What is Relevant Mathematics?
An exploration of two perspectives on relevant mathematics
in the high school classroom
by
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ABSTRACT

Recently there has been an increase in the number of people calling for the incorporation of relevant mathematics in the mathematics classroom. Unfortunately, various researchers define the term relevant mathematics differently, establishing several ideas of how relevancy can be incorporated into the classroom. The differences between mathematics education researchers' definitions of relevant and the way they believe relevant math should be implemented in the classroom, leads one to conclude that a similarly varied set of perspectives probably exists between teachers and students as well. The purpose of this exploratory study focuses on how the student and teacher perspectives on relevant mathematics in the classroom converge or diverge. Specifically, do teachers and students see the same lessons, materials, content, and approach as relevant? A survey was conducted with mathematics teachers at a suburban high school and their algebra 1 and geometry students to provide a general idea of their views on relevant mathematics. An analysis of the findings revealed three major differences: the discrepancy between frequency ratings of teachers and students, the differences between how teachers and students defined the term relevance and how the students’ highest rated definitions were the least accounted for among the teacher generated questions, and finally the impact of differing attitudes towards mathematics on students' feelings towards its relevance.
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Chapter 1

INTRODUCTION

The voices calling for relevant mathematics in schools are becoming more prevalent in recent years. Researchers, administrators and educators alike are asking the question: how can we design mathematics material so that it relevant for students. Research shows that relevant classroom instruction and activities can increase student engagement and motivation for the academic task. This increase naturally leads to an increase in student performance and learning. Unfortunately, relevant mathematics is not prevalent in all classrooms. One researcher found that elementary teachers frequently used motivational strategies within their classrooms, but only used relevant strategies, 8% of the time (Husman & Lens, 1999). This finding is not surprising considering the multitude of different interpretations of what it means to create relevant curriculum. Research like this emphasizes the importance of not only coming to an understanding of what is meant by relevant mathematics but a more thorough understanding of how it can be incorporated into classrooms across the country.

This need for understanding of relevant mathematics is further encouraged by the increased push for more mathematics focus in schools. Arizona Board of Education now requires high school students in Arizona to complete four years of mathematics in order to graduate from high school. This increases the mathematics requirements by two years. These new requirements leave mathematics teachers seeking new ways to engage students and demonstrate for them the importance of the mathematics they are learning in school. Likewise,
high schools students are starting to think about their future lives outside of high school. Due to this, high school students are starting to question the value of what they are learning. Through an incorporation of relevant mathematics in the classroom, teachers can increase their students’ motivation and engagement by showing students the relevance of the concepts they are learning. For this to be successful, teachers, along with curriculum designers need to have a deeper understanding of what students perceive as relevant mathematics.

The disparity between mathematics education researchers’ definitions of relevancy and the way they believe relevant math should be implemented in the classroom, leads one to conclude that a similarly varied set of perspectives probably exists between teachers and students as well. Due to the unique forces influencing both the students’ and teachers’ perspectives, there is not a unique truth in the study of how relevant mathematics takes shape within the classroom. The students’ and teachers’ perspectives on relevant mathematics could describe the same situation but in different lights, creating parallel, but distinct realities. A description of what is occurring in a classroom depends on whose perspective you are examining: the teacher’s or the students’. Neither perspective is less true than the other; both are valuable in their own right and necessary to be considered during the research process. An understanding of the differing perspectives is especially critical when it comes to relevancy, since teachers who are attempting to teach relevant mathematics, may not be reaching the students as intended because the students, in fact, do not feel that the material is relevant.
Understanding these two different truths will help researchers and educators to better recognize the mechanisms behind relevant mathematics classroom practice. This study focuses on how the student and teacher perspectives on relevant mathematics in the classroom converge or diverge. Specifically, do teachers and students see the same lessons, materials, content, and approach as relevant? If it is discovered that the perspectives differ, then analysis of the ways they are different will be conducted, in an effort to understand how the differences might be utilized to improve the impact of classroom activities.

There are many potential benefits to gaining a better understanding of the students’ and teachers’ perspectives on relevance in the mathematics classroom. Through an understanding of the differences between the two perspectives, people will be able to help them more effectively communicate. Mathematics curricular materials, lessons and activities could be better designed to be more “relevant” for students. Understanding the student perspective on relevant mathematics, can open an interchange that will enable the curriculum that is used in the classroom to not simply dictate to students what is important, but actually include materials that they feel is relevant to their lives.

The following chapters discuss the previous research on the subject, methods used in this study, and discussion of results. Chapter two focuses on the literature and previous research on relevant mathematics. A closer examination of the research highlights five major interpretations of the term relevant and how the term is applied with respect to mathematics. Previous research also shows the
benefits of looking at both the teacher and student perspectives on issues of curriculum and classroom practice. Chapter three discusses the methods utilized in this study of relevant mathematics. This includes a detailed description of the study’s sample, a rationale for the survey instrument used, as well as which statistical methods where utilized to analyze the findings. Chapter four presents a breakdown of the research results looking first at the teacher responses, then student responses and finally a comparison of teacher and student responses. Chapter five delves deeper into the three major differences that emerged in the data: the discrepancy between frequency ratings of teachers and students, the differences between how teachers and students defined the term relevant and how their highest rated definitions were the least accounted for among the teacher generated questions, and finally the impact of differing attitudes towards mathematics on students’ feelings towards its relevance. This final chapter focuses on a discussion of the implications of these differences on classroom practice, curriculum design and future education research on relevant mathematics.
Chapter 2

LITERATURE REVIEW

Why Relevant Mathematics?

The need for mathematics curriculum to be relevant for the learner has been encouraged by different sources for a variety of reasons. One of the most common reasons presented for using relevant mathematics in the classroom is to provide students with a reason for learning the mathematics concepts taught to them, creating a more meaningful mathematics for students. Student questions such as, “When am I ever going to use this” and “why do we need to learn this?” along with feelings that mathematics is too abstract and irrelevant are common thoughts in mathematics classrooms (Clarke & Roche, 2009; Otten, 2011).

Relevant mathematics provides a way of answering these questions by showing the purpose of mathematics thereby helping students understand why they are learning the material (Pierce & Stacey, 2006).

It is widely agreed that if students are more engaged in classroom activities then their academic performances increases as well (Harris, 2011; Kidwell, 2010). Following other researchers, this thesis research is based on the assumption that more relevant mathematics curriculum will intrinsically motivate and engage students in the mathematics classroom, thus leading to an increase in student performance. In a three year study on elementary students’ beliefs about mathematics, Kloosterman, Raymond and Emenaker (1996) found that students would not be highly motivated unless they believe what they are learning will be valuable to them. The use of relevant mathematics can help students to
understand how what they are learning will be valuable in the future and worthwhile to learn. In a similar vein, relevant mathematics often involves challenging problems that involve finding practical yet unexpected solutions to problems (Hootstein, 1994; Pierce & Stacey, 2006). Enjoyable experiences for students can lead to an increase in positive affect and more positive feelings about mathematics therefore an increased effort to learn by the student.

Policy makers, curriculum designers, and researchers all encourage teachers to incorporate relevant mathematics in their classroom through various means. Both the Common Core State Standards and the National Council of Teachers of Mathematics emphasize the importance of integrating mathematics into real world contexts to help prepare students for their future careers (Common Core State Standards Initiative, 2011; National Council of Teachers of Mathematics, 2000). These groups have created mathematics standards that will require students to be able solve problems that may arise in everyday life beyond the simple computational mathematics problems seen in a traditional mathematics curriculum. To help with this, professional development groups, such as the “Rigor-Relevance Framework” teach teachers how to create classroom lessons and units that are both academically rigorous while engaging students with relevant material and activities (International Center for Leadership in Education, n.d.). Likewise, researchers write articles that describe to teachers how they can incorporate relevant mathematics in their classroom. For example, Clarke and Roche (2009) felt that students would benefit from less repetitive work, higher level problems with multiple solutions as well as opportunities to explain their
thinking. They shared an example of how a contextual practical problem could be easily incorporated in a middle school classroom. This article not only provided an example of how to make classroom mathematics relevant for students but also clearly outlined for the reader the benefits of using this method of instruction in the classroom.

**Definitions of Relevant Mathematics**

Despite the numerous claims for the importance of relevant mathematics, there is a lack of consensus on for whom the curriculum is to be relevant and who is making the final decision on what makes something relevant. A major ambiguity surrounding the term “relevant” is what it means when the term is used in the context of education. While there may not be a single agreed upon definition of what relevant means, when it comes to designing classroom curriculum a richer discussion of the term would be useful. Each of the current definitions has their own implications for curriculum design and classroom practice when teachers are trying to formulate relevant mathematical material for their classrooms.

**Relevant as “Real World”**

The traditional meaning used when discussing relevant mathematics curriculum is solving problems that place mathematics in a real world context. The focus is on creating a mathematics curriculum that makes real world connections and applications through mathematics in a context (Boaler, 1993; Callingham, 2004; Carraher & Schliemann, 2002; Clarke & Roche, 2009;
Gainsburg, 2008; Pierce & Stacey, 2006; Sparrow, 2008). Under this definition of relevant, mathematics problems are designed to imitate those that may be encountered by students outside of school (Carraher & Schliemann, 2002). A teacher’s job is to help students understand how use mathematics not only as a useful tool for describing different real world situations, but also for solving problems that may be faced during everyday situations. Much of the modern research on the subject cautions against assuming that the traditional word problem is necessarily mathematics in a real world context. Instead, researchers focus on what is “real world,” “everyday,” or “realistic” mathematics and how teachers can incorporate it into their classrooms. One of the crucial components of this real world context is not about the context itself, but rather that the problems presented to students do not have a single correct solution or unique method that can be used to approach the problem (Boaler, 1993; Carraher & Schliemann, 2002; Clarke & Roche, 2009; Greer, Verschaffel, & de Corte, 2002; Otton, 2011; Sparrow, 2008).

**Relevant as Utility**

Another commonly used definition of relevant refers to the utility of mathematics, which is often associated with the previous definition (Onion, 2004; Sealey & Noyes, 2010; Young-Loveridge, Taylor, Sharma, & Hawera, 2006). Studies have shown that motivating students through description of the usefulness of what they are learning for the students’ future life has a strong positive correlation with students on task behavior (Husman & Lens, 1999). Multiple studies on students’ beliefs and feelings towards mathematics have found many
students refer to the usefulness of mathematics, when discussing the relevancy of mathematics. Young-Loveridge, Taylor, Sharma, and Hawera (2006) completed a study that looked at 2nd to 8th grade student perspectives on what is mathematics. Based on student responses, they subdivided the concept of utility further into students who focused on the immediate usefulness of mathematics versus students who were concerned with the usefulness of mathematics in their futures.

Kloosterman, Taymon and Emenaker (1996) study of elementary students’ beliefs on mathematics found that 90% of the participants found mathematics useful, but that sometimes those students just meant it would help them get to the next grade. In a similar vein, Onion’s (2004) study with high school students found that many of the students saw the “relevance” of mathematics in its value of gaining them access to employment or higher education. Despite this admission of the utility of mathematics, many of the student participants in the study admitted that they did not see the value in the mathematics they were currently learning in school, nor how it would help them in their later careers. A similar observation was made in the Kloosterman, Taymon and Emenaker study (1996), which was that while elementary students found mathematics useful, they did not truly appreciate the real world connections that could be made with mathematics. Relevant in terms of the utility of mathematics is a difficult definition to completely separate from the real world contexts, but is a definition used by students in previous research studies and does allow one to examine alternative uses that are seen as important.

Future time perspective is a branch of research that focuses on how student motivation is influenced by this need of utility within the classroom.
Education research on future time perspective looks at how students conceptualize the future and the consequences of long and short time goal setting on motivation (Husman & Lens, 1999; Volder & Lens, 1982). Research emphasizes the importance of students’ perceived utility of the mathematical concepts in increasing academic motivation and performance within the classroom (Husman & Lens, 1999).

**Relevant as Value**

In a more general sense, relevance in mathematics is seen as mathematical content that is valuable or meaningful to the learner (Browder, 1976; Hootstein, 1994; Masingila, 2002). Scholars who advocate this meaning of relevant see that a real world context alone is not good enough to engage students, but only becomes valuable when the context is meaningful to students (Carraher & Schliemann, 2002). One way to do this is through culturally relevant pedagogy, which incorporates the mathematic concepts into larger social justice issues in the students’ lives (Gutstein, 2006). For the most part this definition is sufficiently vague and can be interpreted many different ways, leaving each teacher on his or her own to determine what is meaningful to learners.

**Relevant as Thinking Skills**

Moreover, some feel that the primary value of relevant mathematics is not necessarily it being set in a realistic context, but that it will help students develop their fundamental thinking skills (Callingham, 2004; Carraher & Schliemann, 2002; Nicol & Crespo 2005; Otton, 2011; Young-Loveridge, Taylor, Sharma, & Hawera, 2006). Under this definition, the key notion is flexibility. Students
should be learning how to use mathematics to make sense of ever changing situations and apply the thinking skills they are learning in school within many different contexts (Carraher & Schliemann, 2002). Otton (2011) argues that the real world contexts limit students’ perceptions of the actual relevance of mathematics and instead the importance should be placed on the mathematics instead of the context.

**Insufficient Perspective on the Definitions of Relevant**

The research on relevant mathematics is in some ways insufficient such as lacking a thorough definition of the concept. This is evident in the limiting way that some researchers define relevant. These researchers seem to feel that their own definition of relevant is the only possible definition of relevant. Yet, from the literature, it becomes obvious that relevant is a term that can be defined slightly differently by virtually everyone, depending on their own personal experiences and objectives. For instance, some people find everything relevant in mathematics because everything is somehow connected in the world and hence mathematics can be used to explain everything in the world around us. Other people find it necessary that relevant material to be more specific and utilitarian in nature. In other words, if there is not an obvious purpose, then the mathematics is not relevant. While in the philosophical world, it is possible to contemplate all of these possible interpretations, when attempting to develop specific approaches to mathematical curricula it is necessary to find an effective method to incorporate relevancy into the mathematics classroom by accepting a more concrete explanation of the term.
The Teacher Perspective

An initial understanding of how teachers perceive relevant mathematics is crucial for creating a framework within which one can compare and better understand the viewpoint of the student. Teacher perspectives provide a starting position for describing and understanding what is occurring in the classroom. While academics and curriculum material designers may encourage a certain type of relevance, it is the teacher who determines exactly what teaching methods, curriculum materials, and instructional strategies will be used in the classroom. Teachers’ decisions on classroom practice are shaped by many factors including beliefs, knowledge, goals, cultural elements as well as different people’s expectations (Gainsburg, 2008). Teachers may feel that only a certain type of relevancy is important and therefore only expose their students to that one type. This will limit students’ personal experience with relevant mathematics and thereby influence their opinions on the subject. Through an understanding of the teachers’ views and their application of relevant mathematics, one can better understand the shape that relevancy takes within different mathematics classrooms. This provides the framework against which other perspectives can be compared and evaluated.

