to study student motivation. This lends to a glaring need to focus specifically on middle-school students' perspectives on how teacher practices affect their motivation to learn mathematics.

Theoretical Bases and Organization

This study identifies the source(s) of student motivation, as well as students' perceptions of teacher practices that increase or decrease motivation while learning Algebra 1. The study is specific to 7th and 8th grade Algebra 1 students. Students may identify strategies used by current and previous teachers, as well as desired strategies that they wish to experience. No similar study has been found.

CHAPTER II

REVIEW OF LITERATURE

The link between students' motivation to learn mathematics and their achievement levels is undeniable within educational research. Simply defined, motivations are reasons individuals have for behaving in a given manner in a given situation (Middleton & Spanias, 1999). Academic motivations primarily consist of two distinct types: intrinsic and extrinsic. Intrinsic motivation is demonstrated when people engage in activities that are inherently enjoyable, interesting, or challenging (Csikszentmihalyi & Nakamura, 1989; Deci & Ryan, 1985). Conversely, extrinsically motivated students engage in tasks to obtain rewards (e.g., points/grades, teacher approval, candy, stickers, free time).

In recent years there has been a growing concern over the application of reward systems in educational settings (Cameron & Pierce, 1994). The use of extrinsic rewards in capturing the motivation of students learning mathematics is encouraged by Cameron and Pierce, yet strikes a nerve with other researchers, including Kohn (1993) and Deci and Ryan (1996). According to Kohn, "Rewards are less effective than intrinsic motivation for promoting effective learning" (p. 144).

The most useful findings in recent work on motivation in mathematics education have been articulated by Givvin Kazemi, Salmon, and Stipek (1998) and Middleton and Spanias (1999), who agree that motivation in mathematics can be affected by careful instructional design. Moreover, knowing students intimately may be most powerful in

influencing motivation (Middleton & Spanias). Ample research exists in the areas of intrinsic and extrinsic motivation within the educational setting in general; yet linking the effects of specific teacher practices to student motivation in learning mathematics in particular is less prominent. Absent from the literature is the consideration of student perceptions of whether or not such practices actually do affect their motivation.

Intrinsic and Extrinsic Motivation

When children are motivated intrinsically to perform an academic activity, they spend more time engaged in the activity, they learn better, and they enjoy the activity more than when motivated extrinsically (Lepper, 1988). Intrinsically motivated students feel that learning is important with respect to their self-image and tend to focus on learning goals, which lead to understanding and mastery of mathematical concepts (Middleton & Spanias, 1999). On the other hand, extrinsically motivated students tend to focus on performance goals, which are geared toward obtaining favorable judgments and rewards and/or avoiding judgments or punishment (Middleton & Spanias).

Teacher Practices Affecting Motivation

The National Council of Teachers of Mathematics (NCTM) (2000) declares that "the kinds of experiences teachers provide clearly play a major role in determining the extent and quality of students' learning" (p. 21). Particularly during the middle school years, students are making crucial decisions about themselves as learners that can influence their attitudes, motivation, and participation in mathematics for the remainder of their lives. It is suggested by the NCTM (2004) that middle-school mathematics teachers, in particular, need to capitalize on the characteristics of students at this level. This

becomes especially important due to the difficult leap between 7th grade mathematics and algebra, which is the current recommendation for 8th grade (MF, 2006). When teachers better understand and capitalize on the characteristics of their student population through instructional practices, it seems likely that desired outcomes such as positive attitudes, as well as increased motivation and participation in mathematics, will emerge.

There is little research on classroom practices that foster either the benefits of positive emotions or the disadvantages of negative emotions. Positive emotions (especially pride) are prominent in most theories of motivation, yet motivation research that can be applied to educational practices has focused more on increasing knowledge gain versus students' affective construct and high regard for mathematics (Givvin et al., 1998). It is suggested, however, that when teachers place value on learning goals versus performance goals, more positive emotional experiences and enjoyment will emerge for students learning mathematics (Kazemi & Stipek, 2002). This, in turn, may result in increased motivation. A study conducted by Givvin et al. (1998) involving a fractions unit for 4th through 6th graders concluded that

> the affective climate, which has heretofore been the least studied of the three teacher-practice dimensions, turned out to be the most powerful predictor of students' motivation. (p. 483)

In addition, there is a desperate need for teachers to emphasize that students' success in mathematics is attributable to both their ability and effort (Middleton & Spanias, 1999), in order to increase student motivation in learning mathematics. However, teachers face very real obstacles when stressing the value and importance of students' effort versus sheer ability. One obstacle lies within the requirement for teachers to give grades for

students' ability and performance, leaving little to no room to highlight effort. Alternative grading schemes emphasizing effort were not found in the motivation literature. Another obvious dilemma that teachers may encounter is finding time to implement any of the suggested action steps with the demands of high-stakes standardized testing.

In summary, some practices mentioned in the literature to be found in mathematics classrooms, as well as those specifically linked to student motivation when learning mathematics, include using technology and/or visual aids; connecting to students while placing emphasis on learning goals versus performance goals; creating autonomy; teacher modeling; connecting concepts and placing emphasis on task importance/ relevance; implementing problem-solving; focusing on computational skills; and placing value on effort by providing feedback (not just scores or grades) within assessments. These practices, which are described below, may provide an initial framework that teachers can follow in an effort to enhance student's intrinsic motivation.

Promoting Participation

Educators might be quick to describe student participation as students volunteering to share their thinking aloud to the class, teachers calling upon students to share, and/or students working problems on the board. It is necessary and accurate to broaden the description to include students being engaged in the task at hand, completing work as directed, and even being still while quietly thinking. Regardless of the definition, educators often believe that participation sometimes paves the way for motivation. Some teachers claim that students complain of boredom due to laziness or simply to have an excuse not to participate (Seeley, 2009). Students absolutely need to accept responsibility for participating in mathematics tasks; however, if efforts can be made to structure

audience-appropriate and relevant learning experiences then perhaps more students will participate and at a more meaningful level. As suggested by Seeley (2009),

> Instead of driving students away from education with irrelevant, low-level tasks, teachers have the opportunity to invite students in mathematics in challenging and interesting ways that can keep students interested, keep them in school, and help them learn the mathematics they need for their future. (p.202)

Use of Technology

Mathematics plays an important role in the development of technology. On the same token, technology makes some mathematics possible for the first time (Seeley, 2009). The use of technology is shadowing the chalk board and pencil-and-paper approach in today's mathematics classrooms, whether through the use of calculators, allowing for accurate and efficient calculations, through graphing calculators to show connections between visual and symbolic representations, or through student tablet laptops with software capable of displaying student work to the class with a click of the mouse. Students are often more comfortable and knowledgeable in using technology than their teachers. Some students light up and are immediately engaged when given the opportunity to use technology in the classroom. Effort should be made towards implementing technology to helping students learn more mathematics, in addition to being better prepared for our technology-driven workforce.

Connecting to Students While Placing Emphasis on Learning Goals

Within the literature, motivation theorists make distinctions between learning goals and performance goals. Learning goals are described as focusing on developing skills, increasing understanding, and achieving mastery, whereas performance goals are described as focusing on appearing intelligent by receiving good grades or recognition, or

by avoiding looking incompetent (Kazemi & Stipek, 2002). Achievement-motivation researchers, as well as mathematics reformers, promote practices that encourage students to focus on learning goals (Kazemi & Stipek). Such practices include creating a climate where the focus is on understanding, where mistakes are regarded as a natural and helpful part of the learning process, and where substantive feedback focusing on mastery versus grades is provided. A classroom climate that fosters such experiences may involve teachers personally connecting to students and being available to provide individual assistance.

Autonomy and Grouping

One way to create autonomy within a classroom is through grouping: allowing students to choose to either work in groups or to work individually and allowing students to choose compatible members for their group. Furthermore, giving students freedom to develop their own ways of tackling and representing a problem can be a means of promoting autonomy in the mathematics classroom. According to the NCTM (2000), a major goal of school mathematics programs is to create autonomous learners. Through autonomy, students take control of their learning by defining their goals and monitoring their progress, thus learning more and learning better (NCTM). Allowing students to work on projects of their own choosing encourages motivation (Mazano, 2003). Encouraging student risk-taking (Givvin et al., 1998) and providing experiences of autonomy (Deci & Ryan, 1996) are popular contributors to intrinsic motivation as seen throughout the literature.

Instruction/Teacher Modeling

An instinctual exercise for many mathematics teachers is to model problems for students, often through note taking exercises or relating to homework assignments.

Students rarely reject teachers showing them how to work out a problem as watching and copying requires little demand. Teachers in the United States often tell students what to do and how to do it, and strip tasks of their complexity, thus providing insufficient opportunity for students to develop new mathematical learning (Seeley, 2009). According to Seeley (2009), "Offering students a chance to struggle may go hand in hand with motivating them, if we do it right" (p. 90).

Connecting Concepts and Placing Emphasis on Task Importance and Relevance

Mathematical tasks must be challenging enough to avoid low motivation, or boredom, yet must allow for a high degree of success if given appropriate effort by the student (Middleton & Spanias, 1999). Especially important for young adolescents at the middle-school level is the need for relevant and meaningful tasks. Students at this age are beginning to question the world around them and are undergoing tremendous physical, intellectual, and emotional change. As they develop their own self-image, they can be quite introspective and exhibit intense curiosity and strong willingness to learn things that they consider useful. According to the NCTM (2004), mathematics lessons that are relevant, interesting, and challenging will not only address middle-school students' needs but will also help them to develop an appreciation for mathematics.

Implementing Problem-solving

Echoed in the 21st century workplace is the demand for critical thinking and complex problem-solving (Seeley, 2009). Seeley points out that "The National Council of Teachers of Mathematics calls for a strong commitment to problem-solving and mathematical processes like thinking, reasoning, and making connections" (p. 116), which goes

beyond solving word problems requiring a recently learned procedure. Students demand real-world connections to mathematics, which are often intertwined within problem-solving scenarios. Thus, one might predict an increase in motivation when students encounter such scenarios, however, encouraging students to persevere and accept that struggling is a natural and often necessary component of doing mathematics seems to be an ongoing yet vital challenge for educators. Allowing sufficient time for students to formulate strategies, maintaining flexibility through the broadening of a comprehensive skill set, and allowing students the opportunity to communicate ideas with peers are all ways in which teachers can foster successful problem-solving.

Focusing on Computational Skills

According to Kilpatrick, Swafford, and Findell (2001), the use of computational skills is referred to as procedural fluency and is defined as "the knowledge of procedures, knowledge of when and how to use them appropriately, and skill in performing them flexibly, accurately, and efficiently" (p. 121). Teachers need to recognize how skill and understanding are interwoven, and assist students in monitoring which situations vary in need for speed and accuracy versus estimation and conceptual understanding. Emphasizing learning with understanding can lead to higher levels of skill than that which could be attained by practice alone (Kilpatrick et. al., 2001). Through the upcoming implementation of common core standards, teachers need to continue to place value on procedural fluency and understand its role.

Assessment and Placing Value on Effort

As described in the Mathematics Framework for California Public Schools (2006), proficiency in most of mathematics is not an innate characteristic, but rather

achieved through persistence, effort, practice, and effective rigorous instruction. Practices displaying a high regard for effort, and which portray effort as an investment that will lead to knowledge or skills, rather than as a risk that will cause failure, frustration, or embarrassment, are especially important for discouraged students who believe that they have a limited aptitude for mathematics learning (Brophy, 1986).

Mathematics reformers have recommended that teachers give substantive feedback rather than scores or grades on assignments (Kazemi & Stipek, 2002). Students need to feel that making errors and having inadequate solutions are a powerful part of the learning process. Focusing on learning, as opposed to obtaining correct solutions, can motivate students to put forth greater effort. Research shows that emphasis on substantive, informative evaluation should contribute to intrinsic interest in mathematics tasks (Kazemi & Stipek). Providing feedback on effort for prior successes supports students' perceptions of their progress in learning, sustains motivation, and increases efficacy for continued learning (Schunk, 1989). Schunk found that linking children's prior achievements with effort (e.g., "You've been working hard") led to higher task motivation, self-efficacy, and subtraction skill.

While few alternative grading techniques are offered throughout the literature, it is recommended that teachers present tests as opportunities to assess progress rather than to find out which students do not know the material (Brophy, 1986). A dilemma that teachers may experience is finding time to implement required formative assessment, let alone informative.

Student Perceptions

The NCTM (2004) encourages teachers to tap into the curious, investigative, patterning, sorting, and classifying minds of students when striving for magic within their lessons, to ask them what they think, what they see, what are their ideas, opinions, and reactions. Why not take this one step further by tapping into students' minds in regard to what the research says about practices that are motivating to them? In doing so, students may feel empowered in their learning experience. If so, further research is needed to determine whether this empowerment may generate increased motivation.

It seems obvious that students may serve as the greatest resource in understanding how teacher practices affect their motivation to learn mathematics; however, it was not revealed within the literature that the suggested practices previously described had emerged from elicited responses from students themselves. Noticeably absent from the literature are students' perceptions of teacher practices that affect their motivation, and, in particular, practices that are de-motivating. Additional studies are needed to unveil specific teacher practices that students perceive to be motivating or de-motivating when learning mathematics.

My own perception as a teacher is that students find problem-solving situations requiring a deeper level of thinking to be de-motivating. The majority of today's students do not appear to me to want to put forth the effort to read through word problems nor the thinking required for persevering through the solution. In these situations, students appear easily to give up and skip to less demanding procedural problems. Their motivation appears simply to complete the task rather than understand how the mathematics is connected to the world in which they live. The literature, however, claims that

providing meaningful and challenging tasks is one way in which teachers can increase motivation. Clearly, this presents a discrepancy—a discrepancy that students themselves may be able to help explain or confirm.

CHAPTER III

METHODOLOGY

Design of the Investigation

This study was designed to identify what students say is the source of their motivation to learn mathematics, as well as the effects of teacher practices on student motivation by surveying147 Algebra 1 students in 7th and 8th grades. Five Algebra 1 classes of two different teachers were surveyed. The study used a survey including 43 Likert scale questions and 7 free-response questions. Claiming "not at all true" for a question pertaining to being motivated does not equate to an actual decline in motivation, therefore, 10 of the 43 questions refer to motivation being decreased, in the hope of discovering specific teacher practices that may actually cause students to feel "turned off." Furthermore, it was of interest to see if responses from these items were constant with personal experience. Follow-up interviews were conducted to gain additional insight into the free-response questions.

The sources of motivation mentioned in the survey include the importance of mathematics as a subject, the desire to earn good grades, parental desires, teacher desires, and student desires. The teacher practices mentioned in the survey are categorized as follows: promoting participation/student sharing, use of technology and visual aids, connecting to students and parents/teacher availability, grouping, instruction/teacher

modeling, connecting concepts, implementing problem-solving, focusing on computational skills, and assessment/effort.

Population

Students enrolled in Algebra 1 at Olympus Junior High School (JHS) in Roseville, California, made up the sample for this study. Only students who provided parent/guardian written consent participated. Table 1 shows the breakdown for various groups at Olympus JHS at the time of the study.

Table 1

Student Groups by Percent

Group	Percent
African American	1.2
Asian	8.4
Hispanic or Latino	5.8
White (non-Hispanic)	81
Other	3.6
Socio-economically disadvantaged	2.7

The sample included 147 7^{th-} and 8th-grade students, of whom 39% were female and 61% were male. The curriculum used for the Algebra classes was published by McDougal/ Littell, which is a traditional Algebra 1 curriculum that addresses the California state standards for Mathematics. The 2006 Academic Proficiency Index score for Olympus

JHS was 878, with 65% of the students proficient and above on the California Standards Test (CST) in Mathematics.

Treatment

The data collection instrument, which can be found in Appendix A, was piloted to two middle-school students from a different county in an effort to ensure question clarity. No adjustments to the instrument were made.

After gaining permission from two teachers and the principal at Olympus Junior High School in Roseville, California, teachers were sent parental permission forms for their Algebra 1 students. The teachers collected the parental permission forms. The parental permission form can be found in Appendix B. The data collection instrument was administered when it was convenient. For consistency purposes, the instrument was administered by the same teacher for all five participating classes and was read aloud, in its entirety, to allow for equal wait time and voice inflection.

Several days prior to the administration of the data collection instrument, a tape-recorded teacher-led discussion in each of the five classes took place in an effort to develop one overall definition of motivation. The compiled definition was included on the actual instrument. The data-collecting instrument consisted of 43 survey questions using a five-point Likert scale format where respondents specified their level of agreement to a statement (1=very true, 2=sort of true, 3=neither true nor false, 4=not very true, and 5=not at all true) by putting a check in the appropriate box. Approximately one-fourth of the questions asked about motivation decreasing while the majority of questions asked about motivation increasing. The survey also included seven open-ended questions for which students provided written responses. All questions were written in simple terms

intended for the middle-school audience. A sample question in the section using the Likert scale format is “My motivation increases when the teacher is available to answer individual questions.” Respondents could avoid using extreme response categories (very true/not at all true) or agree with statements as presented in the hope of portraying themselves in a favorable light. Other students might “ride the fence” by repeatedly choosing “neither true nor false.” Such threats to validity may be minimized through follow-up interviews.

Open-ended questions included “List some things that your teacher does that makes you want to do math.” Eleven of the surveys contained responses that seemed unclear, or indicated that there may be underlying insight to uncover. The students corresponding to each of the 11 surveys were asked to participate in an individual open-ended face-to-face interview. An example of an interview question is “In your response to number ___ of the survey, what did you mean by ‘I don’t like the notes’? What is it about the notes that you don’t like?”

Each of the 11 students selected for an interview were scheduled a time slot during the school day or after school, depending on the students’ preference. A brief tape-recorded interview was conducted by the survey administrator. The interview protocol can be found in Appendix C. The survey administration protocol can be found in Appendix D.

Data Analysis

Each completed survey was numbered 1 through 147 for future reference and to cross reference content from the free-response questions with the Likert items, as

needed. Each of the five Likert scale choices was assigned the appropriate point value. The ten questions asking about motivation being decreased had the same point allocation as they were not necessarily worded "negatively." This number was the "score" for each of the 43 Likert items.

A column was created in an Excel spreadsheet for each of the 147 numbered surveys along with a row for each of the 43 Likert items. A score of 1, 2, 3, 4, or 5 for each question was entered for each survey for each item. The percentage of students who responded with each possible score was also calculated for each survey question. The sum, median, mode, and standard deviation were calculated for each survey question. The highest possible sum is 735 and would occur if all 147 respondents chose the most favorable response of "very true." The sum allows for easy ranking of sources of motivation and teacher practices, although the wording of decrease needed to be considered for those items. Therefore, all items referring to a practice being motivational were ranked separately from those referring to decreased motivation. The mode is most suitable for easy interpretation of the responses, and the standard deviation shows variance from the mean.

The answers for each of the six free-response questions for all surveys were typed into a Word document. Question 46 was disregarded as a definition of motivation was previously developed through a class discussion and included on the first page of the survey. The responses from the remaining five items were coded according to the theme of the response. For example, a response such as "When we have class time to work on our homework" was coded "T," for "Time," and was displayed in an Excel pie chart as a teacher practice category of "Giving time to work/practice." All responses relating to

having sufficient work time fell into this category. Responses with themes too unique to merge with those from other responses were coded "O," for "Other."