There have been a few studies that specifically addressed teachers’ experiences and feelings about incorporating real world problems into their classrooms. One by Pierce and Stacey (2006) examined teachers’ reasons for selecting certain real world problems to use in their classrooms. They found that teachers selected problems based on the three following curriculum issues. First,
teachers selected real world problems fit within the designated state standards. Second, teachers picked questions with a specific solution that corresponded to the mathematics taught. Finally, students selected questions they felt would increase student engagement in the mathematics classroom. An interesting finding was that teachers would select an easier problem situated in a context more familiar to the students over a more rigorous problem in a less familiar context. Gainsburge (2008) surveyed teachers about their experiences using real world connections in their mathematics classrooms, found that the two most common methods used by teachers to incorporate real world math was through “student-solved word problem” and “planned example or reference in teacher presentation” (Gainsburge, 2008, p. 204). Some of the real world topics included structural and interior design, shopping pricing, banking and budgeting. Both of these studies show that teachers are cognizant of their use of relevant mathematics and are fully capable of describing how it is incorporated into their classrooms.

Previous research that has relied on teachers’ perspectives also points to the short-comings of being solely dependent on teacher responses to surveys and interviews. An issue that Gainsburge noticed was that some teachers would over emphasize the importance of real world examples in their classroom, which was contradicted by the researcher’s classroom observations. Likewise, while examining meaning in mathematics education Thompson (in press) described a teacher who thought she was teaching meaningfully, by encouraging students to think about the big ideas behind mathematical concepts instead of just focusing on the procedures to solve problems. While interviewing a student in this teacher’s
class, Thompson discovered that the student saw the “meanings” as just a new series of more complex rules. Other studies have highlighted the differences including the Learners’ Perspective Study (LPS) which used the video recall method to look into elements of a lesson that were felt to be significant to the teachers and the students (Clark, n.d.). Their findings reflected the parallel truths present in the classroom between these two perspectives. Japanese teachers in this study always highlighted the importance of the climactic moment that a lesson was designed around, yet many Japanese students would fast forward through this moment in their post-lesson interview. All of these examples demonstrate the importance of using multiple perspectives when trying to gain an understanding of what is actually being taught in a mathematics classroom.

**The Student Perspective**

Too often teachers and researchers make assumptions about how the students view events within the classroom without collecting quality empirical evidence upon which to base their assumptions. During the last decade, researchers have started to embrace the importance of the notion of “student voice” or “pupil perspective” particularly on the international level (Blackman, 2011). These terms are often applied to studies that incorporate methods that involve students discussing their views on school matters, including teaching methods as well as learning preferences. The rarity of student’s perspective in research on mathematics curriculum may reflect a notion that only the voices of the mathematics education researchers and mathematics teachers are important...
when designing and implementing curriculum. This happened previously during the 1970s, when the curriculum development movement started to use the term “relevance” to claim that the content of the curriculum would appeal to students. Unfortunately, the “relevance” of the curriculum reflected an adult view and nobody seemed to care to ask what material would actually be meaningful to the students (Rudduck & Flutter, 2000). Since students spend so much time doing mathematics in school, perhaps it is time now to start asking them what they actually think about the mathematics they do and use their responses to better the mathematics curriculums available.

There are many reasons why it is important to incorporate the student perspective into a study on relevant mathematics. For example, previous research has observed that students view classroom events differently than both teachers and researchers (Patrick & Ryan, 2008; Urdan, 2004). There is a lot of information that can be gathered and learned by simply asking students their opinions about things. Kloosterman, Raymond and Emenaker (1996) found that the elementary students they worked with were more conscious about things in the classroom than many teachers and researchers give them credit for. Likewise, Pedder and McIntyre (2006) when interviewing 8th grade school students found that students were aware of how they preferred to learn and what motivates them to learn. Moreover, research has shown that students are enthusiastic when consulted about school, curriculum, teaching practice and learning (Flutter, 2007; Morgan, 2009 Rudduck & Flutter, 2000). Students are active participants in
Student views of the “real world” may influence their view of what makes relevant mathematics curriculum thereby making it crucial to understand their perspective on the topic. Traditionally, teachers have used word problems as a way to bring relevant mathematics into the classroom. Several scholars warn that many of these problems are simply normal abstract mathematics problems hidden in the veneer of the real world. Greer, Verschaffel, and de Corte (2002) found that students seemed to understand that these problems were unrealistic, but were okay with this because that was not the purpose of a math problem. Even teachers fall victim of the word problem trap according to Pierce and Stacey (2006) who found teachers selected certain types of real world problems for superficial reasons. Some scholars believe that students are fully aware of this disconnect between reality and the real world math problems and see it as a failure to actually create relevant mathematics (Otton, 2011). Not all scholars find this a problem. Boaler (1993) argues that the reality of the context is not a problem and that the context will still enhance transfer.

Rarely, student perspective has been used to help improve curriculum directly. In hopes of improving Britain’s “Science for all curriculum,” Osborne and Collins (2011) conducted focus group interviews examining students’ attitudes towards school science. They used this information to highlight aspects of science that students valued and used in their everyday lives. Unfortunately, there are certain limitations when using student perspectives to improve
curriculum directly. Students are typically only presented with one type of curriculum and therefore have no basis for comparing the present with an alternative curriculum or the experience base to suggest alternatives (Rudduck & Flutter, 2000). Despite this limitation, students are still able to talk about the forms of teaching and learning they prefer and can comment on the lessons that have been taught to them.

While using the student perspective may have limitations in the way it can help improve curriculum, the fact that it is rarely used in this area is the reason why it can now be such an important contribution for improving teachers’ classroom practice. In talking with students, teachers can gain a better understanding on what factors make a difference to students learning as well as what activities they enjoy and help them learn (Flutter, 2007; Morgan, 2009). Flutter (2007) discussed examples of multiple ways that teachers can use student voice to strengthen their teaching practice through increasing their professional knowledge and understanding, including using questionnaires on both a classroom and school wide level. To truly design classroom practices that will be relevant for students, researchers and teachers need to better understand how students perceive the classroom activities on this subject. Carefully collected student perspectives can create the crucial feedback loop in the classroom practice system, informing teachers and curriculum designers alike if the changes in the curriculum and instruction are really making a difference in the students’ mathematical thinking and learning.
It could be argued that how a student perceives classroom practices is unimportant and all that matters is how the students perform on high stake assessments. Yet research has shown how motivation, affect, and beliefs influence students’ performance (Hannula, 2006; House & Telese, 2008). Masingila (2002) found that students’ perceptions of math influenced how the respondents perceived that they used math outside the classroom. If students do not perceive the curriculum as relevant even if teachers and curriculum designers believe it is, then it will probably not increase their motivation or perception of math. Based on this research we could hypothesize that students’ perceptions of relevance in classroom practice, which includes their attitude towards it, will also impact their learning and thereby their performance.

This study attempts to gain a deeper understanding of how both teachers and students perceive relevant mathematics within the classroom. The research clearly demonstrates that among researchers there is a lack of consensus about what is relevant mathematics. This same discrepancy over the meaning and implications of relevant mathematics is probably present between teachers and students. If a goal is to create relevant mathematics curriculum, then teachers and researchers need to better understand the current role it plays in the mathematics classroom as well as how students view it happening within the classroom.
Chapter 3

METHODS

Setting

This exploratory study on relevant mathematics took place in a suburban high school in Arizona. The school has only been open three years, this being the first year that it had 9th through 12th graders in attendance. The school’s population is approximately 1736 students. Of these students 76.38% were white of non-Hispanic origin.

This school was selected because the researcher works as a math teacher at the high school. The advantages of using this school far out-weighed any potential for biases, which the researcher thought and minimized. The researcher avoided potential for biases by not including any of the researcher’s own students in the potential student participant population. Since this is an exploratory study, designed to provide a general idea about student versus teacher perspectives on relevant mathematics, it was key that the researcher gained full cooperation from the teachers and students at the school. Having already established a working relationship with the teachers as well as the principle of the school caused it to be easier for the teacher to agree to participate in the study

Participants

Teachers

Seven mathematics teachers at the school volunteered to participate in the study. The teacher participants included all of the teachers who taught algebra 1
and geometry at the school, except the researcher. Only teachers who taught these subjects were asked to participate, because for this study the researcher chose to focus on the two courses that every high school student is required to pass before graduation. The teacher participants had various levels of teaching experience including two first year teachers, one third year teacher, one in her eighth year of teaching, one in his tenth year of teaching and two teachers who had been teaching over 20 years. All of the teachers had taken a math course in the last seven years. In addition, teachers in this district are required to complete at least 15 hours of professional development each year. Moreover, both the algebra 1 and the geometry teachers meet in professional learning communities, PLCs, which are set up to encourage collaboration and improve teaching practice. This reflects the importance placed on continuing education by the district as well as the teachers’ desire to improve continually.

All of the teachers partook in some level of “Rigor Relevance Relationship,” RRR, training during the past three years. The district as well as the school principal, encourages teachers to use RRR teaching methods. Based on the International Center for Leadership in Education (n.d.), Rigor Relevance framework, during the trainings teachers learn about four different quadrants that a lesson can be in based on its rigor and relevance to students. Teachers then are shown how to design lessons and units that centers around quadrant D activities, which are high in rigor and relevance. This professional development presents “relevance” as a “real world” activity that allows students to apply the concepts they have learned in a realistic problem or activity. The school takes this a level
further by doing school based trainings every year on RRR and encouraging teachers to teach at least one quadrant D unit through pay for performance requirements. Through this training, the participating teachers have become familiar with the idea of incorporating relevance in their mathematics classrooms.

**Students**

The goal of this study was to go beyond using only the teacher’s perspective by getting feedback from as many students as possible. The only requirement for a student to participate in this study was that they were enrolled in either algebra 1 or geometry and not a student in one of the researcher’s classes. All parents at the school were informed about the study through an email, which is the form of communication used for all school announcements. In late April, during math class, students were introduced to the study and a permission letter was sent home. Before a student could participate in the study, they had to return the signed permission form within two weeks of receiving the letter. Approximately 190 students returned the permission letters, which included their email addresses. Once the permission letter was submitted, students were then sent an email that included a link for the survey. Unfortunately, not all of the students who submitted the permission letters completed the survey.

In the end, 103 students participated in the study by taking part or all of the online survey. Of these students, 77 were enrolled in algebra 1 while 26 were taking geometry. The researcher had hoped to get approximately an equal number of students from each teacher’s course. However, that proved to be difficult and in the end, some teachers had only a few students while others had
significantly more. This meant that during the analysis, it would be difficult to look at the effects that a single teacher has on students’ perceptions of relevance for a particular mathematics problem, but this was not a central goal of the project.

Despite the uneven number from each teacher, the student population was diverse in their experiences with and feelings about math. Among the student participants in the study, there was an even distribution between the different grades they have earned in math over the last year. During the semester before the study took place, of the student participants 28 earned As, 27 earned Bs, 29 earned Cs, 20 earned a D or an F. Similarly, the students’ feelings about math were also evenly distributed. When asked about their general attitude towards mathematics 30 responded that they liked math, 37 were indifferent, and 36 disliked the subject. Some people worry that when using student voice that only the more confident learners will participate and share their views, while to have a strong study particular attention needs to be given to insure the widest range of voices is heard (Flutter, 2007). The background information of the students who completed the survey demonstrates that a wide range of students responded to the survey, especially considering that they are with volunteers.

Instrument

A multi-part online survey was used to gather data from the study participants. This traditional method is frequently used in research, its quantitative emphasis makes it easier to gather and compare information about a
large number of subjects at once. This method provided an effective way to gain a general overview of both the students and teacher perspectives on relevant mathematics. There have been other studies, which used a questionnaire to compare teacher and student perspectives. For example, Kunter et al. (2008) used a questionnaire to gather data on students and teachers thoughts about enthusiasm and instructional behaviors in the classroom. In a study completed by Morgan (2009), students claim to like the survey method of being consulted because it was quick. This was an important consideration when choosing a method because I did not want to scare potential participants off because of the time commitment. Despite the advantages of using a survey to gather data, the researcher understood the limitations of this method. While this method allows the researcher to get information from numerous students at once, it does not allow for deep insight into the students’ views since often they are given limited choices for their responses. Critics accuse questionnaires as only revealing the “tip of the iceberg” and leave the complexities of the situation buried beneath the surface (Osborne & Collins, 2011). Before exploring the underlying complexities, the research needs to first show that there is actually something worth studying, a significant difference between the teacher and student perspective. If this proves the case, this masters’ exploratory study could be followed up with a more focused and part qualitative investigation.

**Pilot**

In order to ensure that the surveys would provide the useful results, a group of volunteer teachers and students completed a pilot study. The researcher
asked the two teachers who completed the pilot study to write down if any of the questions were confusing and how long it took them to complete. One of the researcher’s classes completed the pilot student survey. While taking the survey, students mentioned to the researcher which of the questions did not make sense as well as which ones were too long. Both pilot studies provided valuable insights that influenced the final surveys described in the following section.