In addition, 11 one-on-one interviews were tape recorded and transcribed. Interviewees were asked to clarify or expand upon one to two of their written responses from the survey. The number assigned to each interviewee corresponded with their survey number. Common themes within the interview transcriptions were detected and coded. Such themes, along with those common within the survey responses, are discussed in Chapter 5.

Limitation of the Study

Limitations of this study include the number of students who participated (147), geographical limitations, grade levels of students (7th and 8th), and practices exhibited by past and present teachers of the participants. The study was limited to one junior high school in Placer County, California. Results from free-response items were limited to the number of students who chose to respond. Interviews were limited to only 11 students.

CHAPTER IV

RESULTS

Presentation of the Findings

Source of Motivation

The highest possible sum for each survey question was 735, which would occur if all 147 respondents chose the most favorable response of "very true." For the source of motivation category, the desire/need to earn good grades was the most favorable response, earning the highest sum of 690. As shown in Figure 1, 75% of students claimed this to be "very true." A personal desire to do well showed almost identical percentages, with a sum of 678. Being motivated to learn mathematics because math is an important subject ranked 3rd with a sum of 627. Eighty-five percent of students reported this to be either "sort of true" or "very true." Being motivated because of parental influence had a lesser sum of 583. Lastly, being motivated because of teacher influence had the lowest sum of 450. This question was the only one in the category with a mode value of 3, which corresponds to "neither true nor false." Almost one-third of students chose this option. The median was also 3.

The results mentioned above coincided with the results of the two questions that were worded with a double negative. Almost 90% of students chose "not at all true" or "not very true" for "not being motivated because they do not find mathematics to be useful." Similarly, 86% of students chose "not at all true" or "not very true" for "not

being motivated because they are not good at mathematics." This shows that students do indeed claim to be motivated to learn mathematics.

Teacher practice of promoting participation. As shown in Table 2, each of the five questions in this category had at least 22% of students responding "neither true nor false." This shows that students were somewhat neutral on these items. Almost 50% of students responded "not at all true" or "not very true" when asked if their motivation decreases when their teacher asks them to explain their thinking to other students. The mode was 2 (question 13). Almost 50% of students claimed that it motivates them when their teacher asks them to work out a problem on the board. The mode was 4 (question 12). Almost 50% of students answered "not at all true" or "not very true" when asked (question 10), "Knowing that my teacher might unexpectedly call upon me to answer a question is motivating to me." Even though this combination represented almost 50% of students, the most frequent response for this item was 3, corresponding with "neither true nor false."

Teacher practice of use of technology and visual aids. Question 15 revealed the most significant results, with almost 85% of students claiming "not at all true" or "not very true" when asked if having the option to use a calculator decreased their motivation. Only 13% of students were neutral and fewer than 2% claimed "sort of true" or "very true." Results from question 16 regarding the use of graphing calculators were neutral, perhaps because students in Algebra 1 have had limited exposure to graphing calculators.

Table 1

Student Survey Results

Category/ Question	Sum	Percent 1[a]	2	3	4	5	Median	Mode	SD
Sources of motivation									
1	627	2.0	2.7	10.0	36.7	48.3	4	5	.898422886
2	690	0	.01	4.0	20.0	75.0	5	5	.578671301
3	583	5.0	8.8	15.0	25.0	45.6	4	5	1.20325503
4	450	16.0	124.0	29.0	27.0	13.0	3	3	1.257491779
5	678	1.4	.01	5.0	20.0	72.0	5	5	.741839776
7 (dec)[b]	213	70.7	19.0	5.0	4.0	1.0	1	1	.826299623
8 (dec)	231	65.0	21.0	5.0	8.0	1.0	1	1	.940400841
Promoting participation									
10	376	21.8	27.0	28.0	19.7	3.4	3	3	1.31666952
11	427	15.0	19.7	36.7	17.0	11.6	3	3	1.191428191
12	478	13.0	16.0	22.4	29.0	19.0	3	4	1.292803405
13 (dec)	376	23.8	27.0	26.5	16.3	6.8	2	2	1.207286561
14	429	17.0	15.6	38.0	17.0	12.0	3	3	1.220628834
Use of technology and visual aids									
15 (dec)	219	68.7	16.0	13.0	1.0	1.0	1	1	.819551453
16	465	10.9	10.2	42.9	23.8	12.0	3	3	1.112946792
17 (dec)	322	42.0	17.7	23.1	15.6	2.0	2	1	1.191428191
18	470	8.8	21.8	28.6	22.4	18.4	3	3	1.221348957
19 (dec)	303	40.0	21.8	31.3	6.8	0	2	1	1.004916416
Connecting to students and parent/teacher availability									
20	414	23.1	12.2	34.7	19.7	10.2	3	3	1.272527124
21	602	3.4	4.1	18.4	27.9	46.3	4	5	1.051939144
22	398	25.2	14.3	36.0	13.6	10.9	3	3	1.278875379

continued

Category/ Question	Sum	Percent 1[a]	2	3	4	5	Median	Mode	SD
Grouping									
23 (dec)	300	49.0	20.4	13.6	13.6	5.0	2	1	1.255613523
24	488	8.8	12.9	32.7	28.6	17.0	3	3	1.160497164
Instruction/teacher modeling									
25	531	13.0	6.1	16.3	36.0	28.6	4	4	1.306441288
26	476	6.1	17.7	37.4	23.8	15.0	3	3	1.096272803
27 (dec)	231	66.0	16.0	13.0	4.0	1.0	1	1	.911006022
28	570	2.7	11.6	16.3	34.0	35.4	4	5	1.099770905
29	565	2.7	5.4	25.2	38.1	28.6	4	4	.987683886
Connecting concepts									
30	586	.01	6.1	20.4	39.5	33.3	4	4	.918342151
31	558	4.0	8.2	21.1	37.4	29.3	4	4	1.075002139
32	533	4.0	9.5	27.9	36.7	21.8	4	4	1.051146988
Implementing problem solving									
33	434	13.0	26.5	25.2	23.1	12.2	3	2	1.225207651
34 (dec)	476	13.0	18.4	18.4	32.7	18.0	4	4	1.295378144
35	305	33.3	38.8	17.7	7.5	2.7	2	2	1.024120232
36	312	41.5	25.2	17.0	12.2	4.0	2	1	1.194647696
Focusing on computational skills									
37	542	4.0	4.0	34.7	33.3	23.8	4	3	1.008823124
38	530	7.5	14.3	19.0	28.6	30.6	4	5	1.25929374
39	365	27.2	27.9	21.1	17.0	6.8	2	2	1.241864637
40 (dec)	430	12.0	29.9	25.9	19.7	13.0	3	2	1.212679248
Assessment/effort									
41	547	5.4	8.8	22.4	34.7	28.6	4	4	1.129579495
42	510	10.2	11.6	25.2	27.2	25.9	4	4	1.268702924
43	609	5.4	3.4	10.9	32.0	48.3	4	5	1.094202409

continued

Category/ Question	Sum	Percent					Median	Mode	SD
		1[a]	2	3	4	5			
44	459	11.8	18.4	29.3	27.9	13.0	3	3	1.194647696
45	526	4.8	10.2	33.3	25.9	25.9	4	3	1.118339209

[a] 1=not at all true; 2=not very true; 3=neither true nor false; 4=sort of true; 5=very true
[b] word "decrease" in question.

When asked if the use of a LCD projector to display math PowerPoint slides decreases motivation (question 17), over 41% of students responded "not at all true" and over 17% responded "not very true." Twenty-three percent of students were neutral for this item.

Not one student responded "very true" when asked if their motivation decreases when their teacher draws a diagram on the board that relates to a math problem (question 19). This was the only 0/147 on the entire survey relating to teacher practices. Almost one-third of students were neutral and almost two-thirds responded "not at all true" or "not very true." Overall, students were neutral for question 18, relating to viewing video clips and information from the Internet via LCD projector or Promethean board. The mode for this item was 3.

Teacher practice of connecting to students and parents/teacher availability. Students responded favorably to their teacher being available to answer individual questions, with over 75% reporting "sort of true" or "very true," and with a mode of 5. With a mode of 3, responses were neutral regarding teachers asking about students' lives outside of class. Although only a little over one-third of the students responded with "neither true nor false," slightly less than one-third of students chose the opposite ends ("not at all true/not very true" and "sort of true/very true"). This shows that students are divided

regarding the link between teachers asking about their lives outside of class and their motivation in class.

Similarly, the mode was 3 for the item regarding the possibility of teachers contacting parents, although almost 40% reported “not at all true” or “not very true” when asked if this is motivating to them.

Teacher practice of grouping. Almost half of all students reported “not at all true” when asked if their motivation decreases when their teacher has them work with others. The mode for this item was 1. 20% of students who responded “not very true.” When asked in the next item if they are motivated when their teacher has them work individually, about 45% of students responded favorably with “sort of true” or “very true,” however, almost one-third of students were neutral. The mode was 3. This is discussed further in Chapter 5 as results appear to be saying two different things.

Teacher practice of instruction/teacher modeling. The most pronounced result from this category had a mode of 1; two-thirds of students reported “not at all true” when asked if their motivation decreases when their teacher shows steps on how to solve problems. Only 13% of students were neutral with this question and 4% responded favorably. Only one other question on the survey showed a more significant result (Figure 1, question 15). This shows that students want math problems to be modeled for them.

Similarly, the results from question 28 show students” desire for teachers to discuss homework during class time. Almost 70% of students claimed this practice to be motivating.

Teacher practice of connecting concepts. Each of the three items in this category had a mode of 4. Over 70% of students responded “sort of true” or “very true” when asked if it motivates them when their teacher explains why they are learning a particular concept (question 30). Likewise, over two-thirds of students said it motivates them when their teacher talks about how math is used in the real world, and over half of the students favored having new concepts connected to previously learned concepts (question 32). This shows that on average, students favored learning the “why” behind the mathematics and the connection to previous concepts and to the real world.

Teacher practice of implementing problem-solving. The most dominant response for this category related to the question about students explaining their thinking. Over 70% of students chose “not at all true” or “not very true” when asked if their motivation increases when the directions to a problem ask to explain their thinking (question 35). The mode was 2. Over 65% of students chose the same responses when asked if their motivation increases when their teacher assigns a new problem that he or she hasn’t told them much about. The mode for this item (question 36) was 1. More than half of the students claimed their motivation decreases while doing word problems (question 34), yet a significant 31% claimed this not to be true. The mode for this question was 4.

Teacher practice of focusing on computational skills. Chosen by 31% of students, the mode for question 38 was 5 (“very true”). Overall, almost 60% of students responded favorably (“sort of true”/”very true”) to this question, which asked, “My motivation increases when I work on problems that do not require a lot of thinking.” Only 8% of students reported “not at all true” or “not very true” when asked if their motivation

increases when working on problems involving a routine method (question 37). The mode was 3, with about one-third of students claiming to be neutral ("neither true nor false").

Teacher practice of assessment/effort. Students were neutral about having regularly scheduled quizzes, tests, and homework checks (similar to what is commonly known as a "homework quiz"). The mode for both of these questions was 3. More than 50% of students reported their motivation to increase when teachers gave partial credit (question 42). One-fourth of students were neutral. Over 63% of students responded favorably to teachers placing importance on showing steps versus having the right answer, with a mode of 4. Second to question 15 regarding the use of calculators, students responded most favorably to the practice of constructive comments written on student work versus teachers simply giving a score (question 43). Almost half of all students chose "very true" for this item.

Free-response Results

Figure 1 shows the free-response compilation for question 6 ("Other reasons why I'm motivated to learn mathematics"). One hundred twenty students (81.6%) responded to this question. With over 25% of students in favor, the most prominent response to this question was the desire to get into a good college. Getting a good/specific job was represented by 21% of students, along with the belief that math is useful/ important.

Figure 2 shows the free-response results for question 9 ("Other reasons why I'm NOT motivated to learn math"). Only 60 students (40.8%) responded to this question. Of these, more than one-fourth of the students reported math being hard, confusing,

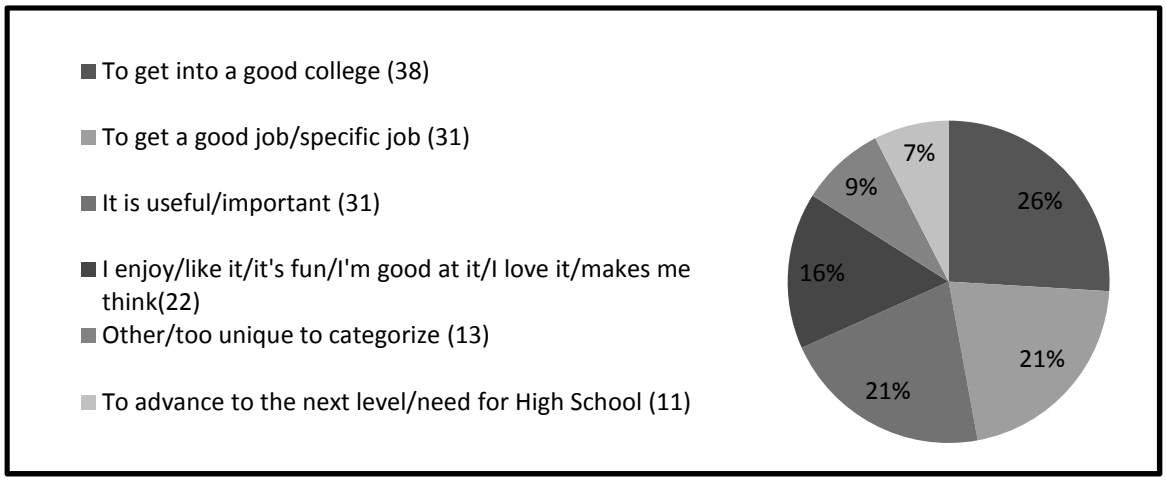

Fig. 1. Free-response results for survey question 6 (“Other reasons why I’m motivated to learn mathematics”).

and/or they are not good at it. More than one-fourth of students reported math to be boring, not interesting, and/or not fun. More than 10% of students claimed their dislike for their teacher to be the reason for not being motivated to learn math. Slightly fewer than 10% of students feel that math is not useful and/or they do not need it for their desired career. Additional categories of responses to this question include; there is too much

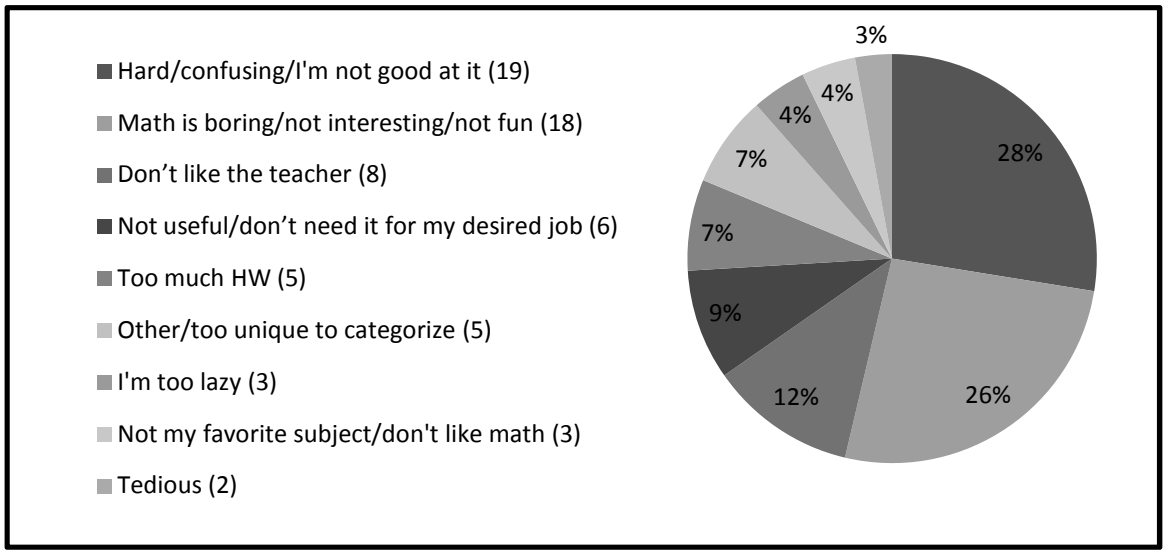

Fig. 2 Free-response results for survey question 9 (“Other reasons why I’m not motivated to learn math”).

homework, I'm too lazy, math is not my favorite subject/I don't like math, math is tedious, and other (too unique to categorize).

Figure 3 shows the free-response compilation for question 47 ("This survey only mentions some of the things that your teacher(s) may have said or done during class. Please describe other things that your teacher has either said or done that caused your motivation to increase when learning mathematics"). One hundred thirty-eight students (93.9%) responded to this question. The most overwhelming response was the teacher

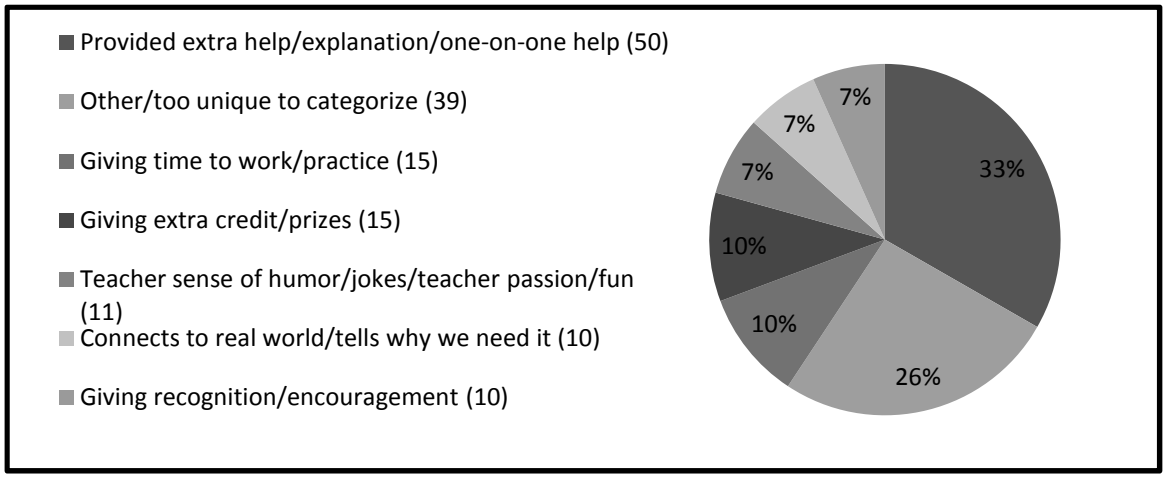

Fig. 3 Free-response compilation for survey question 47 ("This survey only mentions some of the things that your teacher(s) may have said or done during class. Please describe other things that your teacher has either said or done that caused your motivation to increase when learning mathematics").

practice of providing extra help, extra explanation, and one-on-one help. This was reported by one-third of the respondents. Over one-fourth of the respondents mentioned a practice that was too unique to categorize ("other"). Giving time to work/practice was reported by 10% of respondents, as was giving extra credit/prizes. More than 7% of respondents mentioned either their teacher's sense of humor, jokes, passion, and/or making math fun as a motivating practice. Slightly fewer than 7% of respondents favored

connections to the real world and teachers revealing the need for the math concept being taught. The same number of respondents favored teachers giving recognition/ encouragement.