**Teacher Survey**

The teacher participants completed two online surveys for this study. In the initial survey, teachers provided background information, which included years of teaching experience, previous math courses taught, highest math education and beliefs about mathematics. In addition, teachers rated the five different definitions of relevant found throughout the literature: Mathematics in the real world, mathematics that is immediately useful to me, mathematics that will help towards the future (a career path), mathematics that is personally meaningful and mathematics that makes me a better thinker. Teachers could rank each definition from zero to five stars, with five being the most accurate definition and zero not applying at all. Then, the teachers wrote three sample questions that they use in their math classroom and consider examples of relevant mathematics. For each question, the teachers selected which definition of relevant fit with the question. This was an important part of the survey because these were the questions used to write the student questionnaire and the second part of the teacher survey. Finally, teachers wrote one question they felt was not relevant and explained why they selected that question.
The second teacher survey as well as the student survey was designed using teachers’ sample questions from the first survey. The initial number of questions written by the teachers, twenty-eight, had to be cut down for the second survey, because otherwise it would have made the student survey too long leading to a higher drop off rate. The researcher selected fifteen of the questions written by teachers for the following reasons. First, any questions that the teachers wrote that were not part of the algebra 1 or geometry curriculum were not included. The students participating in the study would be from algebra 1 and geometry classes therefore would not be familiar with the mathematics included in some of the higher level questions. Second, the researcher made sure that each of the five interpretations of relevant present in the literature were represented at least once as well as included a few non-relevant questions. It was important that the student survey included a wide range of questions that included different ways that students are exposed to relevant mathematics in their classroom. Likewise, at least one question from every teacher was included in the survey to make sure each student participant saw a question that the student may have seen earlier in the school year during class. Finally, the length of the question was considered, since the researcher did not want to include any questions that were too long. While piloting the study with her own students, the researcher found that the students did not want to read through the long examples. See Table 1 for a list of the fifteen questions selected for the teacher and student survey.
### Table 1

#### Relevant Survey Question Key

<table>
<thead>
<tr>
<th>Question Code</th>
<th>Relevant Question</th>
<th>Definition of relevant picked by the author teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Form</td>
<td>Write an equation in standard form to relate the number of cars and vans or trucks the students must wash to raise $800.</td>
<td>Math in the Real World (RW)</td>
</tr>
<tr>
<td>The Biebs Concert</td>
<td>The Biebs is coming to Phoenix in 4 weeks and you want to go with 2 of your friends. Of course you offered to buy their tickets but each one costs $70! You already have $80 and can save $30 a week. Write a mathematical model to show how much money you will have after 4 weeks. Will you have enough for the concert of a lifetime?</td>
<td>Math that is Personally Meaningful (PM)</td>
</tr>
<tr>
<td>Castle Archer</td>
<td>You are an archer at the top of the castle, 25 feet up. To strike your target outside the castle on the ground, the arrow must travel 35 feet (linearly). At what angle (in relation to the wall of the castle) must your arrow fly to strike the target? a) sketch and label the situation and b) set up to find the angle measure.</td>
<td>Math that makes me a better thinker (BT)</td>
</tr>
<tr>
<td>Pool Fence</td>
<td>Your pool is 15 ft wide and 20 ft long with a 3 ft wide deck surrounding it. You want to build a fence around the deck. How much fence will be needed?</td>
<td>Math that is immediately useful to me (IU)</td>
</tr>
<tr>
<td>CD-ROM storage</td>
<td>A CD-ROM stores about $6.5 \times 10^5$ bytes of info along a track. Each byte uses $9 \times 10^{-6}$ m of space along the track. Find the length of the track.</td>
<td>Not relevant (NR)</td>
</tr>
<tr>
<td>Compound Interest</td>
<td>You deposit $4000 into an account that earns 6% annual interest, compounded annually. A friend deposits $3500 into an account that earns 5.95% annual interest, compounded continuously. Will your friend's balance ever equal yours? If so, when?</td>
<td>RW and NR</td>
</tr>
<tr>
<td>CV student council</td>
<td>Campo Verde’s Student Council needs your help. They are attempting to figure out the best price to charge for an Activity Pass (the pass that lets you into school events free or at a discounted rate). Past experience has shown that at the standard price of $40, eighty people will buy Activity Passes. We also know that for every $1 discount in price, four more people will buy Activity Passes. Answer the following questions, completing the table of values and the graph to help you reach your final decision. Write out your final recommendation for student council in a short paragraph, submitting the table, graph and responses to the questions as support for your recommendation.</td>
<td>RW</td>
</tr>
<tr>
<td>Question Code</td>
<td>Relevant Question</td>
<td>Definition of relevant picked by the author teacher</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Quadratic Equation</td>
<td>Solve the quadratic equation by graphing. (ex: y=x^2+2x-3)</td>
<td>Mathematics that will help in the future (HF)</td>
</tr>
<tr>
<td>Clinometer</td>
<td>Have the students make clinometers and measure the heights of objects around campus using the angle of elevation.</td>
<td>PM</td>
</tr>
<tr>
<td><strong>Billy Savesalot</strong></td>
<td>When Billy Savesalot left his home and ventured out in the world he had only $5 to his name. Yet, Billy Savesalot found a job where he could work everyday and save $400 each day. The relationship between the amount of money Billy has and the time that has passed since he started saving can be expressed by the equation y=400x+5. A) How many days must Billy save for until he has $4,005? Write an equation to answer this question. B) Billy wants to buy a Prius, which costs $20,800. If Billy plans to pay the full cost up front, how many days does he need to save for until he has enough money to buy the car?</td>
<td>HF</td>
</tr>
<tr>
<td>Sum of eight</td>
<td>The sum of eight times a number and five is 37. Find the number</td>
<td>NR</td>
</tr>
<tr>
<td>Running average speed</td>
<td>I enjoy running around the track at school for exercise. Yesterday I completed 12 laps, a total distance of 4800 meters, in 25 minutes. A) What was my average speed in meters per minute? B) What was my average speed in laps per minute?</td>
<td>IU</td>
</tr>
<tr>
<td>Clothing Company</td>
<td>Briley has purchased a clothing company and wants to make sure he stays profitable. His company makes $8,500 each month but he also has to pay $1500 for rent each month and buy new inventory at $500 per unit. Use your knowledge of inequalities to find how many units of new inventory Briley can purchase each month to stay out of debt.</td>
<td>HF</td>
</tr>
<tr>
<td>Five Fences</td>
<td>Five fences meet at a point to form angles with measure x, 2x, 3x, 4x, and 5x around the point. Find the measure of each angle.</td>
<td>NR</td>
</tr>
<tr>
<td>Map Distance</td>
<td>On a map, 1 in represents 40 miles. The measured distance on the map is 31/8 in. Find the actual distance (in miles).</td>
<td>RW</td>
</tr>
</tbody>
</table>
The second part of the teacher survey was primarily made up of the fifteen teacher written questions. For each question, teachers rated them on a Likert Scale as very relevant, relevant, sort of relevant, or not relevant. Then the teachers marked which definition of relevant applied to the question. These questions were set up in the exact same form on the student survey to make for an easier comparison between the teacher responses and the student responses. At the end of the survey teachers were asked how frequently they incorporated relevant mathematics in their classroom. This question was included on the second survey after teachers had read and rated relevant questions, so that they would have a basis for thinking about relevant questions and how frequently they actually use them in their classrooms.

**Student Survey**

For the student participants, a one part online survey was emailed out to all students who submitted a parent permission letter. The permission letter was sent home to a little over 700 students. The permission letters were returned at a 27.5% response rate. Since only 103 students actually took part of the survey this means that only 15.5% of the original students recruited actually took the survey, but that 51.5% of the students who received an email responded.

Using an online format for the survey over a paper copy had several advantages, even though it may have resulted in a lower response rate. Previous studies found that while students liked being consulted they had concerns surrounding issues of trust, anonymity and not wanting to offend their teachers (Morgan, 2009). While piloting the survey, many of the students expressed
similar concerns about not wanting to offend the teacher with their responses. By having the surveys anonymous and completed outside of school, students could feel more comfortable knowing that there was no way that their teacher would ever see their responses and therefore could potentially be more honest in their answers. Likewise, since the responses were submitted electronically, it also removed the worry that somebody might recognize the students’ handwriting. Ensuring that students felt comfortable being upfront in their responses was an important part in the design of the student survey.

The student survey had several different sections. Before starting the survey, students agreed to participate in the survey. It was important that students felt that they were not being forced to take the survey by their parents, but had a choice to participate. Similar to the teacher survey, the first section of the student survey was designed to provide background information about the students that could be used to gain a deeper understanding of the student population as well as to create different subgroups from which to compare the students. The participants provided information about their grade, current math course and teacher, past letter grades earned in math class, and general attitudes towards mathematics. Then, just like the teachers, students were asked to rank the five different definitions of relevant on a scale of 0 to 5 stars. Students were also given the opportunity to write an alternative definition if they felt that none of the five fit the term relevant mathematics. Next, students looked at the fifteen teacher written questions and ranked each question as very relevant, relevant, sort of relevant or not relevant. Additionally for each question, students selected which
definition of relevant they felt applied to the question. After, students described what types of mathematical activities they found most relevant. Finally, the student participants stated how frequently they felt mathematical activities and problems in their current math class are relevant. Many of the questions in the student survey were multiple choice, there were three opportunities for the students to share their own words in free response questions. While multiple choice questions may limit the student voice to options provided by the researcher, this type of question is designed to make it easier to compare the opinions of large number of students and to start to uncover basic patterns within the group’s thinking. Once the patterns have been discovered it will be easier for future researchers to use the patterns to conduct a more in depth qualitative study on the subject of relevant mathematics.
Chapter 4

RESULTS

In this chapter, the results of the study are divided into three areas of focus: characteristics of the teachers, characteristics of the students, and the concordance between teachers and students. This section describes the findings of this study along with tables that include the specifics of the data gathered. The following chapter will include a discussion of the results.

Characteristics of the Teachers

Definitions of Mathematics

The teacher participants in the study all wrote different definitions for the term mathematics, but there were still some common ideas among them. The majority of the responses referred to the study or use of numbers in their definition of mathematics. Some of the teachers also mentioned mathematics in terms of a study of properties, patterns, and relationships. Two major purposes of mathematics emerged in the teachers’ definitions. First, teachers saw the purpose of mathematics was to find solutions to problems. Second, teachers defined the purpose of mathematics to predict events and explain why different events occur in the world. Only one teacher referred to mathematics as just “a set of commonly accepted rules.” These definitions illustrate that majority of these teachers feel that mathematics is more than just a set of steps or a rule to be memorized, but that it is important that the study of mathematics includes thinking skills and development of mathematical meaning.
Definitions of Relevant

After answering questions on their mathematical background, each teacher rated the five different definitions of relevant on a scale of one to five stars, with one star being not a good definition and five stars for the most fitting definition. Averaging the responses of the seven teachers provided a general idea of which definitions the teachers found to be most applicable. For the complete list of the mean teacher ratings along with the standard deviation for each definition, see Table 2. The definition, mathematics that is personally meaningful, received the highest average rating of a 4.14, with the lowest standard deviation. The definitions of mathematics in the real world, mathematics that is immediately useful and mathematics that will help towards the future all received equal ratings of 3.71. Mathematics that makes you a better thinker received the lowest rating of 2.86. Teachers were given the opportunity to provide their own definitions for the term, but only one teacher did. This teacher defined relevant as “a purpose for the content even if it is not personally meaningful.”

Among the teachers, there was relative uniformity in the ratings of the five different meanings of relevant mathematics. Three of the five definitions, real world mathematics, mathematics that is immediately useful, and mathematics that will help towards the future received the same mean rating. This may be due to the fact that the teachers at this school all participated in similar professional development classes on incorporating relevance into their classrooms. These professional development courses encourage teachers to use real world problems
and activities within the classroom (International Center for Leadership in Education, n.d.). These courses provide the teachers with a similar background in understanding of how relevance can be incorporated into the classroom. Another possible explanation for the identical ratings may be due to teachers considering the three definitions overlapping or amounting to the same thing. It is possible for teachers to see some overlap between mathematics problems that use a real world context and the problems designed to demonstrate to students the utility of mathematics. Especially because the relevance training that the teachers received does not discern between these different interpretation of the word “relevance” (International Center for Leadership in Education, n.d.). Additional findings in this study emphasize why it is important for teachers to start to differentiate between these three definitions, because the students do not see them in the same light.

Surprisingly, the definition that received the lowest rating by the teachers, mathematics that makes you a better thinker, is the type of relevance that is more closely aligned with traditional mathematics curriculum than the other four definitions. Teachers may incorporate many problems designed to teach student how to think, but the results of this study show that they do not associate them with relevant mathematics. This is not the type of relevant mathematics encouraged in the relevance training these teachers received so it is not surprising they rated it the lowest of the five definitions. Perhaps the teacher participants see the purpose of mathematics as providing students with practical and directly applicable skills over simply teaching student how to think.
Table 2

Teacher and Student Definition Ratings

<table>
<thead>
<tr>
<th>Relevant Definitions</th>
<th>Mean Teacher Rating (σ)</th>
<th>Mean Student Rating (σ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics in a real world context (RW)</td>
<td>3.71 (1.38)</td>
<td>3.28 (1.32)</td>
</tr>
<tr>
<td>Mathematics that is immediately useful to me (IU)</td>
<td>3.71 (1.11)</td>
<td>2.96 (1.30)</td>
</tr>
<tr>
<td>Mathematics that will help in the future, towards a career path (HF)</td>
<td>3.71 (1.25)</td>
<td>3.39 (1.44)</td>
</tr>
<tr>
<td>Mathematics that is personally meaningful (PM)</td>
<td>4.14 (0.69)</td>
<td>2.37 (1.36)</td>
</tr>
<tr>
<td>Mathematics that makes me a better thinker (BT)</td>
<td>2.86 (1.07)</td>
<td>2.91 (1.41)</td>
</tr>
</tbody>
</table>

Overall, the teacher participants rated the definition that relevant is mathematics that is personally meaningful higher than all the other definitions. It was the only definition which received a mean rating over four. This may be partially due to this definition being open to many different interpretations. It could also be that the teacher participants saw this definition as an incorporation of all the other definitions. That through designing curriculum to be personally meaningful for students, that it will also have a real world context and help students prepare for their futures.

Teacher Generated Questions

Teachers had to rate the 15 selected questions in terms of how relevant for students they felt each question was, the complete list of teacher ratings and the standard deviations see table 3. In order to compare the teacher ratings the responses to the question was quantified and a mean rating was found for each question. For the purpose of this discussion, the researcher chose to focus on the
four questions teachers marked as more relevant and the three questions the
teachers marked as least relevant. The teacher participants rated the Biebs concert
question, a linear function word problem, the highest with a mean score of 3.43
and a standard deviation of 0.53. Three of the teachers described this problem as
very relevant and four found it to be just relevant. There was less of a consensus
among which definition of relevant this question fit with best, with four different
definitions being associated with this question. The teacher participants rated the
CV student council, the pool fence and the average running speed questions the
same, a 3.14. The CV student council question had a strong agreement among the
teachers, 6 of the 7 rating it as relevant giving it a standard deviation of 0.38. The
other two questions showed less agreement among the teachers, with at least one
teacher for each rating them as only sort of relevant.