Figure 4 shows the free-response compilation for question 4 ("Please describe other things that your teacher has either said or done that caused your motivation to decrease when learning mathematics"). One hundred twenty students (81.6%) responded to this question. The most dominant category for this question included more than 25% of the students, whose responses were too unique to categorize. Slightly fewer than 20% of students said either too much, excessive, and/or unnecessary homework. Almost as many

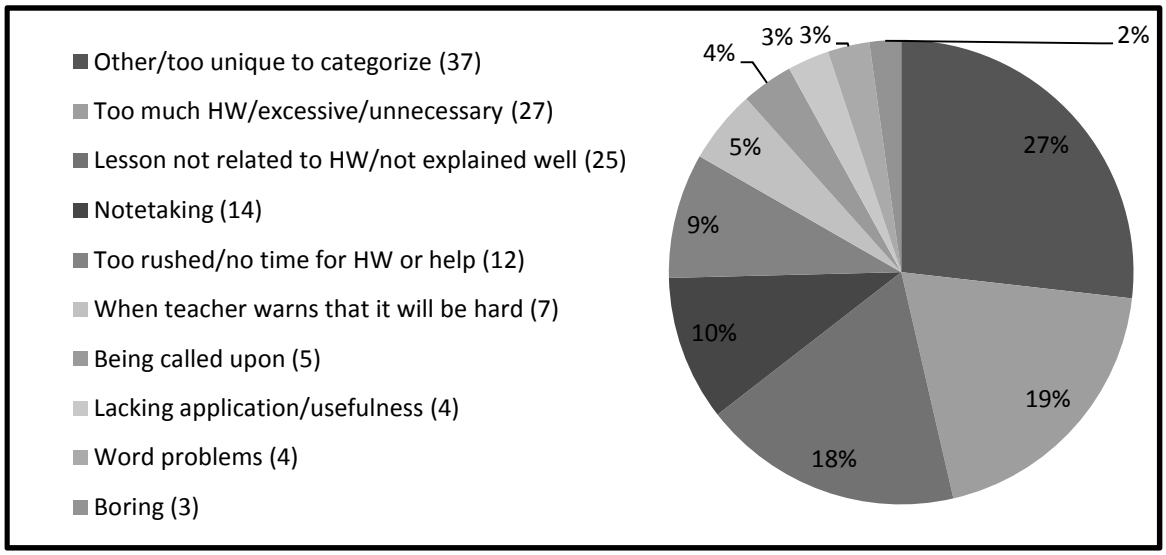

Fig. 4 Free-response compilation for survey question 48 ("Please describe other things that your teacher has either said or done that caused your motivation to decrease when learning mathematics").

students felt the lesson was not related to the homework and/or not explained well. These results show that students are skeptical about the value in homework. About 10% of

students claimed note taking decreases their motivation. A similar number of students felt rushed during the lesson and wanted more time for homework and/or help.

Figure 5 shows the free-response compilation for question 49 ("Please share some things that have not yet been mentioned that you think would be motivating for you in learning mathematics, that you would like to have as part of your math class"). One hundred nineteen students (81%) responded to this question. Almost half of the responding students expressed a desire for either more class time to do homework, getting help

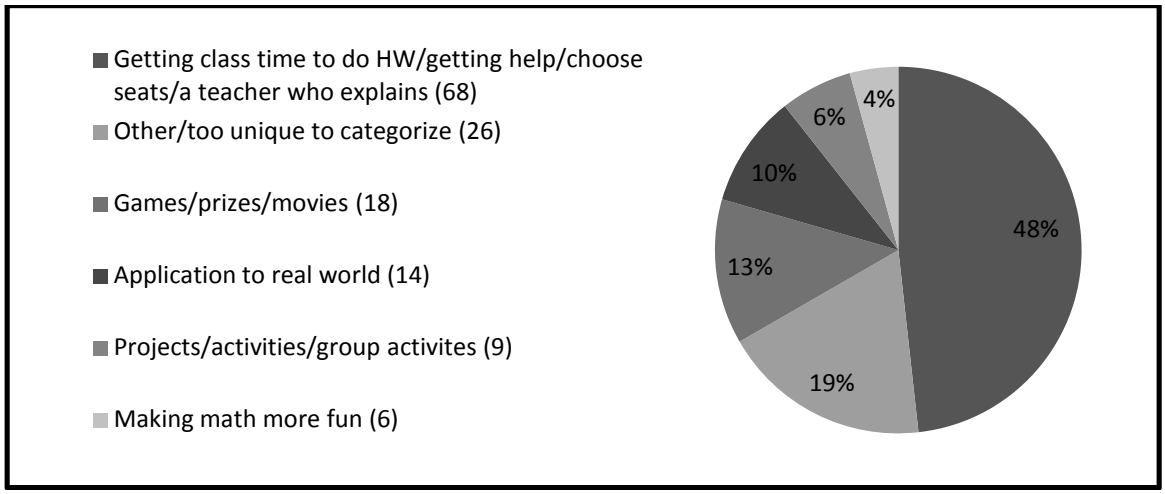

Fig. 5. Free-response compilation for survey question 49 ("Please share some things that have not yet been mentioned that you think would be motivating for you in learning mathematics, that you would like to have as part of your math class").

on homework, choosing seats (to work with students of their choice), and/or a teacher who explains things. These were categorized together because they were centered on receiving help. Almost 20% of responses were too unique to categorize. Almost 13% of respondents said games, prizes, and/or movies would be motivating to them. Less significant responses included real-world applications (9.9%), projects and/or group activities (6%), and making math more fun (4%).

Figure 6 shows the free-response compilation for question 50 ("Please share things that have not yet been mentioned that you think would cause your motivation to decrease when learning mathematics"). Only 98 students (66.7%) responded to this question. The most dominant category for this question included 38% of the students, whose responses were too unique to categorize. Having too much homework and/or less class time for homework was claimed to decrease motivation for 20% of respondents. Not

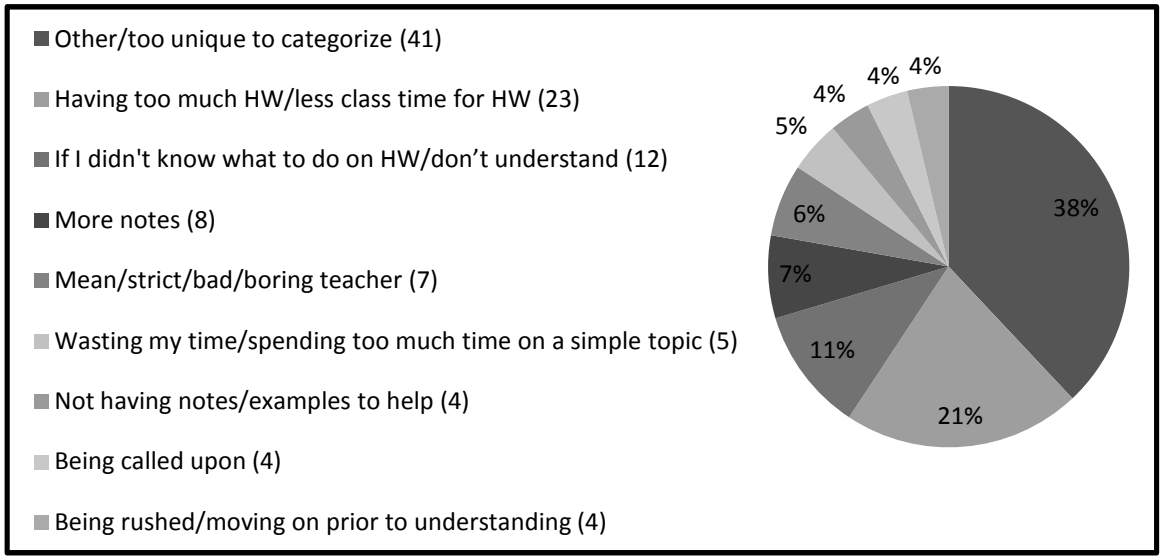

Fig. 6. Free-response compilation for survey question 50 ("Please share things that have not yet been mentioned that you think would cause your motivation to decrease when learning mathematics").

knowing/understanding what to do on the homework was reported to decrease motivation for over 10% of respondents. Slightly over 7% of respondents claimed that taking more notes decreased motivation, while almost 4% of respondents attributed their decrease in motivation to not having notes/examples to help. The same number of respondents attributed being called upon and being rushed to move on prior to understanding as reasons for their decrease in motivation.

Results from Interviews

In question 10, the student made a generalization that most of the math learned in 8th grade will never be used in the real world. Through the interview, the student clarified that some professions are going to use the math, but people seeking those professions will need to explore the concepts in much more depth than what is covered in a "two week period in 8th grade." This student also added that, in an effort to motivate students, teachers need to stop and help when the whole class is struggling.

In question 15, the student claimed not to be motivated to learn mathematics because he is "not planning on being a math teacher." Through the interview, the student expressed to have no desire to pursue a job dealing with math and seemed to believe that math is only used in specialized careers, such as a rocket scientist or math teacher.

In question 19, the student reported experiencing a decrease in motivation when teachers teach out of the textbook because it causes him to feel like he did not learn the whole subject. Through the interview, he expressed frustration when teachers only pull problems and examples out of the book, because he feels that he could do this on his own at home. This student also shared a desire for more in-depth learning than what the textbook examples require.

In question 24, the student described math as an important foundation once you're on your own and facing challenges throughout adult life, and identified this as being an additional reason for being motivated to learn mathematics. When probed further in the interview regarding how learning math is important for facing life challenges, and, what types of challenges, the student linked using one's brain to solve math problems to problem-solving in certain life situations. The student also credited an increase in

motivation to the teacher's passion for math and ability to go beyond the textbook to teach.

In question 25, the student attributed increased motivation to feeling that the teacher cares about her. When probed in the interview about her perception on how a teacher shows that he or she "cares," the student explained "by offering one-on-one help, going out of her way to tell me if I need help, and trying her best to answer my questions when I go up to her."