Three of the questions stood out among the teacher ratings as being
marked as the least relevant questions for students. The quadratic equation
question had a mean score of 1.29. Only one teacher marked this question as
relevant, the same teacher in the first part of the survey rated the relevant
definition, mathematics that makes you a better thinker, a four out of five. The
other six teachers marked this question as not relevant. The teachers also rated
the five fences question and the sum of eight question as not relevant. In the first
part of the survey, both of these questions were considered not relevant by the
teachers that wrote them. In general, for all of these less relevant questions, the
teachers categorized them as the type of relevant mathematics designed to help
Table 3
Teacher Responses to Relevant Questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean (σ)</th>
<th>Response breakdown</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Biebs is coming to Phoenix in 4 weeks and you want to go with 2 of</td>
<td>3.43 (0.53)</td>
<td>VR – 3 R – 4</td>
<td>RW – 1 IU – 3 HF – 0 PM – 2 BT – 1 OTH – 0</td>
</tr>
<tr>
<td>your friends. Of course you offered to buy their tickets but each one</td>
<td></td>
<td>SR – 0 NR – 0</td>
<td></td>
</tr>
<tr>
<td>costs $70! You already have $80 and can save $30 a week. Write a</td>
<td></td>
<td>RW – 1 IU – 3 HF – 0</td>
<td></td>
</tr>
<tr>
<td>mathematical model to show how much money you will have after 4 weeks.</td>
<td></td>
<td>PM – 2 BT – 1 OTH – 0</td>
<td></td>
</tr>
<tr>
<td>Will you have enough for the concert of a lifetime?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Campo Verde’s Student Council needs your help. They are attempting to</td>
<td>3.14 (0.38)</td>
<td>VR – 1 R – 6</td>
<td>RW – 4 IU – 2 HF – 0 PM – 1 BT – 0 OTH – 0</td>
</tr>
<tr>
<td>figure out the best price to charge for an Activity Pass (the pass that</td>
<td></td>
<td>SR – 0 NR – 0</td>
<td></td>
</tr>
<tr>
<td>lets you into school events free or at a discounted rate). Past</td>
<td></td>
<td>RW – 2 IU – 2 HF – 0</td>
<td></td>
</tr>
<tr>
<td>experience has shown that at the standard price of $40, eighty people</td>
<td></td>
<td>PM – 2 BT – 1 OTH – 0</td>
<td></td>
</tr>
<tr>
<td>will buy Activity Passes. We also know that for every $1 discount</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>in price, four more people will buy Activity Passes. Answer the</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>following questions, completing the table of values and the graph to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>help you reach your final decision. Write out your final recommendation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for student council in a short paragraph, submitting the table, graph</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>and responses to the questions as support for your recommendation.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I enjoy running around the track at school for exercise. Yesterday I</td>
<td>3.14 (0.69)</td>
<td>VR – 2 R – 4</td>
<td>RW – 2 IU – 2 HF – 0 PM – 2 BT – 1 OTH – 0</td>
</tr>
<tr>
<td>completed 12 laps, a total distance of 4800 meters, in 25 minutes. A)</td>
<td></td>
<td>SR – 1 NR – 0</td>
<td></td>
</tr>
<tr>
<td>What was my average speed in meters per minute? B) What was my</td>
<td></td>
<td>RW – 3 IU – 1 HF – 0</td>
<td></td>
</tr>
<tr>
<td>average speed in laps per minute?</td>
<td></td>
<td>PM – 0 BT – 0 OTH – 0</td>
<td></td>
</tr>
<tr>
<td>Your pool is 15 ft wide and 20 ft long with a 3 ft wide deck</td>
<td>3.14 (0.90)</td>
<td>VR – 3 R – 2</td>
<td>RW – 6 IU – 1 HF – 0 PM – 0 BT – 0 OTH – 0</td>
</tr>
<tr>
<td>surrounding it. You want to build a fence around the deck. How much</td>
<td></td>
<td>SR – 2 NR – 0</td>
<td></td>
</tr>
<tr>
<td>fence will be needed?</td>
<td></td>
<td>RW – 2 IU – 0 HF – 2</td>
<td></td>
</tr>
<tr>
<td>When Billy Savesalot left his home and ventured out in the world he</td>
<td>3.00 (0.82)</td>
<td>VR – 2 R – 3</td>
<td>RW – 2 IU – 0 HF – 2 PM – 3 BT – 0 OTH – 0</td>
</tr>
<tr>
<td>had only $5 to his name. Yet, Billy Savesalot found a job where he could</td>
<td></td>
<td>SR – 2 NR – 0</td>
<td></td>
</tr>
<tr>
<td>work every day and save $400 each day. The relationship between the</td>
<td></td>
<td>RW – 2 IU – 0 HF – 2</td>
<td></td>
</tr>
<tr>
<td>amount of money Billy has and the time that has passed since he started</td>
<td></td>
<td>PM – 3 BT – 0 OTH – 0</td>
<td></td>
</tr>
<tr>
<td>saving can be expressed by the equation y=400x+5. A) How many days</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>must Billy save for until he has $4,005? Write an equation to answer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>this question. B) Billy wants to buy a Prius, which costs $20,800. If</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Billy plans to pay the full cost up front, how many days does he need</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>to save for until he has enough money to buy the car?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>Mean (σ)</td>
<td>Response breakdown</td>
<td>Definitions</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>----------</td>
<td>--------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Briley has purchased a clothing company and wants to make sure he stays</td>
<td>2.86</td>
<td>VR R 6 SR NR 0</td>
<td>RW 3 IU 0 HF 4 PM 0 BT 0 OTH 0</td>
</tr>
<tr>
<td>profitable. His company makes $8,500 each month but he also has to pay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$1500 for rent each month and buy new inventory at $500 per unit. Use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>your knowledge of inequalities to find how many units of new inventory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Briley can purchase each month to stay out of debt.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You deposit $4000 into an account that earns 6% annual interest,</td>
<td>2.86</td>
<td>VR R 5 SR NR 1</td>
<td>RW 1 IU 0 HF 2 PM 2 BT 2 OTH 0</td>
</tr>
<tr>
<td>compounded annually. A friend deposits $3500 into an account that earns</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.95% annual interest, compounded continuously. Will your friend's</td>
<td>2.71</td>
<td>VR R 5 SR NR 1</td>
<td>RW 3 IU 3 HF 0 PM 0 BT 0 OTH 0</td>
</tr>
<tr>
<td>balance ever equal yours? If so, when?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Write an equation in standard form to relate the number of cars and</td>
<td>2.71</td>
<td>VR R 5 SR NR 1</td>
<td>RW 3 IU 3 HF 0 PM 0 BT 0 OTH 0</td>
</tr>
<tr>
<td>vans or trucks the students must wash to raise $800.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On a map, 1 in represents 40 miles. The measured distance on the map</td>
<td>2.57</td>
<td>VR R 5 SR NR 1</td>
<td>RW 4 IU 1 HF 0 PM 1 BT 1 OTH 0</td>
</tr>
<tr>
<td>is 31/8 in. Find the actual distance (in miles).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have the students make clinometers and measure the heights of objects</td>
<td>2.29</td>
<td>VR R 2 SR NR 0</td>
<td>RW 2 IU 1 HF 1 PM 0 BT 1 OTH 1</td>
</tr>
<tr>
<td>around campus using the angle of elevation.</td>
<td>(0.49)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>You are an archer at the top of the castle, 25 feet up. To strike your</td>
<td>2.14</td>
<td>VR R 2 SR NR 1</td>
<td>RW 2 IU 0 HF 0 PM 1 BT 3 OTH 0</td>
</tr>
<tr>
<td>target outside the castle on the ground, the arrow must travel 35 feet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(linearly). At what angle (in relation to the wall of the castle) must</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>your arrow fly to strike the target? a) sketch and label the situation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>and b) set up to find the angle measure.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A CD-ROM stores about $6.5 \times 10^8$ bytes of info along a track.</td>
<td>1.86</td>
<td>VR R 1 SR NR 2</td>
<td>RW 2 IU 0 HF 2 PM 0 BT 1 OTH 1</td>
</tr>
<tr>
<td>Each byte uses $9 \times 10^6$ m of space along the track. Find the</td>
<td>(0.69)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>length of the track.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The sum of eight times a number and five is 37. Find the number</td>
<td>1.57</td>
<td>VR R 1 SR NR 4</td>
<td>RW 0 IU 0 HF 0 PM 0 BT 6 OTH 0</td>
</tr>
<tr>
<td>Five fences meet at a point to form angles with measure x, 2x, 3x,</td>
<td>1.43</td>
<td>VR R 1 SR NR 5</td>
<td>RW 1 IU 0 HF 0 PM 0 BT 5 OTH 0</td>
</tr>
<tr>
<td>4x, and 5x around the point. Find the measure of each angle.</td>
<td>(0.79)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solve the quadratic equation by graphing. (ex: $y=x^2+2x-3$)</td>
<td>1.29</td>
<td>VR R 1 SR NR 6</td>
<td>RW 0 IU 0 HF 0 PM 0 BT 6 OTH 0</td>
</tr>
</tbody>
</table>
students become better thinkers. For more details on the teacher responses, including the definitions selected for each question see Table 3.

**Characteristics of the Students**

**Student Groups**

There are three groups that can be formed within the student sample based on a survey question designed to learn about students’ attitudes towards math: the students who like mathematics, who feel it is okay, and those who dislike it. The first set of students responded when asked their general attitude towards mathematics they chose “like” or “like a lot.” This group makes up approximately 29% of the student sample including 21 algebra student and 8 geometry students. These students reported that in the previous semester in mathematics class 13 of them earned As, 11 earned Bs and 6 earned Cs. The largest group was the students who described their attitudes towards mathematics as “okay” or “no feelings one way or another.” This group made up 36% of the total student sample and included 29 algebra students and 9 geometry students. From this set of students 14 earned As, 10 earned Bs, 11 earned Cs, 2 earned Ds, and 1 earned an F the previous semester in mathematics. The last group of students marked that they “dislike” or “really hate” mathematics. This group formed 34% of the total student population and included 27 algebra students and 9 geometry students. As a whole, these students reported earning lower grades in mathematics class the previous semester when compared with the other two groups. Among this group, only 1 student earned an A, while 6 students earned Bs, 12 students earned Cs, 11 earned Ds and 6 earned Fs. It is important to
understand the differences between these groups of students, because their responses on the rest of the survey differed noticeably.

**Definitions of Mathematics**

During the background section of the survey, students had to complete the sentence, “mathematics is.” Among the students, who reported liking mathematics the words “fun” and “easy” was part of the majority of the responses. Two of the students who liked mathematics a lot, described it as “challenging,” but clearly, this was meant as a positive characteristic. Among the students who liked mathematics, several mentioned that mathematics is “important,” recognizing it as an “important life skill” and “a great tool.”

Replies to this question were more mixed among the group of students neutral towards mathematics. Some students were still positive in their responses, but others were negative in tone and some were even both positive and negative at the same time. A small number of student still reported that mathematics was sometimes “fun” and “interesting.” However more common among this group’s responses, were the words “confusing,” “hard,” and “difficult” when describing mathematics. Despite these feelings, a number of students still described mathematics as “useful,” “necessary,” and “important” “life skill.” One student went so far as to say, “I do not really like it [mathematics], but I think I will use it one day.” Other students were completely negative in their responses, claiming mathematics was “boring,” “not fun” and “not important.” One student’s response stated mathematics was “sometimes pointless as this will not help us in our life.”
The responses among the students who disliked math were overwhelmingly negative in their opinions on the subject. Most of these students found math to be hard, confusing, and boring subject that in general is a waste of time, since they do not understand how it will help them in their futures. Several of the responses in this group tied into negative emotions including embarrassment caused by poor performance in math class. One student claimed that his teacher caused the subject to be additionally “frustrating” and “upsetting.”

Many of the responses among this group of student describe mathematics as “pointless” and a “waste of time.” There were several mentions by students of not understanding “how we will use it in the future” and how it does not “pertain to my future plans (career).” Two students even went so far as to claim that mathematics education should not continue beyond elementary school. One bluntly said, “I think math should stop being taught at around 5th grade.” While the other student explained further, “I know I will need addition, multiplication, division, and subtraction in the workplace, but I don’t foresee going into a job that requires y=x² +18x+131. It’s not a total waste of time, just something I am not interested in.” These general feelings about the subject of mathematics influence students’ responses and ratings of relevance on the rest of the survey.

Definitions of Relevant

Before looking at specific questions, students were asked to rate the different meanings of relevant. In the online survey, students had an option to fill in one to five stars for each of the different definitions of relevant. The directions for the question instructed students that a blank response was the same as a zero
rating, meaning the definition did not fit the word “relevant.” Unfortunately, it is impossible to know if the blank was intentional or a mistake so the researcher decided to not fill in zeros for every blank rating and instead only count the rating on a scale of 1 to 5, omitting the blank responses. This does not affect the general rankings of the different definitions, just means that the student ratings are probably slightly higher than they would be if all blanks as zeros were included as well as a slightly lowering the standard of deviation for each definition.

The students favored two of the definitions over the others when determining which definition fit the term relevant in how it applies to mathematics. On average, students rated mathematics that will help in the future, towards a career path the highest at 3.39, while mathematics in the real world followed closely behind at 3.28. Only these two definitions received a mean rating above a three. The lowest rated definition was mathematics that is personally meaningful, which received a mean rating of 2.37. For a complete list of student ratings as well as the breakdown among the different student groups, see Table 4.

The ranking of the different definitions was the same across some of the groups within the study sample and varied across others. When comparing students in algebra 1 to those in geometry the geometry students rated the definitions slightly higher. Despite the researchers’ initial predictions; there was not a large difference in responses between students who were enrolled in geometry versus those enrolled in algebra 1. On the other hand, the differences between the responses from students who reported liking mathematics in
comparison to those who disliked the subject appear to be significant. The group of students who liked mathematics is formed by the students who reported that they “like” or “like a lot” mathematics. The group who dislikes mathematics is made up of the students who responded that they “dislike” or “really hate” mathematics. Students who liked mathematics rated all of the definitions above a three, while students who disliked mathematics rated all of the definitions below three. With the exception of mathematics that is personally meaningful, the standard deviation for the students who liked mathematics was much lower than for students who disliked mathematics. This demonstrates a greater amount of consensus among the students who liked mathematics in their feelings towards these definitions when compared with those who dislike mathematics.

Table 4

Student Definitions Ratings

<table>
<thead>
<tr>
<th>Definitions</th>
<th>All Students</th>
<th>Geometry Students</th>
<th>Algebra Students</th>
<th>Students who Like Math</th>
<th>Students who Dislike Math</th>
<th>Total times cited by students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real World</td>
<td>3.28 (1.32)</td>
<td>3.50 (1.38)</td>
<td>3.18 (1.28)</td>
<td>4.00 (0.89)</td>
<td>2.56 (1.29)</td>
<td>466</td>
</tr>
<tr>
<td>Immediately Useful</td>
<td>2.96 (1.30)</td>
<td>3.04 (1.21)</td>
<td>2.90 (1.31)</td>
<td>3.78 (0.92)</td>
<td>2.19 (1.20)</td>
<td>132</td>
</tr>
<tr>
<td>Help Towards Future</td>
<td>3.39 (1.44)</td>
<td>3.58 (1.11)</td>
<td>3.30 (1.52)</td>
<td>4.22 (0.83)</td>
<td>2.72 (1.35)</td>
<td>133</td>
</tr>
<tr>
<td>Personally Meaningful</td>
<td>2.37 (1.36)</td>
<td>2.57 (1.40)</td>
<td>2.28 (1.33)</td>
<td>3.27 (1.13)</td>
<td>1.37 (0.73)</td>
<td>100</td>
</tr>
<tr>
<td>Better Thinker</td>
<td>2.91 (1.41)</td>
<td>2.91 (1.38)</td>
<td>2.88 (1.41)</td>
<td>3.92 (1.02)</td>
<td>1.86 (1.14)</td>
<td>224</td>
</tr>
</tbody>
</table>
The student ratings contrast sharply with those of the teacher participants. The student mean rating of the personally meaningful definition was the lowest of the five options. One hypothesis is that this low rating stems from the students’ lack of understanding of the meaning of this definition. Students may not perceive how learning can be personally meaningful or it may be a term they lack the educational experience of dealing with this term. It also could be that students understand the term but may not feel that mathematics is meaningful to them or at least type of mathematics that they have experienced throughout their schooling. More evidence on this issue is that the personally meaningful definition was the least chosen in application to the example questions. It was not that students felt this definition fit with not relevant questions, because for those the students tended to select “other” or better thinker definitions. Despite this avoidance of the personally meaningful definition on the teacher written questions, students suggested that they wanted relevant mathematics to be helpful to “me,” “I,” and “myself.” As one student described relevant mathematics problems as “the ones that I will actually use or do in real life.” There seems to be a sharp contrast between the students rating of the different definitions of relevant and their descriptions of relevant mathematics examples. If teachers believe that relevant mathematics is content that is personally meaningful and students do not see this type of mathematics as relevant, it may explain why teachers feel they are incorporating relevance more frequently than the students think they are.

Student responses reflect a familiarity with mathematics in a real world context, suggesting that this type of relevance is currently the most common in
their classrooms. This definition received the second highest average rating and was the most commonly picked definition among the sample problems. Students seem to want to understand the purpose of what they are learning, so they find problems that demonstrate how mathematics is applied in the real world as relevant. While this definition was commonly selected by students, this may be partially due to the fact placing mathematics in any real world context in a word problem is often how mathematic is thought to be made relevant. This definition also has broad implications and can be applied to a multitude of problems that are not always relevant for the students. During this study, students did not always rate the problems set in a real world context as “relevant.” When asking to describe relevant examples, some students were very specific on the type of real world contexts that they actually found relevant. For instance, one student stated, “I feel that math that applies to taxes, insurance and day to day stuff, but not silly stuff…but actual necessary things.” These findings support the notion that from the student perspective a real world context is necessary for the mathematics to be relevant, but not sufficient.

Nine different students provided alternative definitions for the term relevant. Even though it was implied in the provided definitions, several of the students associated the term with mathematics that is used outside of the classroom including other classes in school and their future. Other students seemed to imply personally meaningful with their definitions of relevant including the following responses, “they (the questions) attract my attention” and “it makes me see a different perspective in life.” Another group of students used
the other option to state that math was simply not relevant. One student explained, “I think that some math that I learn in high school can be and is probably going to be very useful to me but most of it I will never use and I think math teachers make it ridiculous because if I really needed the answer instead of remembering an equation, I could just google it or use a nifty thing called a calculator.” For a complete list of all of the student responses to this and the other free response questions in the survey see Appendix I.

**Teacher Generated Questions**

After rating the definitions of relevant, students went through the same 15 questions that the teachers rated, and stated if they felt each questions was very relevant, relevant, sort of relevant or not relevant. To aid with the comparison, a numerical value was assigned to each response, for instance a response of very relevant was a four while a response of not relevant was a one. A complete breakdown of the student responses for each question as well as the means for the two groups of students who liked and disliked mathematics, see table 5. Four questions received higher mean rating than the rest. The pool fence question, received the highest mean rating of 2.85. The teacher who originally wrote this question classified it as mathematics that is immediately useful to me while the majority of the students, 57%, felt it was an example of mathematics in a real world context. The Biebs concert question was the second highest rated question at a mean rating of 2.80. The teacher who wrote the question classified it as an example of mathematics that is personally meaningful, while 53% of the students who responded viewed it as an example of math in the real world context. The
<table>
<thead>
<tr>
<th>Question</th>
<th>Total Mean</th>
<th>Like Mean</th>
<th>Dislike Mean</th>
<th>Total Response Breakdown (%)</th>
<th>Total Definitions (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your pool is 15 ft wide and 20 ft long with a 3 ft wide deck surrounding it. You want to build a fence around the deck. How much fence will be needed?</td>
<td>2.85 (0.92)</td>
<td>3.21 (0.92)</td>
<td>2.63 (0.83)</td>
<td>VR – 27 R – 40 SR – 25 NR – 8</td>
<td>RW – 57 IU – 11 HF – 11 PM – 2 BT – 12 OTH – 7</td>
</tr>
<tr>
<td>The Biebs is coming to Phoenix in 4 weeks and you want to go with 2 of your friends. Of course you offered to buy their tickets but each one costs $70! You already have $80 and can save $30 a week. Write a mathematical model to show how much money you will have after 4 weeks. Will you have enough for the concert of a lifetime?</td>
<td>2.80 (0.91)</td>
<td>3.21 (0.77)</td>
<td>2.59 (0.95)</td>
<td>VR – 23 R – 43 SR – 24 NR – 10</td>
<td>RW – 53 IU – 18 HF – 4 PM – 15 BT – 7 OTH – 3</td>
</tr>
<tr>
<td>You deposit $4000 into an account that earns 6% annual interest, compounded annually. A friend deposits $3500 into an account that earns 5.95% annual interest, compounded continuously. Will your friend’s balance ever equal yours? If so, when?</td>
<td>2.78 (0.96)</td>
<td>3.12 (0.91)</td>
<td>2.40 (0.86)</td>
<td>VR – 26 R – 38 SR – 25 NR – 11</td>
<td>RW – 48 IU – 15 HF – 17 PM – 11 BT – 7 OTH – 2</td>
</tr>
<tr>
<td>Briley has purchased a clothing company and wants to make sure he stays profitable. His company makes $8,500 each month but he also has to pay $1500 for rent each month and buy new inventory at $500 per unit. Use your knowledge of inequalities to find how many units of new inventory Briley can purchase each month to stay out of debt.</td>
<td>2.72 (0.82)</td>
<td>3.17 (0.87)</td>
<td>2.18 (0.72)</td>
<td>VR – 19 R – 42 SR – 30 NR – 8</td>
<td>RW – 44 IU – 9 HF – 29 PM – 5 BT – 8 OTH – 5</td>
</tr>
<tr>
<td>On a map, 1 in represents 40 miles. The measured distance on the map is 31/8 in. Find the actual distance (in miles).</td>
<td>2.62 (0.93)</td>
<td>2.92 (0.93)</td>
<td>2.44 (0.89)</td>
<td>VR – 18 R – 39 SR – 30 NR – 13</td>
<td>RW – 53 IU – 10 HF – 7 PM – 8 BT – 14 OTH – 8</td>
</tr>
</tbody>
</table>
### Question

<table>
<thead>
<tr>
<th>Question</th>
<th>Total Mean</th>
<th>Like Mean</th>
<th>Dislike Mean</th>
<th>Total Response Breakdown (%)</th>
<th>Total Definitions (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>When Billy Savesalot left his home and ventured out in the world he had only $5 to his name. Yet, Billy Savesalot found a job where he could work everyday and save $400 each day. The relationship between the amount of money Billy has and the time that has passed since he started saving can be expressed by the equation $y=400x+5$. A) How many days must Billy save for until he has $4,005? Write an equation to answer this question. B) Billy wants to buy a Prius, which costs $20,800. If Billy plans to pay the full cost up front, how many days does he need to save for until he has enough money to buy the car?</td>
<td>2.61 (0.94)</td>
<td>3.12 (0.93)</td>
<td>2.20 (0.85)</td>
<td>VR – 20  R – 35  SR – 33  NR – 13</td>
<td>RW – 46  IU – 6  HF – 16  PM – 7  BT – 12  OTH – 13</td>
</tr>
<tr>
<td>I enjoy running around the track at school for exercise. Yesterday I completed 12 laps, a total distance of 4800 meters, in 25 minutes. A) What was my average speed in meters per minute? B) What was my average speed in laps per minute?</td>
<td>2.61 (1.01)</td>
<td>3.23 (0.86)</td>
<td>2.14 (0.93)</td>
<td>VR – 21  R – 37  SR – 25  NR – 18</td>
<td>RW – 26  IU – 22  HF – 4  PM – 18  BT – 12  OTH – 17</td>
</tr>
<tr>
<td>Campo Verde’s Student Council needs your help. They are attempting to figure out the best price to charge for an Activity Pass (the pass that lets you into school events free or at a discounted rate). Past experience has shown that at the standard price of $40, eighty people will buy Activity Passes. We also know that for every $1 discount in price, four more people will buy Activity Passes. Answer the following questions, completing the table of values and the graph to help you reach your final decision. Write out your final recommendation for student council in a short paragraph, submitting the table, graph and responses to the questions as support for your recommendation.</td>
<td>2.60 (0.90)</td>
<td>2.88 (0.93)</td>
<td>2.50 (0.82)</td>
<td>VR – 16  R – 39  SR – 33  NR – 12</td>
<td>RW – 44  IU – 18  HF – 9  PM – 9  BT – 10  OTH – 11</td>
</tr>
<tr>
<td>Write an equation in standard form to relate the number of cars and vans or trucks the students must wash to raise $800.</td>
<td>2.47 (0.95)</td>
<td>3.11 (0.96)</td>
<td>2.13 (0.75)</td>
<td>VR – 16  R – 31  SR – 37  NR – 16</td>
<td>RW – 61  IU – 10  HF – 9  PM – 2  BT – 14  OTH – 3</td>
</tr>
<tr>
<td>Question</td>
<td>Total Mean</td>
<td>Like Mean</td>
<td>Dislike Mean</td>
<td>Total Response Breakdown (%)</td>
<td>Total Definitions (%)</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>------------</td>
<td>-----------</td>
<td>--------------</td>
<td>-----------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>The sum of eight times a number and five is 37. Find the number</td>
<td>2.28</td>
<td>2.69</td>
<td>2.19</td>
<td>VR – 15 R – 27</td>
<td>RW – 19 IU – 11 HF – 7</td>
</tr>
<tr>
<td>You are an archer at the top of the castle, 25 feet up. To strike your target outside the castle on the ground, the arrow must travel 35 feet (linearly). At what angle (in relation to the wall of the castle) must your arrow fly to strike the target? a) sketch and label the situation and b) set up to find the angle measure.</td>
<td>2.09</td>
<td>2.43</td>
<td>1.88</td>
<td>VR – 12 R – 18</td>
<td>RW – 28 IU – 5 HF – 13</td>
</tr>
<tr>
<td>A CD-ROM stores about $6.5 \times 10^8$ bytes of info along a track. Each byte uses $9 \times 10^6$ m of space along the track. Find the length of the track.</td>
<td>2.07</td>
<td>2.32</td>
<td>1.59</td>
<td>VR – 10 R – 21</td>
<td>RW – 32 IU – 9 HF – 17</td>
</tr>
<tr>
<td>Five fences meet at a point to form angles with measure $x$, $2x$, $3x$, $4x$, and $5x$ around the point. Find the measure of each angle.</td>
<td>1.89</td>
<td>2.24</td>
<td>1.71</td>
<td>VR – 5 R – 19</td>
<td>RW – 27 IU – 7 HF – 2</td>
</tr>
<tr>
<td>Solve the quadratic equation by graphing. (ex: $y=x^2+2x-3$)</td>
<td>1.84</td>
<td>2.27</td>
<td>1.53</td>
<td>VR – 6 R – 23</td>
<td>RW – 7 IU – 7 HF – 7</td>
</tr>
<tr>
<td>Have the students make clinometers and measure the heights of objects around campus using the angle of elevation.</td>
<td>1.81</td>
<td>2.27</td>
<td>1.53</td>
<td>VR – 7 R – 14</td>
<td>RW – 27 IU – 6 HF – 13</td>
</tr>
</tbody>
</table>
question on compound interest was the next highest with a mean rating of 2.78. Two different teachers referred to this type of question on their first survey, one who felt it was not relevant and the other who classified it as math in the real world context, which 48% of the students agreed with. The clothing company question was the fourth highest rated at a 2.72. The teacher who originally wrote this question classified it as mathematics that will help in the future and 29% of the students agreed with this classification.

Three of the questions stood out as being rated the least relevant by the student participants. The Clinometer question received the lowest rating of 1.81. The teacher who wrote this question classified it as mathematics that is personally meaningful, only 8% of the students agreed. In general, students’ opinion were split over which definition of relevant fit with this problem, since 27% picked real world context while 24% selected better thinker and another 23% chose the other option. The next lowest rated question was the solving quadratic equation question, which received a 1.84. The teacher who originally wrote this question included two similar questions one classified as mathematics that will help towards the future and mathematics that makes me a better thinker, 41% of the students selected the later definition as well. The five fences question was the third lowest rated at a 1.89. This problem was written as an example of a not relevant question.

For the fifteen teacher-written examples, students also classified the definition of relevant they believed the question embodied thereby providing some insight into the different perspectives. Amid the student responses, there
seems to be an association between the questions considered not relevant and students selecting the definition mathematics that makes me a better thinker. For two of the three questions that students found not relevant, the quadratic equation and five fences questions, the highest percent of the students selected better thinker as the associated definition. Likewise, teachers seemed to share this outlook in rating the same two questions as the least relevant and also associating them with the better thinker definition. This seems to support the notion that both the teachers and students agree that problems designed to develop student thinking skill are not relevant for the students.

After reviewing all of the questions, the researcher totaled the number of times the student participants selected each of the five definitions. Students in reference to the teacher written questions selected the definition mathematics in the real world the most often. This definition was selected 466 times out of the 1200 responses, which was 38.8% of the total responses. Even though mathematics that will help in the future was the highest rated definition on the survey question, yet it was only selected 133 times in reference to the teacher written problems, approximately 11.1% of all the responses. This finding implies that the students do not feel that the mathematics presented to them will be useful in their future, which is the type of relevancy that they find to be most important. For a complete list of the totals for each definition, excluding the other category, see Table 4.