The same survey also revealed a decrease in motivation when "the teacher doesn't explain enough, and therefore I don't understand the concept." When probed in the interview on whether or not this was the only reason for the student's lack of understanding, the student blamed a lack of examples in the notes that could assist with the homework problems as well as a disconnect between the types of problems assigned and the examples provided.

Question 46 described an increase in motivation when the teacher takes time to make sure everyone understands. When probed in the interview as to what the teacher actually does to ensure student understanding, the student said, "She takes time to take questions." The student continues to explain how the math can still be confusing even when provided with notes. It was not revealed exactly how the teacher helps students through their questions.

In question 73, the student claimed a decrease in motivation when teachers put stars or smiley faces on graded work. In the interview, the student confirmed that, indeed, receiving stars causes her to feel bad for those who did not receive a star; likewise, she

feels bad herself when she does not receive a star. When probed further in regards to how this decreases her motivation, the student was not able to articulate what the results of her decreased motivation look like, rather, that the star giving simply causes her to be upset and "bummed out" for the remainder of the day.

When asked in the interview if there was anything else that she would like teachers to know about motivating students to learn algebra, the student replied, "Just encourage people. Let them know that they can do it."

In question 78, the student shared an experience of increased motivation when teachers show how math is used in the real world, along with helping students to have fun with math. When asked to describe how a teacher helps students have fun with math, the student responded with "teacher enthusiasm" along with opportunities for class competitions.

In the survey, the same student claimed being good at math as an additional reason for being motivated to learn mathematics. When probed in the interview on whether or not she would be as motivated to learn math if she weren't good at it, the response was, "No, because I wouldn't understand it as much and I wouldn't want to move further into it."

In question 97, the student communicated a decrease in motivation when teachers announce ahead of time that the test will be difficult and that students in earlier periods did not do well. When asked to elaborate during the interview, the student shared feelings of worry and being stressed out. The stress, in turn, causes him to forget steps and to "mess up." After expressing understanding for why a teacher might provide a class

with this type of "heads-up," the student shared that he would be more relaxed and encouraged if the teacher simply said something to the effect of, "the test is going to require your concentration, so take your time." Whether or not the student's motivation actually decreases when teachers warn of the level of difficulty for a task, meaning his desire to learn, work hard, and personally succeed decreases, was not indicated.

In question 110, the student identifies extra credit opportunities as a means of increasing motivation when learning mathematics. In the interview, the student described feelings of hope for raising his grade by completing extra credit work. When asked if extra credit opportunities caused an increase in motivation for learning mathematics or just increased motivation to complete the extra credit in order to earn a higher grade, he admitted to the latter.

In the same survey, the student reported a decrease in motivation when the teacher announced that upcoming lessons would only get harder than what they have experienced thus far. In the interview, the student explained how this made him feel like things weren't going to get any easier from that point—that it wasn't going to lighten up and that everyone was going to have to work harder. When asked if there was anything else that he would like teachers to know about motivating students to learn algebra, the student replied, "Just make sure they go over every question."

In question 123, the student identified having more class time to work on homework as a motivating experience when learning mathematics. When asked in the interview to elaborate on why he desires class time to work on homework, he said it

allows for more study time for other classes as well as having opportunities to ask for help.

In summary, 2 of the 11 interviews exposed a student desire for teachers to teach beyond what is included in the textbook. From the students' perspective, going beyond the textbook proved teachers' mathematical knowledge and provided a more desired in-depth learning experience. Three interviews addressed the usefulness of mathematics, by either appreciating when teachers explained how math is used in the real world or by perceiving math to only be used in a small number of specialized careers not likely to be pursued by the interviewees. Three interviewees expressed feelings of encouragement as a means of increasing motivation. Three interviews associated experiences of being challenged, confused, needing to work hard, and struggling with feelings of decreased motivation. Lastly, 4 of the 11 interviews revealed a desire for teachers to answer questions and be available for help, which was claimed to be motivational when learning mathematics.

CHAPTER V

DISCUSSION

Mathematics teachers are often caught in the conundrum of how much modeling of the mathematical concepts and procedures they should provide, versus allowing students to constructively struggle through problem-solving and doing mathematics. Obviously, there is need for a balance between the two as one should not exist solely without the other. Fear of "spoon-feeding" content to students arises when too much modeling occurs. Students then seem to become accustomed to and dependent upon the teacher showing every possible variation of a procedure, and tend to "give up" when independently approaching a problem that seems slightly unfamiliar because it has not been modeled. Teachers struggle with finding the most efficient way to teach mathematics, as they are often overwhelmed with the high number of standards to cover, short class periods, and large class sizes. Yet the research is flooded with the message that persevering and thinking hard through complex situations is a fundamental part of doing and learning mathematics (Bjork, 1994; Hiebert, Carpenter, Fennema, Fuson, Human, Murray, Olivier, & Wearne, 1996; Lampert, 2001; Stein & Lane, 1996; Stein, Smith, Henningsen, & Silver, 2000).

Through the data analysis of this study, a discrepancy emerged from some of the teacher practices affecting motivation, as perceived by students. Overall, as indicated

by the interviews, as well as survey questions 15, 19, 21, 23, 27, 28, 47, and 49, students expressed a high desire for assistance, whether it be from their teacher, classmates, or calculators. One conclusion that could be drawn from this is that students may be quick to accept paths that would make their lives "easier," and that they are somewhat lazy or not willing to put forth meaningful effort. A less-obvious and perhaps contradicting outcome, however, arose within the interviews, as well as survey questions 19, 30, 31, 32, 33, 34, 37, and 43, indicating an undercurrent of student desire for teacher practices promoting thinking and meaningful mathematical challenges. Only one student out of all 147 chose "not at all true" for question 30, which asked if it is motivating when the teacher explains why they are learning a particular concept, versus simply telling students that they need to know it. Likewise, only nine students chose "not very true" for the same question. If the students from this study truly wanted an "easy" route to success paved with teacher-modeling, hand-holding, and help from peers, then one must ponder why they would even care about why mathematics is important, as such a high percentage of students claimed. Concluding that there is motivation for learning why mathematical concepts are being taught may imply a subtle exposure of a desire for more meaningful experiences in mathematics, rather than simply going through the motions in order to save time, avoid struggle, and earn good grades. Furthermore, providing constructive comments rather than a score (question 43) reported to be the most motivational teacher practice measured in the survey. One must also wonder then, why students care so much about receiving constructive feedback; perhaps because students yearn for teacher encouragement. In this study, one side of the two-faced coin shows students favoring practices that deliver a path

of least resistance. The other side, however, expresses students' openness to a richer mathematical experience and possibly points to a craving for reaching to levels they never thought possible.

A similar rationale spurs from the results of question 19, which asked if motivation decreases when the teacher draws a diagram on the board that relates to a math problem. This was the only question on the survey where not one student selected a particular extreme option, in this case, "very true." The mode was 1 ("not at all true"). This shows that students will not only readily accept assistance offered through a visual aid, but also, on a deeper level, it uncovers an undeniable level of regard for understanding what is happening mathematically. If students only care about going through the motions of getting a problem "finished" with less concern about obtaining true understanding, then their motivation may decrease if a teacher takes extra time to draw a diagram on the board. This was not the case. Often times, a diagram offers insightful connections about a scenario, which can lead to a more significant understanding and may be exactly what students want.

Although demographics and standardized test results are not necessarily determining factors for students being motivated to learn, it seemed reasonable to predict that the population included in this study would, indeed, prove to be generally motivated to learn mathematics. With over 95% of favorable responses, the strongest source of motivation to learn mathematics as reported by 7th- and 8th- grade Algebra 1 students was "a want/need to earn good grades" (question 2). Perhaps wanting to earn good grades is related to a strong desire get into a good college, as shown with the highest percentage in

the free-response results for question 6 relating to sources of motivation. Thus, students in this study claim to be motivated to learn mathematics.

The top reason for not being motivated to learn math, as reported by those who responded, was feeling that math is hard, confusing, or not being good at it. Almost as prominent was the feeling that math is boring, not interesting, or not fun. Fewer than half of the students responded with reasons for not being motivated, which must be considered when interpreting these results and, only supports the claim that students generally do feel motivated to learn mathematics. Consequently, the ten survey questions worded with "decrease motivation" were expected to have lower sum values, which would associate with scores of 1 and 2 ("not at all true" and "not very true"), when asked if a particular practice decreases motivation. Overall, this was the case. Almost half of the survey questions having the highest sums contained wording involving motivation being "increased." The top 16 sums did not include any questions worded with "decrease." Six of the nine survey questions having the lowest sum values referred to motivation being decreased. It would not be informative to rank the teacher practice categories due to the unequal distribution of the "decrease" questions.

The highest sum of the decrease questions was question 34, which asked if motivation decreases while doing word problems. Both question 33 and question 34 had equivalent mode representations and were among the bottom fourth of questions having the largest standard deviations. Although it was anticipated to have both the highest sum out of the decrease questions and be aligned with question 33, which asked about being motivated when assigned challenging problems, it was surprising that the sum for

question 34 was only 476. It is common knowledge amongst math teachers that most students avoid word problems at all costs. The most frequently asked questions during class time are with regards to help on word problems. Often times, students fail to even read the word problem and seem paralyzed in developing any sort of plan of attack. Perhaps the somewhat adverse wording for question 34 ("decrease") influenced student responses resulting in a lower sum and mode than one would expect, yet the second to largest standard deviation. The 43 students who responding with "sort of true" or "very true" on question 33 (challenging problems) also chose "not at all true" or "not very true" on question 25, which asked if earning credit for note-taking is motivating. This shows a relatively positive correlation, meaning students who appreciate challenging work do not care for the mundane task of taking notes. Furthermore, the fact that question 33 showed a significant percentage of students claiming to be at least somewhat motivated when assigned challenging problems (35%), and again in question 34 where 31% of students claimed their motivation does not decrease while doing word problems, must be contemplated in reference to the undercurrent of students' desire for challenge. Through personal experience, along with the overwhelming trend of students favoring their teacher working out problems in class and providing one-on-one assistance, it was expected that results for questions 33 and 34 would weigh more heavily towards students not being motivated when assigned challenging problems and word problems.