Overall, students most often selected mathematics in the real world context, with this definition being picked by the highest percentage of students on
twelve of the questions. Included among these were the three questions that students on average rated the most relevant, the pool fence question, the Biebs concert and the compound interest question. At the same time, students classified questions as having a real world context, but they are not necessarily finding these questions to be highly relevant. For both questions on the clinometer and CD-ROM megabytes, the highest percentage of students selected mathematics in the real world as the definition, but both questions were on average rated not relevant or sort of relevant. If all it took was to place the mathematic concepts in a real world context to make them relevant, then all twelve of the questions classified as having a real world context should have received a highly relevant rating.

In contrast, very few students associated mathematics that will help in the future with the questions, yet this definition itself, was rated the highest among the students. For all of the questions except one, this definition was selected by less than 20% of the students as the type of relevancy demonstrated by the problem. This is further evidence to support the idea that while students are finding certain problems relevant, these problems are not specifically addressing the type of relevancy students most desire. This also demonstrates a difference between the teacher and student perspectives towards certain problems. Three of the questions included in the survey, solving a quadratic equation, Billy Savesalot and the clothing company questions, were specifically written by teachers with this definition in mind. In addition, two or more teachers selected this definition on four of the questions: Billy Savesalot, compound interest, CD-ROM megabytes, and the clothing company. This shows that teachers believe that they
are addressing this type of relevancy in their classrooms, but the students are not perceiving it as such. Mathematics that will help students in the future was emphasized in student responses, not only in the definition rating but also in their free response description of relevant mathematics examples. Unfortunately, student survey responses demonstrate that for the most part students do not feel that this concept is part of the questions that are traditionally considered relevant by teachers.

**Student Generated Activities**

At the end of the survey, students were able to describe specific mathematical activities and problems that they felt were examples of relevant mathematics. While there were some common answers these were not given all by the same group of students. In the responses, the types of problems students described related to the five definitions given earlier in the survey. Throughout the student responses, there were many references to mathematics that would be useful and could be applied outside of school. As one student described the problems as “the ones that I will actual use or do in real life.” In a similar vein, several students asked for activities and problems that would help in the future, specifically “activities where the teacher can say what the skill would help with later in life.” Among these responses, some students asked for personalized problems or activities, “ones that will help ME for the future.” Moreover, some students wanted problems that related to their current, daily lives. One student demanded problems, “that applies to taxes, insurance and day to day stuff, but not silly stuff about the gym and how much it is to get in or how many calories they
burn and how many sit ups they have to do, but actual necessary things.” A few of the students who liked math referred to relevant mathematics as making them better thinkers. “I believe that almost all the activities are either making us better thinking, heightening our ability to look at things from a logical perspective can go a long way in life.”

Some of the common responses did not relate at all to the five relevant definitions found in the literature. The most frequent of these responses was the basic mathematical operations, meaning adding, subtracting, multiplication, and division. Students with all different attitudes towards mathematics claimed relevant mathematics was the basic operations. One student explained, “because they’re the most common forms of math.” These students do not seem to place any importance in learning mathematics beyond the elementary school level.

The task of understanding why students found certain real world context more relevant than others is difficult to determine based on the data gathered in this survey. Since this was just an exploratory study, students simply had to state if the question was relevant or not, but were not asked to explain their selection. An example of the lack of consistency in the relevancy of different real world contexts is apparent in questions that dealt with money. Several of the students also mentioned wanting to do mathematics that dealt with money, this includes students who also wanted real world problems and ones that would help towards their futures. A student stated, “money is always relevant due to the fact that very soon I will have a job.” When asked to provide specific examples of relevant mathematics problems 13% of the responses specifically mentioned money.
While this percentage may not seem high, money problems were the second most mentioned specific type of problem that the student participants requested. However, not all of the questions that included a context with money received a high relevancy rating. Two of the six questions that referenced money, the standard form and CV student council questions, were rated in the lower half, while the Biebs concert and the compound interest questions were rated among the top three most relevant questions. These examples, emphasize that it is not enough to simply have a mathematics question that deals with money in order to be relevant to students, but it is necessary to use money situations that students consider that they might actually need to use mathematics learned to help them in the future handle their money.

Concordance Between Teachers and Students

Frequency of Relevant Mathematics

After examining the teachers and students separately, the researcher ran various statistical tests to determine if there was a significant difference between the teacher and student perspective on the similar questions. The first area of comparison focused on how frequently teachers and students felt that the mathematics presented in their classroom was relevant for students. In order to compare the frequency rankings, the researcher assigned each of the options a numerical value, six for “almost every class” and zero for “never.” Overall, teachers felt that they were relevant more frequently than the students did. The teacher’s mean ranking was a 5.00, which on average the teachers felt they
provided relevant material for the students 2-3 times per week. Students on the other hand had a mean ranking of 3.74, which was between once a week and once a quarter. This was supported by the Mann-Whitney Test which was performed on the data and showed that the teacher and student responses were 2 standard deviations apart, receiving a z-score of -2.012 (p= 0.04 level).

**Teacher Generated Questions**

Deeper insight into the different frequency ratings by the teachers and students can be gained through a closer examination of both the teacher and student responses to these questions. A two sample t-test was used to determine if there was a significant difference between the teachers and the students in their rating of the fifteen teacher generated questions. For most of the questions there was no clear statistical pattern, the reason for this may be due to the small number of teachers, seven, in comparison to students, about ninety, as well as the relatively few options for people to pick from. Despite these issues, a pattern seems to emerge where teachers rated questions either as relevant or not relevant more strongly when compared with the student responses. In fact, on five of the questions there appeared to be a significant difference between teachers and students with p<0.10. For a complete list of the means, standard deviations, and t-scores for the questions that showed a significant difference, see table 6.

The CV student council question stood out with the most significant difference between the teacher and student ratings. Assuming unequal variance, the t-statistic was -3.168, p = 0.008. The teachers rated this question significantly more relevant than the student participants did. This question was rated the
Table 6

Two-Sample T-Test Significant Differences

<table>
<thead>
<tr>
<th>Question</th>
<th>Teacher Mean (σ)</th>
<th>Student Mean</th>
<th>t-score</th>
<th>Significance</th>
<th>Mean difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campo Verde’s Student Council needs your help. They are attempting</td>
<td>3.14 (0.38)</td>
<td>2.60 (0.90)</td>
<td>-3.17</td>
<td>0.01</td>
<td>-0.55</td>
</tr>
<tr>
<td>to figure out the best price to charge for an Activity Pass (the pass</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>that lets you into school events free or at a discounted rate). Past</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>experience has shown that at the standard price of $40, eighty people</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>will buy Activity Passes. We also know that for every $1 discount in</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>price, four more people will buy Activity Passes. Answer the following</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>questions, completing the table of values and the graph to help you</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reach your final decision. Write out your final recommendation for</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>student council in a short paragraph, submitting the table, graph and</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>responses to the questions as support for your recommendation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Biebs is coming to Phoenix in 4 weeks and you want to go with 2 of</td>
<td>3.34 (0.53)</td>
<td>2.80 (0.91)</td>
<td>-1.80</td>
<td>0.07</td>
<td>-0.63</td>
</tr>
<tr>
<td>your friends. Of course you offered to buy their tickets but each one</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>costs $70! You already have $80 and can save $30 a week. Write a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mathematical model to show how much money you will have after 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>weeks. Will you have enough for the concert of a lifetime?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I enjoy running around the track at school for exercise. Yesterday I</td>
<td>3.14 (0.69)</td>
<td>2.61 (1.01)</td>
<td>-1.877</td>
<td>0.096</td>
<td>-0.53</td>
</tr>
<tr>
<td>completed 12 laps, a total distance of 4800 meters, in 25 minutes. A)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What was my average speed in meters per minute? B) What was my</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>average speed in laps per minute?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>You will make a clinometer and then measure the heights of objects</td>
<td>2.29 (0.49)</td>
<td>1.81 (0.97)</td>
<td>-2.292</td>
<td>0.045</td>
<td>-0.48</td>
</tr>
<tr>
<td>around campus using the angle of elevation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Sum of eight times a number and five is 37. Find the number.</td>
<td>1.57 (0.79)</td>
<td>2.28 (1.03)</td>
<td>1.77</td>
<td>0.08</td>
<td>0.71</td>
</tr>
</tbody>
</table>
second most relevant among the teachers, but was among the lower half among the students. This question was considered either relevant or very relevant by all of the teacher participants. Yet only 55% of the student participants agreed, while 45% of the students classified this question as only sort of relevant or not relevant. It is easy to understand why the teachers classified this problem as relevant; the problem is set in a situation that the students might come across in their high school day to day lives. However, from the students’ ratings of the different definitions of relevant, it is apparent that many students place a higher value on real world contexts that will help towards their future careers over their immediate lives. Another possible explanation for the difference in the ratings may be because students saw the real world context as contrived and not realistic.

Of the other questions that demonstrated a significant difference between teachers and students, on all but one the teachers had a higher mean rating than the students. For the Biebs concert question, with equal variances assumed the t-statistic was -1.804, p = 0.074. This question had the highest mean rating from the teachers among all fifteen teacher generated questions and was the second highest among students. Clearly, both groups found this question relevant. The teacher who wrote this question designed it to be personally meaningful for students, by creating a traditional math problem in the guise of a real world context that including saving money for a concert, which is something some students do. The students probably liked this question because it included a familiar context, saving money to attend an event, in this case a concert. Additionally, the problem dealt with handling money, a topic that several students
mentioned as an important real world context that they wanted to learn more about. This problem demonstrates the importance of a familiar real world context as well as a mathematical concept that students deem important when designing relevant mathematics problems.

Another question which was rated much less relevant by students compared to the teachers was the Clinometer question. Assuming unequal variance, the t-statistic was -2.292, p = 0.045. Among the teachers this question received a rating of 2.29 with none of the teachers classifying it as not relevant. In contrast, the question was considered the least relevant among the students earning an average rating of 1.81 and 47% of the students considering it not relevant. There is a chance that the low rating among the students may be the result of them being unfamiliar with the term “clinometers.” This term does not come up in the mathematics curriculum until fourth quarter geometry, so the majority of the students participating in this study might be unfamiliar with the word. This is probably not the sole reason for the low rating, because 42% of the students enrolled in geometry classes rated this question as not relevant. No matter what the specific reason, this question is another example of a mathematics question set in a real world context, but students do not feel that this context is enough to make the question relevant. Perhaps all the question needs is a little bit of added background about the purpose of a clinometers and the different careers that use this tool to help students understand how this problem can actually be mathematic that will help students in their potential future careers.
Among all the questions that showed a significant difference, students only rated one question more relevant than the teachers, the sum of eight times a number question. Assuming equal variance, the t-statistic was 1.770, \( p = 0.08 \). This question was rated the third lowest among the teachers, but was only the sixth lowest for the students. It is difficult to explain why students gave this question a high relevancy rating, considering that it does not fit with the definition of relevant they rated the highest, nor the type of relevant problems they described at the end of the survey.

In all of the questions, it was typical that the mean teacher rating was more strongly not relevant or relevant when compared with the student sample. This was probably partially due to the small number of teacher participants, seven, when compared to the much larger student sample which ranged in respondents from ninety-four to eighty-three. Students were more diverse on their ratings, with at least a few students finding every question very relevant and some finding the same question not relevant. The standard deviation among the students for every question was between 0.82 and 1.03. In contrast, the seven teachers were more uniform in their responses, with the standard deviation never above 0.90 and reaching as low as 0.38. This uniformity among the teachers may be another example of the impact of the similar relevance training that all of the teachers have received.
Results Summary

There were some key differences between the teacher and student responses in the survey. Teachers rated the personally meaningful definition the highest, while students rated this definition the lowest of the five options. On the other hand, students felt that the definition “mathematics that helps towards the future (career path)” was the best description of relevant mathematics, but did not find this type of relevancy very often among the teacher generated questions. Students who disliked mathematics rated the definitions as well as the teacher generated questions lower than students who said they enjoyed mathematics. Also, the teachers tended to find questions to be either more or less relevant than the students, which may be partially due to the small number of teacher participants.
Chapter 5

DISCUSSION

Findings of this study highlight teacher and student perspectives on relevant mathematics, these viewpoints have the potential to influence future classroom practice and curriculum design. Overall, there was considerable agreement between the teachers and students ratings on most questions. The most informative responses can be found in the few areas where teachers’ and student responses differed. The three key differences include the discrepancy between frequency ratings, the differences between how teachers and students defined the term relevant and how the highest rated definitions where the least accounted for among the teacher generated questions, and finally the impact of differing attitudes towards mathematics on students’ perceptions of relevant mathematics.

Discrepancy in the Perception of Frequency

A key issue that emerged from the data is the discrepancy between the teachers’ and students’ perception of how frequently their current mathematics course provides relevant activities and problems to the students. Some of the other patterns that emerged from the data provide insight into this discrepancy. An analysis of the teachers’ and students’ ratings of the different definitions of the term relevant highlights some of the basic differences in perspectives of the two groups. In addition, teachers and student rating of the relevance of the sample math problems included in the survey shows the types of problems students favor and brings to light further aspects of the disconnects between the teachers and
students. On a related, but different topic, the results of this study demonstrate that students with positive versus negative attitudes towards mathematics have very different opinions on what mathematics are relevant to them. All of these findings can be used to help direct future research on relevant mathematics as well as future mathematics curriculum design and teacher practice.

In general, teachers feel that they are being relevant more often than the students in their classes feel they are relevant. On the average teachers in this study felt that they were being relevant two to three times per week, while the students felt that their mathematics courses were only relevant between once a month and once a quarter. This means that more often than not a teacher may feel that they are incorporating relevant mathematics into the classroom yet students do not recognize it as such. This finding confirms what Gainsburge (2009) discovered when asking teachers how often they incorporated real world math in their classrooms. Gainsburge found that one teacher out of the five who participated in the study claimed during interviews that real world mathematics was an important and frequent occurrence in her classroom. However, after observing the teacher’s classroom, Gainsburge noticed that the real world activities cited during the interview were actually extra credit projects. While this is not comparing the same two perspectives that are examined in this thesis, it supports the findings in this study that it is possible for teachers to feel that one thing is happening in their classroom while someone with a different perspective, such as a student or a researcher, experiences something else entirely.
There are many reasons why it is important that teachers understand what mathematics students actually view as relevant. Professional development groups, such as the International Center for Leadership in Education (n.d.) which trained the teacher participants, encourage teachers to incorporate relevant lessons in order to increase student engagement and therefore student performance. Relevant mathematics is encouraged by many different education groups as well as the new Common Core State Standards. If students are not actually finding their lessons to be relevant, then the benefits of incorporating relevant mathematics into the curriculum may not be there. Part of the purpose of designing relevant mathematic curriculum is to increase the engagement of the students. If they are not finding the material to be relevant then chances are there will be no difference in the level of student engagement when compared with non-relevant mathematics material. The focus of much of the present study is an examination of the different aspects of this situation, the definition of relevant, the rating of the relevant questions, and way student attitude influence the student perspective on relevance, looking closer at why this may be happening and what can be done in the future to lessen the impact.

The gap between the classroom experiences of the teachers and their students might be solved by some modest changes in the teacher behavior. A teacher may have designed a lesson that has the potential to be relevant for students, but the students do not explicitly understand how or why it is. To help them be aware of the relevance may take some additional explaining by the
teachers to inform students why the math or activity they are learning will impact their futures or could be used in the world outside of school.

**Differing Definitions of Relevant**

One reason that may lead to the difference in the perception of frequency may be due to differences in how teachers and students define the term relevant mathematics. The findings of this study show that teachers and students have different conceptions for the meaning of relevant mathematics. Through an understanding of what students believe is relevant mathematics, teachers can design future relevant activities to correlate with the students' perceptions of relevancy.

**Personally Meaningful Mathematics**

The results of the study illustrate the value teachers place on creating mathematics that is personally meaningful to students, but the failure of these same teachers in fostering these feelings within their students. Helping high school students understand how mathematics is personally meaningful is not a straightforward task. Gutstein (2006) along with other advocates of culturally relevant pedagogy, encourage mathematics teachers use student selected community problems as a vehicle for presenting mathematical content. Gutstein found that by presenting the mathematics through issues the students found important, students were more engaged in the learning process and come to better understand the role mathematics plays in the world at large. His success with incorporating culturally relevant mathematics into his classroom, demonstrates
how one teacher was able to successfully demonstrate to students how mathematics can be personally meaningful. Perhaps if more professional development workshops and trainings helped teachers better understand how to incorporate culturally relevant pedagogy, defined in part by the students themselves. Teachers would be more successful in helping students see the personally meaningful aspects of mathematics.

Mathematics that Helps Towards the Future

The key to making the real world mathematics problems relevant for students is apparent in the definition they rated the highest, mathematics that will help towards the future. The high school students who participated in this study seem to be focused on their futures. The realities of life after school, including finding a job, managing money, or getting into college, are fast approaching for these students. This is similar to the findings of Onion’s (2004) study, which found that students seemed to be focused on the value of mathematics in them gaining access to employment and higher education. These 14 to 18 year old students like the ones in this current study, are determining the “relevance” of mathematics based on how it will help them in their futures.

Traditionally one of the goals of education is to prepare students for the future. The student responses show that many of the participants view mathematics courses as something that they are required to take, because it is important for their professional future not because of intrinsic motivation. According to future time perspective research, if these students better understood the utility of mathematics in their futures than this would result in an increase in
intrinsic motivation (Husman & Lens, 1999). The students’ responses to the survey questions clearly show that students want to better understand the utility of mathematics. It now is up to the mathematics teachers and curriculum designers to come up with interesting ways to demonstrate for students how mathematics will be useful to them and thereby increase their motivation to be successful in mathematics.

These findings suggest that further thinking needs to be done on exactly what mathematics students perceive as being helpful in their futures and how to design mathematics curriculum so that students understand why the concepts and skills they are learning will be relevant in their future. This may involve development of new curriculum materials that place a greater emphasis on how mathematics ties in with student’s future career paths. Unfortunately, many teachers do not have the background knowledge necessary to meaningfully incorporate this type of relevancy in the mathematics classroom without outside resources. One idea is to create a mathematics textbook organized by the various concepts within the Common Core State Standards for mathematics. The book could describe how the most popular careers used the various mathematical concepts present in each standard. Moreover, the book could provide examples of relevant problems and activities for the teachers to do with their students to help prepare them for their futures outside of school. This is just one idea, but in order to effectively incorporate mathematics that will help prepare students for the future, more needs to be done to help teachers learn how to teach this type of relevant mathematics.
Real World is Not Enough

The findings of this study highlight the notion that students do not find all real world context based problems to be relevant. This is in agreement with several studies that found students do not necessarily view the real world contexts of many word problems as realistic and therefore lacking in relevancy (Boaler, 1993; Greer, Verschaffel, de Corte, 2002; Otton, 2011). It’s important for teachers and curriculum designers to understand why students feel certain real world contexts are relevant while others are not, like the CV student council and the Clinometer question from this study. With this knowledge of why students feel certain questions are less relevant, teachers can begin to improve their teaching practice as well as begin to design mathematics curriculum material that is specifically tailored to the students’ views of relevant mathematics. At this point in the research process, one can only hypothesize why students found certain real world contexts more relevant than others. As a teacher, the researcher can make educated guesses by looking at the questions, but a follow-up study that goes into more depth would be required to gain a better understanding of why students felt that some of these questions were less relevant than others.

Student Attitudes and Relevance

The student participants were not completely uniform in their opinions on relevant mathematics and therefore it is important to consider the responses of different student groups. The great difference in these students’ attitudes towards mathematics seem to influence their opinions on what type of mathematics is
relevant for them in addition to their attitudes and performance in a classroom. Understanding the differences between these two groups’ responses is important to both teachers and curriculum designers, because research has shown that students’ attitudes towards a subject can influence students’ academic performance (Hannula, 2006; House & Telese, 2008). Hopefully, through an understanding of the mathematics that these groups find relevant, teachers and curriculum designers can work to create mathematics that is more relevant for all students and thereby help the students who dislike the subject start to like it a little more.

The basic differences between the students who like math compared with those who do not are evident in their descriptions of what mathematics is. When asked to complete the sentence “mathematics is,” students who liked mathematics comments reflected their enjoyment of the subject and how they already believe mathematics will be useful to them. As one student explained, mathematics is “a great tool if you know what you are doing.” In contrast, students who dislike mathematics comments on the subject reflect their strong feelings of hate and lack of enjoyment during math class. Many of the students in this group shared the opinion of this student who described mathematics as “mostly pointless stuff I’m never going to use.” The students in the dislike group tend to be the lower performing students among the participants, who struggle in the classroom and are clearly experiencing a disconnect with the subject. It is difficult to imagine that these students find mathematics at all relevant when they feel it is “very hard, and confusing and it is not teaching me things I am going to need in the future.”
From the students’ comments, it is clear that many of the students who have negative feelings towards mathematics find that there is very little relevant about the subject based on their experiences. This is the opposite outlook of the students who liked mathematics, who seem to already appreciate the usefulness of mathematics and realize that it will be relevant to their futures. A close look at the rest of these two groups’ responses will help to highlight the differences and hopefully lead to ways to reach both groups of students with relevant mathematics curriculum.

One of the key differences between the students who liked mathematics versus those who dislike the subject was their rating of the definitions of the term relevant. Students who like mathematics rated all five of the definitions above a three, while students who disliked mathematics rated all five definitions below a three. This means that the students who like mathematics believe that all of the definitions basically apply to relevant mathematics and therefore have a wider acceptance of what mathematics can be considered relevant. Despite their low rating of the definitions, the students who disliked mathematics still rated certain examples as relevant; this means that these students still see the potential of relevance in the subject. Perhaps they just do not count these specific aspects of mathematics as relevant or it could be that these students have so many negative feelings towards mathematics that for now the subject is simply too painful and nothing they imagine can make it better. If future research can determine the aspects of mathematics that these students do find relevant, or maybe ask them at
an earlier age, it may help to create relevant mathematics curriculum that could improve this group of students’ negative attitude towards the subjects.

Another part of the survey that highlighted the differences between these two groups was the type of problems and activities these students defined as examples of relevant mathematics. Both groups mentioned problems that relate to real life and help towards the future as relevant mathematics. This is another example that emphasizes the importance of connecting mathematics to students’ potential futures outside of school in order to design relevant mathematics curriculum. Students who liked mathematics were the only ones to express a desire for relevant mathematics that makes them think and presents a challenge. This is something teachers should consider when differentiating, there are students in their classroom that enjoy the challenge mathematics can present and do not require even a real world context for it to be relevant as long as it forces them to think outside of the box. Students who dislike mathematics provided nearly an opposite example, making multiple references to the basic math operations of adding, subtracting, multiplying and dividing as the only type of relevant mathematics. These students see neither the value nor relevance of mathematics beyond elementary school. So in order to keep them engaged in the subject through the required years of mathematics, it is super important to demonstrate that higher mathematics has a role in their lives. In addition to basic operations, students who disliked mathematics defined relevant mathematics as having practical everyday purposes, like banking. It is important for both teachers and curriculum designers to understand the difference between these two groups.
of students and their opinions about relevant mathematics. Through an understanding of these groups, teachers and curriculum designers can attempt to try to limit the impact of attitude within a mathematics curriculum, by presenting differentiated material that is relevant to each group.

**Future Research on Relevant Mathematics**

The findings of this study and future research on the subject have the potential to influence mathematics curriculum design and classroom practice. Throughout their responses students clearly expressed a desire to learn about the mathematics that will help them in the future, possibly in a career. Yet the majority of the students felt that this was not present in any of the relevant mathematics questions presented to them. This is something that needs to be addressed by both individual teachers and curriculum material designers. In the future, a greater emphasis should be placed on how mathematics can be used in various popular work related fields. Teachers could explain why a unit, activity or problems is related to a career or other practical activities. This might include a discussion or explanation of where students might come across the mathematics concepts they are learning in the world outside of school. Unfortunately, teachers do not necessarily have the educational background or experience in different fields to provide students with this knowledge. At this point, it becomes the responsibility of people who design curriculum materials to create resources that teachers can use to help students better understand the role mathematics plays in different careers. In the end, to design this material, researchers need to provide a
better vision of what high school students think is relevant towards their futures.

On top of this, it is important that these student suggestions are integrated into the official mathematics curricula supported by the state standards, so that students are still learning the material that officials deem necessary while presenting it in a relevant context for students.

This exploratory study demonstrated that future research into the area of relevant mathematics is necessary to gain a more complete picture of what high school students perceive as relevant mathematics. The next research study could be a qualitative study that focuses solely on the student perspective. Researchers need to better understand why students rated the relevant teacher written questions the way they did in order to help improve relevant mathematics curriculum. It may also be informative to have a study which focused on the students who disliked mathematics. These students expressed discontent with the subject and felt that what they are taught in math class is not relevant to them. So a future study could determine what aspects of mathematics are relevant to them if the options provided in this study did not fit their conceptions of relevant mathematics. If mathematics can be more relevant for these students and therefore more interesting, it will probably increase their engagement and performance in math class. Moreover, it could be informative to conduct a study on relevant mathematics with younger students, such as junior high age, to see if their perception of what is relevant differs from high school students. By the time students enter high school they are focused on their futures and life after school, while junior high students may have a different outlook since they have so much
more schooling ahead of them. Although numerous insightful patterns emerge from this study, it is just the tip of the iceberg and a lot more research needs to be done in order to fully understand the student perspective of relevant mathematics.
REFERENCES


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APPENDIX A

IRB APPROVAL
To: James Middleton
Payne

From: Mark Roosa, Chair  
Soc Beh IRB

Date: 03/20/2012

Committee Action: Exemption Granted

IRB Action Date: 03/20/2012

IRB Protocol #: 1202007513

Study Title: Relevancy in Math Classrooms

The above-referenced protocol is considered exempt after review by the Institutional Review Board pursuant to Federal regulations, 45 CFR Part 46.101(b)(1).

This part of the federal regulations requires that the information be recorded by investigators in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects. It is necessary that the information obtained not be such that if disclosed outside the research, it could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.

You should retain a copy of this letter for your records.
Background Information

1) What is your name? (Your name will be kept confidential.)*
   ____________________

2) How many years have you been teaching?
   __________________

3) What math courses are you currently teaching? How long have you been teaching this course(s)?
   Math Course 1: _________________________
   Years teaching math course 1: _________________________
   Math Course 2: _________________________
   Years teaching math course 2: _________________________

4) What mathematics courses have you previously taught? (Select all that apply.)
   [ ] Math Topics 3-4 (geometry)
   [ ] Honors Math Topics 3-4 (geometry)
   [ ] Math Topics 1-2 (algebra 1)
   [ ] Honors Math Topics 1-2 (algebra 1)
   [ ] Honors 8th Grade Math (algebra 1)
   [ ] Regular 8th Grade Math (pre-algebra)
   [ ] Honors 7th Grade Math (pre-algebra)
   [ ] Regular 7th Grade Math
   [ ] Honors Math Topics 5-6 (algebra 2)
   [ ] Math Topics 5-6 (algebra 2)
   [ ] Honors Pre-Calculus
   [ ] Pre-Calculus
   [ ] Calculus AB
   [ ] Calculus BC

Math Background

5) What is the most advance mathematics course you took in college?
   __________________

6) When did you take your most advance mathematics course?
   __________________
7) What was the most recent college mathematics course you took?

____________________________________________

8) When did you take your most recent college mathematics course?

____________________________________________

9) Theoretically, how would you define mathematics?

Definition of Relevancy

10) What does the term "relevance" mean to you in the context of mathematics education?
Rate each definition, on a scale of 5 to 0, where 5 stars is the best definition for the term "relevance." Leaving a definition blank (no stars) means the definition does describe the word "relevance".

<table>
<thead>
<tr>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics in a real world context ___</td>
</tr>
<tr>
<td>Mathematics that is immediately useful to me ___</td>
</tr>
<tr>
<td>Mathematics that will help in the future (towards a career path) ___</td>
</tr>
<tr>
<td>Mathematics that is personally meaningful ___</td>
</tr>
<tr>
<td>Mathematics that makes me a better thinker ___</td>
</tr>
<tr>
<td>Other ___</td>
</tr>
</tbody>
</table>

11) If you included "other" in your ranking please describe your other definition of the word "relevancy."

Relevant Examples

Write three math problems, one for each of your top three rated definitions of relevancy. These examples should be based on types of problems that you actually use in your classroom. To save you time, if the problem is from the district approved textbook, you may just write the page and problem number. If the problem is from the Topics 1-2 share drive worksheets, please put the name of the worksheet and the problem number. After each example add the type of relevancy that applies to the problem you selected.