Another interesting correlation emerged amongst question 30 and question 43 in regards to the consequence of how the survey questions were worded. These two questions were amongst the top three teacher practices for the entire survey, with sums of

586 and 609, respectively, and were the only questions on the entire survey worded with considerable similarity. Question 30 stated, “It motivates me when my teacher explains why we are learning a particular concept, versus simply telling us that we need to learn it.” Question 43 states, “It motivates me when my teacher writes constructive comments on my paper rather than simply giving a score.” The word “simply” may have persuaded students to respond more favorably as it may have been diminishing to the former statement. One may have readily predicted these two questions to have high sums; however, such persuasive wording should have been avoided.

It was also predictable that question 40, referring to motivation decreasing when teachers assign a lot of similar type problems, would have a mode of 2 (“not very true”) perhaps because students may want to avoid struggling, and perceive it to be a simple task when little variation amongst the assigned problems exist. On the other hand, the wording “a lot of problems” might have inaccurately lead students toward agreement, thus choosing “sort of true” (almost 20%) or “very true” (13%) as students’ number one complaint is the amount of work they receive. Wording choice may have also led to a lower standard deviation and mode, signifying less agreement to the statement. The most contributing factor to decreased motivation as revealed in free-response question 48, referring to “other things that caused your motivation to decrease,” was “too much, excessive, or unnecessary homework.” Educators need to distinguish between the quantity and quality of work students receive.

In regards to student participation, questions 10 (“Knowing that my teacher might unexpectedly call upon me to answer a question is motivating to me”) and 11 (“It

motivates me when my teacher asks for a volunteer to work out a problem on the board") fell within the lower half of ranked sums and both showed neutral responses with modes of 3. These results might be surprising as teachers tend to believe that encouraging and even pushing students to participate would increase students' desire to succeed. Perhaps the reason for such an unexpected neutrality and even unfavorable responses to question 10 was because students may prefer to have personal "think-time," versus being put on the spot to publicly formulate their thinking. Another possibility may have to do with a fear that their teacher would be reading their survey responses and may consequently implement the said practice more frequently. Students may have "held back" knowing that more favorable responses would suggest a means of increasing motivation and thus appeal to their teacher. Likewise, results from question 22 ("Knowing that my teacher can contact my parents is motivating to me") were surprisingly neutral with a mode of 3 and a standard deviation ranking in the highest fourth of the data. Perhaps students wanted to "play it down" in fear of teachers reading the results and making phone calls home, assuming they interpreted the question to refer to undesirable calls. If taken at face value, on the other hand, it is possible that students truly wouldn't mind if their parents were called, because perhaps only minor consequences would take effect for this particular group of students.

It appears as though students accurately interpreted question 12 ("It motivates me when my teacher asks me to work out a problem on the board") to have a complimentary-like flavor, as there was a noticeable difference between the results of this question and question 10, which was worded almost identically. Students likely

associated question 12 with the teacher having confidence in them, as opposed to singling them out or keeping them on their toes, as was more the intention behind question 10. Results from question 12 were consistent with a similar question, question 13, which asked about motivation decreasing when teachers ask students to explain their thinking to other students. These two results (questions 12 and 13) reveal a general feeling of comfort in working out problems on the board or sharing their implied formulated thinking to other students (not necessarily to the class). One must wonder then, why the overall glaring student desire for teachers to work out problems from the assignments and provide one-on-one assistance, as indicated by the free-responses, interviews, and survey results. This reveals a discrepancy; students overwhelmingly claim to want "help" from their teachers through modeling problems, yet don't seem to mind being asked to publicly work problems and share their thinking. Again, the undercurrent of students wanting challenge and willingness to be an active learner appears.

In terms of grouping, personal experience shows students expressing positive emotions when they walk into a classroom to find the desks arranged in groups. There is often, however, a small number of students who prefer to work individually, either because they are painfully shy, fear they will get stuck carrying the majority of responsibilities, or want to be able to choose the members of their group. Teachers commonly associate group work with increased motivation because students express enthusiasm, interest, and a willingness to take risks while in the safety net of their peers. At the same time, teachers often dread the potential for students to easily get off task and overly socialize while working in groups, especially at the secondary level. Structuring groups

by assigning roles to each group member can be helpful in keeping kids on task. In the free-response results, prior to compiling some of the categories for question 49, over 13% of responding students offered being able to choose their seats as an additional motivational factor not previously mentioned in the survey. Some students specifically mentioned wanting to select people from whom they felt comfortable receiving help, which was why this joined the condensed category of "Getting class time to do HW/getting help/choose seats/a teacher who explains." Other student did not specify a reason for choosing seats. The topic did not emerge from the interview data. Having almost 70% of students claiming "not at all true" or "not very true" when asked in question 23 if their motivation decreases when the teacher has them work with others does not necessarily indicate an increase in motivation; just that there is not a significant decrease. Otherwise, one would expect there to be more 1s and 2s in question 24, which asked about being motivated when working individually. Here, one-third of the students were neutral and approximately 45% favored working individually. What students are claiming here is that they are generally neutral, and even motivated, to work individually, yet their motivation does not necessarily decrease when working in groups. Thus, students' motivation may not be positively affected by working in groups as many teachers might predict, though students might enjoy the social interaction and benefits of working with peers. However, perhaps students do not want to be dragged down by non-contributing group members, but, rather, they aspire to have a more productive and possibly challenging experience than their typical collaboration opportunities have offered. Reform strategies describe student collaboration as a necessity in providing students with the interactional skills that

are often required in the workplace and in society (Green, 1997), so it is important for teachers to continue to provide such opportunities.

Also important is the consideration of how technology can be used to enhance mathematical learning and possibly increase motivation. In an era when adolescents are so enthralled with multimedia and dependent upon technology, it was somewhat of a surprise that the results from the questions asking about PowerPoint slides (question 17), and video clips and internet resources (question 18), did not link more significantly towards increased motivation. In fact, both questions had a greater standard deviation than more than half of the survey questions. Especially peculiar was question 18, where the mode (3) indicated neutrality. This supports the claim that students may have a deep desire to be doing challenging math versus being entertained by viewing math.

Swelling class sizes and increased demands being placed upon teachers make it extremely difficult to provide challenging activities, personalized assistance, and procedural techniques. When considering student perceptions of teacher practices that affect motivation to learn mathematics, specifically Algebra 1, as revealed in this study, one must also consider the role that students play in their learning experience. Doing math requires a willingness to approach new challenges, along with possessing a level of perseverance necessary to successfully problem-solve. Results from question 34 indicate a less significant decrease in motivation for word problems, associated with the teacher practice that encourages problem-solving and perseverance, than one might expect. Perhaps because on a deeper, more subconscious level, middle-school students are motivated

by encouragement and support through a deep and rich mathematical learning experience, as supported by the results of this study.

Recommendations

Students claim to have motivation to learn, largely due to the desire to obtain good grades and to get into a good college. Students favor teacher practices that promote assistance with the concepts and assigned practice problems, constructive feedback on work, and autonomy with seating arrangements. This research could be expanded to additional schools in an effort to obtain better results. Recommendations to improve the study include compiling free-response questions prior to interviewing students, as this would produce more meaningful follow-up questions for the interviews; and having a consistent number of questions including those worded with "decrease" for each teacher practice category. Furthermore, it is unknown how often one student interpreted a question one way, while another student another way.

Young people are not alone in facing new challenges and demands. With the pressures of meeting state standards combined with the increased challenge of competing with today's stimulating world of multi-media, it becomes more and more difficult for teachers to find time to creatively implement suggested practices said to enhance student motivation in learning mathematics. Further research is necessary in determining adequate ways in which districts can support teachers with staff development along with ways in which teachers can give grades that are an accurate reflection of a student's ability while simultaneously placing value on effort and providing personalized constructive comments. Knowing students intimately may allow teachers to maximize their

effectiveness while implementing the suggested practices mentioned above. Teachers who are attuned to their students' motivational triggers are better able to adjust their classroom practices to motivate their students (Middleton, 1995). This suggests that it may be worthwhile for school districts to provide staff development in the area of student motivation; in particular, identifying students' motivational beliefs and perceived triggers.

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APPENDIX A

STUDENT SURVEY

Note to Student:

The purpose of this survey is for data collection only. Please be completely honest in your responses. Please carefully reflect upon each item before answering. This survey will NOT affect your grade nor cause your teacher to formulate an opinion of you. Stating your name is for follow-up purposes only and will not be reported in the data. Your participation is greatly appreciated.

Name:_____ Class: Algebra 1 Date:_____

For this survey, ***motivation*** is defined as a desire to learn, work hard, and personally succeed.

Source of Motivation

Please put a "√" in the box that best fits your response.		Not at all true	Not very true	Neither true nor false	Sort of true	Very true
1)	I am motivated to learn mathematics because math is an important subject.					
2)	I am motivated to learn mathematics because I want/need to earn good grades.					
3)	I am motivated to learn mathematics because my parents want me to do well.					
4)	I am motivated to learn mathematics because my teacher wants me to do well.					
5)	I am motivated to learn mathematics because *I* want to do well.					
6)	Other reasons why I'm motivated to learn mathematics (please describe – use the back if you need more room):					
7)	I am NOT motivated to learn mathematics because I do not find it useful.					
8)	I am NOT motivated to learn mathematics because I'm not good at it.					
9)	Other reasons why I'm NOT motivated to learn mathematics (please describe – use the back if you need more room):					

Promoting Participation

Please put a "√" in the box that best fits your response.	Not at all true	Not very true	Neither true nor false	Sort of true	Very true
11) Knowing that my teacher might unexpectedly call upon me to answer a question is motivating to me.					
12) It motivates me when my teacher asks for a volunteer to work out a problem on the board.					
13) It motivates me when my teacher asks *me* to work out a problem on the board.					
14) My motivation decreases when my teacher asks me to explain my thinking to other students.					
15) It motivates me when other students explain their thinking about a problem.					

Use of Technology and Visual Aids

Please put a "√" in the box that best fits your response.	Not at all true	Not very true	Neither true nor false	Sort of true	Very true
16) Having the option to use a calculator decreased my motivation.					
17) Using a graphing calculator increases my motivation.					
18) My motivation decreases when my teacher uses the projector to show math Power-Point slides.					
19) My motivation increases when my teacher uses the projector/Promethean board to show video clips and things from the internet.					
20) My motivation decreases when my teacher draws a diagram on the board that relates to a math problem.					

Connecting to Students & Parents/Teacher Availability

Please put a "√" in the box that best fits your response.	Not at all true	Not very true	Neither true nor false	Sort of true	Very true
21) It motivates me when my teacher asks about my life outside of class.					
22) It motivates me when my teacher is available to answer individual questions.					
23) Knowing that my teacher can contact my parents is motivating to me.					

Grouping

Please put a "√" in the box that best fits your response.	Not at all true	Not very true	Neither true nor false	Sort of true	Very true
24) My motivation decreases when my teacher has us work with others (groups/pairs).					
25) I am motivated when my teacher has us work individually.					

Instruction/Teacher Modeling

Please put a "√" in the box that best fits your response.	Not at all true	Not very true	Neither true nor false	Sort of true	Very true
26) Earning credit for note-taking is motivating to me.					
27) It motivates me when my teacher explains the meaning of math words (vocabulary).					
28) My motivation decreases when my teacher shows steps on how to solve a problem.					
29) It motivates me when my teacher discusses homework problems in class.					
30) It motivates me when my teacher shows more than one way to solve a particular math problem.					

Connecting Concepts

Please put a "√" in the box that best fits your response.	Not at all true	Not very true	Neither true nor false	Sort of true	Very true
31) It motivates me when my teacher explains *why* we are learning a particular concept, versus simply telling us that we need to learn it.					
32) It motivates me when my teacher talks about how mathematics is used in the real-world.					
33) It motivates me when my teacher connects a new concept to one that we've already learned.					

Implementing Problem-Solving					
Please put a "√" in the box that best fits your response.	Not at all true	Not very true	Neither true nor false	Sort of true	Very true
34) I am motivated when my teacher assigns challenging problems.					
35) My motivation decreases when I do word problems.					
36) My motivation increases when the directions ask me to explain my thinking for a problem.					
37) My motivation increases when my teacher assigns a new problem that she/he hasn't told us much about.					

Focusing on Computational Skills					
Please put a "√" in the box that best fits your response.	Not at all true	Not very true	Neither true nor false	Sort of true	Very true
38) My motivation increases when I work on problems that involve a routine method.					
39) My motivation increases when I work on problems that do not require a lot of thinking.					
40) My motivation increases when my teacher assigns a lot of practice problems.					
41) My motivation decreases when my teacher assigns a lot of problems that seem to be very similar to each other.					

Assessment/Effort					
Please put a "√" in the box that best fits your response.	Not at all true	Not very true	Neither true nor false	Sort of true	Very true
42) It motivates me when my teacher places importance on showing steps versus having the right answer.					
43) My motivation increases when my teacher gives partial credit.					
44) It motivates me when my teacher writes constructive comments on my work rather that simply giving a score.					
45) My motivation increases when we have regularly scheduled quizzes, tests, and 'homework-checks'.					
46) It motivates me when my teacher checks my homework regularly.					

For items 46 - 50, read the question and write your response in words. Please be as detailed as possible. You may use the back if you need more room.

46) There are several ways in which the word *motivation* can be defined. In your own words, please explain what *motivation* means to you:

_____
_____
_____
_____

47) The survey only mentions some of the things that your teacher(s) may have done during class. Please describe other things that your teacher has either said or done that caused your motivation to **increase** when learning mathematics:

_____
_____
_____
_____

48) Please describe other things that your teacher has either said or done that caused your motivation to **decrease** when learning mathematics:

_____
_____
_____
_____

49) Please share some things that have not yet been mentioned that you think would be motivating for you in learning mathematics, that you would like to have as part of your math class.

_____
_____
_____
_____

50) Please share some things that have not yet been mentioned that you think would cause your motivation to decrease, when learning mathematics.

_____
_____
_____
_____

Thank you very much for your participation.

APPENDIX B

CONSENT LETTER

Dear Parent or Guardian,

Your child's class is being asked to participate in a voluntary research survey. The purpose of the survey is to determine students' perceptions of teaching practices that affect their motivation to learn mathematics. All questions relate to teacher practices affecting motivation, and no intrusive personal questions will be asked. There are neither foreseeable risks nor discomforts to the participants. Benefits from participating may include personal satisfaction for contributing to a study. A copy of the survey is available at the school office.

The survey will be administered in your child's Algebra class towards the end of the 1st trimester. The survey will take one class period. If your child does not return his/her permission slip, he/she will not be able to participate. Each child's participation is voluntary. There is no penalty under any circumstance for non-participation. Students not participating in the survey will be given an alternate activity while the survey is being administered.

All information gathered will be strictly confidential. Surveys will only be viewed by me, the researcher. Follow-up interviews will be conducted for selected participants solely for the purpose of gaining further understanding to the survey responses. These students will choose a 20 minute time-slot for scheduling their interview.

Data for this survey will be used in a master's thesis under the direction of Dr. Chris Yakes of CSU, Chico. If you have any further questions, or if your child would like to be withdrawn from the study at any time, please contact me at 786-2821, ext. 1, or rwood@eurekausd.org.

Please sign the bottom of this page and return it to your child's Algebra teacher. Thank you very much for your cooperation.

Sincerely,

Renée Wood
Mathematics Teacher
Olympus Junior High School

- -

I have read the above information and understand that my student,
___________________________________, is being invited to participate in the above study.

____ I **DO** give permission for my student to participate.

____ I **DO NOT** give permission for my student to participate.

_____________________________	_______________________________	__________
Parent/Guardian Signature	Student Signature	Date

APPENDIX C

INTERVIEW PROTOCOL

Student _____Grade Level ($7^{th}/8^{th}$) _____

Date and Time of Interview _____

Students will be individually asked to participate in an interview. Students will choose a time slot for before school, during lunch, or after school. Reminders will be sent to each student on the day before their scheduled interview. Treats and/or a small gift will be given to each participant as a thank you for their participation.

Instructions for the interviewer
The number one goal of the interview is to probe students' thinking behind their written responses from the survey. Try to get the student to open up and be as honest as possible, and reveal underlying insight into their thinking. Space is provided for note-taking although the interview will be tape-recorded. Notes about the student's non-verbal communication may also be noted (e.g., nodding the head, confused look indicating they didn't understand the question, etc.). Allow for "wait time" for student to gather thoughts. Remember to turn on the tape recorder.

Initial Instructions to the Student
I would like to follow-up with your responses to the survey. I want to assure you that your responses are confidential and will be reported in a way that does not reveal your identity. Your responses will not affect your grade in the class nor cause me to formulate opinions about you. The purpose of this interview is to gather data for a college assignment of mine. I am very grateful for your participation and for your complete honesty. There are no right or wrong answers, I would just like to know how you personally think and feel. The tape-recorder is for me to go back and take thorough notes of the interview. I will be the only listener.

Reminder of the research question
From the students' perspective, how do specific teacher practices affect their motivation to learn Algebra? How do students describe the effects of such practices?

The number of interview questions will depend on the individual's survey responses. An example of a question is as follows:

Ex) For survey question #__, you wrote _____. Please tell me what you meant by _____.

More examples of probe and follow-up questions are, “Can you give me a more detailed description of _____?”, “Could you say something more about _____?”, or, “Do you have further examples of _____?”.

Notes:

Reflective notes/comments:

Closing

We are now at the end of the interview. Your responses have been very useful in helping me understand what you think about mathematics. Is there anything that you think is important for teachers to know about motivating students to learn Algebra that you haven’t said?

APPENDIX D

SURVEY ADMINISTRATION PROTOCOL

This survey will be administered in the students' Algebra classroom during one class period. Students who did not return the permission slip for participating in the study will work on an alternate assignment.

The following definitions will be written on the board for students to refer to during the survey:

Increase – to go up, or to rise.

Decrease – to go down.

Motivation – a desire to learn, work hard, and personally succeed.

Survey Administrator:

Good morning/afternoon. I will begin reading my script for administering my survey. Your silence is appreciated.

At this time, or anytime during the survey, you may opt out even though you and your parents previously stated that you would participate. There is no consequence for not participating.

Your responses will be strictly confidential. Writing your name is for follow-up purposes only and will not be included in the data reporting. Some of you will be selected to participate in an interview with me if I find that I'd like to learn more about your survey responses. Your responses will not affect your grade. Your responses will not cause me to formulate an opinion of you. This survey is for data collection purposes only. The data will only be used for an assignment for CSU, Chico. Your participation is greatly appreciated. Please be as completely honest as possible in your responses. Raise your hand if you have a question. The questions may pertain to things that your current math teacher does OR to things that a previous math teacher did.

I will begin reading each question aloud, will allow you some think time in effort to get an honest and thorough response. You may go back to a question at the end if you need to, but please stay at my pace in the meantime. Thank you again for participating.

Read each question one at a time. This will ensure that each question is read carefully and will help prevent students from rushing through the survey.