12) Relevant Example 1

13) Primary Type of Relevancy for Example 1

( ) Math in a real world context
( ) Math that is immediately useful to me
( ) Math that will help in the future (towards a career path)
( ) Math that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

14) Relevant Example 2

15) Primary Type of Relevancy for Example 2
( ) Math in a real world context
( ) Math that is immediately useful to me
( ) Math that will help in the future (towards a career path)
( ) Math that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

16) Relevant Example 3

17) Primary Type of Relevancy for Example 3
( ) Math in a real world context
( ) Math that is immediately useful to me
( ) Math that will help in the future (towards a career path)
( ) Math that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

Not Relevant

18) Write one example of a problem you believe is NOT relevant for students.

19) Briefly explain why you feel the example provided in the previous question is NOT relevant for students.

Thank You!

Thank you for taking our survey. Your response is very important to us. You will be contacted in the near future to complete the second part of the survey.
APPENDIX C

TEACHER SURVEY 2
Welcome, thank you for completing the first part of the survey. The second part of the survey will focus more on specific examples of relevant math that are actually used in classrooms. You will be asked to complete the following survey, which should take approximately 10 minutes. Your participation in this project is voluntary and you may stop your participation at any time.

1) What is your name? (Your answers will remain confidential.)*

Relevant Examples
For each of the following questions, rate how relevant you feel each situation is if presented to you during math class. If you rate the problem relevant or very relevant, then select which meaning of relevancy that this type of math problem is based on.

2) Write an equation in standard form to relate the number of cars and vans or trucks the students must wash to raise $800.
   ( ) Very relevant
   ( ) Relevant
   ( ) Sort of relevant
   ( ) Not relevant

What is the type of relevancy shown by the example above.
(Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

3) The Biebs is coming to Phoenix in 4 weeks and you want to go with 2 of your friends. Of course you offered to buy their tickets but each one costs $70! You already have $80 and can save $30 a week. Write a mathematical model to show how much money you will have after 4 weeks. Will you have enough for the concert of a lifetime?
   ( ) Very relevant
   ( ) Relevant
   ( ) Sort of relevant
   ( ) Not relevant

What is the type of relevancy shown by the example above.
(Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
4) You are an archer at the top of the castle, 25 feet up. To strike your target outside the castle on the ground, the arrow must travel 35 feet (linearly). At what angle (in relation to the wall of the castle) must your arrow fly to strike the target?

( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) Not relevant

What is the type of relevancy shown by the example above. (Select the best answer.)

( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

5) Your pool is 15 ft wide and 20 ft long with a 3 ft wide deck surrounding it. You want to build a fence around the deck. How much fence will be needed?

( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) Not relevant

What is the type of relevancy shown by the example above. (Select the best answer.)

( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

6) A CD-ROM stores about 650 megabytes (6.5 * 10^8 bytes) of information along a track. Each byte uses about 9 micrometers (9*10^-6 meters) of space along the track. Find the length of the track.

( ) Very relevant
( ) Relevant
What is the type of relevancy shown by the example above. (Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

More relevant examples
For each of the following questions, rate how relevant you feel each situation is if presented to you during math class. If you rate the problem relevant or very relevant, then select which meaning of relevancy that this type of math problem is based on.

7) You deposit $4000 into an account that earns 6% annual interest, compounded annually. A friend deposits $3500 into an account that earns 5.95% annual interest, compounded continuously. Will your friend's balance ever equal yours? If so, when?
( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) Not relevant

What is the type of relevancy shown by the example above. (Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other
8) Campo Verde’s Student Council needs your help. They are attempting to figure out the best price to charge for an Activity Pass. Past experience has shown that at the standard price of $40, eighty people will buy Activity Passes. We also know that for every $1 discount in price, four more people will buy Activity Passes. Create a table of values and a graph to model the relationship between the cost of the Activity Pass versus the total income earned by student council. Then, write a letter to student council recommending a price for the Activity Pass, use the graph and table of values to support your recommendation.

( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) Not relevant

What is the type of relevancy shown by the example above.
(Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

9) Solve the quadratic equation y=x^2+2x-3 by graphing.

( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) Not relevant

What is the type of relevancy shown by the example above.
(Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

10) You will make a clinometer and then measure the heights of objects around campus using the angle of elevation.

( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) Not relevant
What is the type of relevancy shown by the example above.
(Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

11) When Billy Savesalot left his home and ventured out into the world he had only $5 to his name. Yet, Billy Savesalot found a job where he could work every day and save $400 each day. The relationship between the amount of money Billy has and the time that has passed since he started saving can be expressed by the equation \( y = 400x + 5 \)
A) How many days must Billy save for until he has $4,005? Write an equation to answer this question.
B) Billy wants to buy a Prius, which costs $20,800. If Billy plans to pay the full cost up front, how many days does he need to save for until he has enough money to buy the car?
( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) Not relevant

What is the type of relevancy shown by the example above.
(Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

Last page of relevant examples
For each of the following questions, rate how relevant you feel each situation is if presented to you during math class. If you rate the problem relevant or very relevant, then select which meaning of relevancy that this type of math problem is based on.

12) The sum of eight times a number and five is 37. Find the number.
( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) Not relevant
What is the type of relevancy shown by the example above. (Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

13) I enjoy running around the track at school for exercise. Yesterday I completed 12 laps, a total distance of 4800 meters, in 25 minutes.
A) What was my average speed in meters per minute?
B) What was my average speed in laps per minute?
( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) Not relevant

What is the type of relevancy shown by the example above. (Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

14) Briley has purchased a clothing company and wants to make sure he stays profitable. His company makes $8,500 each month but he also has to pay $1500 for rent each month and buy new inventory at $500 per unit. Use your knowledge of inequalities to find how many units of new inventory Briley can purchase each month to stay out of debt.
( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) Not relevant

What is the type of relevancy shown by the example above. (Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other
15) Five fences meet at a point to form angles with measure x, 2x, 3x, 4x, and 5x around the point. Find the measure of each angle.

( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) Not relevant

What is the type of relevancy shown by the example above.
(Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

16) On a map, 1 inch represents 40 miles. The measured distance on the map is 31/8 inches. Find the actual distance (in miles).

( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) Not relevant

What is the type of relevancy shown by the example above.
(Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

17) How frequently in your current mathematics class, do you incorporate mathematical material that is designed to be relevant to students?

( ) Every class
( ) 2-3 times a week
( ) Once a week
( ) Once a month
( ) Once a quarter
( ) Once a semester
( ) Never

Thank You!
Thank you for taking our survey. Your response is very important to us.
APPENDIX D

STUDENT SURVEY
Welcome
Welcome, thank you for considering taking part in “relevancy in math classroom” study. Since you are reading this, that means your parent(s) or guardian has given permission for you to participate in this study concerning students’ and teachers’ views about relevant math.

You will be asked to complete the following survey, which should take approximately 15 minutes.

Your participation in this project is voluntary and you may stop your participation at any time. If you chose not to participate it will not affect your grade in math class in any way.

Do you choose to participate in this study?*
[ ] Yes
[ ] No

Background Information

1) What grade are you currently in?
( ) 9th
( ) 10th
( ) 11th
( ) 12th

2) What math course are you currently enrolled?
[ ] Math Topics 1-2
[ ] Math Topics 3-4

3) Who is your current mathematics teacher?
( ) Mrs. Bahm
( ) Mrs. Downer
( ) Mr. Jeanson
( ) Mr. LeBlanc
( ) Mr. Reeves
( ) Mr. Scott
( ) Mr. Wilson
( ) Ms. Redman

4) What grades did you earn in your math courses during spring and fall 2011?

<table>
<thead>
<tr>
<th></th>
<th>A+</th>
<th>A</th>
<th>A-</th>
<th>B+</th>
<th>B</th>
<th>B-</th>
<th>C+</th>
<th>C</th>
<th>C-</th>
<th>D+</th>
<th>D</th>
<th>D-</th>
<th>F</th>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5) What is your general attitude towards math?
( ) Like a lot
( ) Like
( ) Its okay
( ) No feelings one way or another
( ) Dislike
( ) Really hate

Complete the following sentence.
6) For me, mathematics is...

Relevant Math

7) What does the term "relevance" mean to you in the context of mathematics education?

Rate each definition, on a scale of 5 to 0, where 5 stars is the best definition for the term "relevance." Leaving a definition blank (no stars) means the definition does describe the word "relevance".

<table>
<thead>
<tr>
<th>Definition</th>
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<tbody>
<tr>
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<td></td>
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<tr>
<td>Mathematics that is immediately useful to me</td>
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</tr>
<tr>
<td>Mathematics that will help in the future (towards a career path)</td>
<td></td>
</tr>
<tr>
<td>Mathematics that is personally meaningful</td>
<td></td>
</tr>
<tr>
<td>Mathematics that makes me a better thinker</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

8) If you included "other" in your ranking please describe your other definition of the word "relevancy."

Relevant Examples

For each of the following questions, rate how relevant you feel each situation is if presented to you during math class. If you rate the problem relevant or very relevant, then select which meaning of relevancy that this type of math problem is based on.

9) Write an equation in standard form to relate the number of cars and vans or trucks the students must wash to raise $800.
( ) Very Relevant
( ) Relevant
( ) Sort of Relevant
( ) Not relevant
What is the type of relevancy shown by the example above.
(Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

10) The Biebs is coming to Phoenix in 4 weeks and you want to go with 2 of your friends. Of course you offered to buy their tickets but each one costs $70! You already have $80 and can save $30 a week. Write a mathematical model to show how much money you will have after 4 weeks. Will you have enough for the concert of a lifetime?
( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) not relevant

What is the type of relevancy shown by the example above.
(Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
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11) You are an archer at the top of the castle, 25 feet up. To strike your target outside the castle on the ground, the arrow must travel 35 feet (linearly). At what angle (in relation to the wall of the castle) must your arrow fly to strike the target?
( ) Very relevant
( ) Relevant
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What is the type of relevancy shown by the example above.
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( ) Other
12) Your pool is 15 ft wide and 20 ft long with a 3 ft wide deck surrounding it. You want to build a fence around the deck. How much fence will be needed?
( ) Very Relevant
( ) Relevant
( ) Sort of relevant
( ) Not relevant

What is the type of relevancy shown by the example above. (Select the best answer.)
( ) Mathematics in a real world context
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13) A CD-ROM stores about 650 megabytes (6.5 * 10^8 bytes) of information along a track. Each byte uses about 9 micrometers (9*10^-6 meters) of space along the track. Find the length of the track.
( ) Very relevant
( ) Relevant
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( ) Mathematics in a real world context
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( ) Other
More Relevant Examples
For each of the following questions, rate how relevant you feel each situation is if presented to you during math class. If you rate the problem relevant or very relevant, then select which meaning of relevancy that this type of math problem is based on.

4) You deposit $4000 into an account that earns 6% annual interest, compounded annually. A friend deposits $3500 into an account that earns 5.95% annual interest, compounded continuously. Will your friend's balance ever equal yours? If so, when?
( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) Not relevant

What is the type of relevancy shown by the example above. (Select the best answer.)
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15) Campo Verde's Student Council needs your help. They are attempting to figure out the best price to charge for an Activity Pass. Past experience has shown that at the standard price of $40, eighty people will buy Activity Passes. We also know that for every $1 discount in price, four more people will buy Activity Passes. Create a table of values and a graph to model the relationship between the cost of the Activity Pass versus the total income earned by student council. Then, write a letter to student council recommending a price for the Activity Pass, use the graph and table of values to support your recommendation.
( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) Not relevant

What is the type of relevancy shown by the example above. (Select the best answer.)
( ) Mathematics in a real world context
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16) Solve the quadratic equation $y=x^2+2x-3$ by graphing.

17) You will make a clinometer and then measure the heights of objects around campus using the angle of elevation.
18) When Billy Savesalot left his home and ventured out into the world he had only $5 to his name. Yet, Billy Savesalot found a job where he could work every day and save $400 each day. The relationship between the amount of money Billy has and the time that has passed since he started saving can be expressed by the equation $y=400x+5$

A) How many days must Billy save for until he has $4,005? Write an equation to answer this question.

B) Billy wants to buy a Prius, which costs $20,800. If Billy plans to pay the full cost up front, how many days does he need to save for until he has enough money to buy the car?

( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) Not relevant

What is the type of relevancy shown by the example above.
(Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

Last page of relevant examples
For each of the following questions, rate how relevant you feel each situation is if presented to you during math class. If you rate the problem relevant or very relevant, then select which meaning of relevancy that this type of math problem is based on.

19) The sum of eight times a number and five is 37. Find the number.

( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) Not Relevant

What is the type of relevancy shown by the example above.
(Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other
20) I enjoy running around the track at school for exercise. Yesterday I completed 12 laps, a total distance of 4800 meters, in 25 minutes.
A) What was my average speed in meters per minute?
B) What was my average speed in laps per minute?

What is the type of relevancy shown by the example above.
(Select the best answer.)

21) Briley has purchased a clothing company and wants to make sure he stays profitable. His company makes $8,500 each month but he also has to pay $1500 for rent each month and buy new inventory at $500 per unit. Use your knowledge of inequalities to find how many units of new inventory Briley can purchase each month to stay out of debt.

What is the type of relevancy shown by the example above.
(Select the best answer.)

22) Five fences meet at a point to form angles with measure x, 2x, 3x, 4x, and 5x around the point. Find the measure of each angle.

What is the type of relevancy shown by the example above.
(Select the best answer.)
What is the type of relevancy shown by the example above.  
(Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

23) On a map, 1 inch represents 40 miles. The measured distance on the map is 31/8 inches. Find the actual distance (in miles).
( ) Very relevant
( ) Relevant
( ) Sort of relevant
( ) Not relevant

What is the type of relevancy shown by the example above.  
(Select the best answer.)
( ) Mathematics in a real world context
( ) Mathematics that is immediately useful to me
( ) Mathematics that will help in the future (towards a career path)
( ) Mathematics that is personally meaningful
( ) Math that makes me a better thinker
( ) Other

Almost done

24) In your experience, what types of math activities or math problems do you feel are most relevant to you? Please provide specific examples if possible.

25) How frequently do you feel that mathematical activities and problems in your current math class are relevant?
( ) Almost every class
( ) 2-3 times a week
( ) Once a week
( ) Once a month
( ) Once a quarter
( ) Once a semester
( ) Never

Thank You!
Thank you for taking our survey. Your response is very important to us.
APPENDIX E

QUALITATIVE TEACHER DATA COLLECTED – APRIL 2012
**Theoretically, how would you define mathematics?**

<table>
<thead>
<tr>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>The use of numbers, variables, symbols, properties, etc. to find solutions</td>
</tr>
<tr>
<td>to problems. (A brief definition that probably is nowhere close to being all</td>
</tr>
<tr>
<td>encompassing.)</td>
</tr>
<tr>
<td>The logical process of finding solutions to a problem</td>
</tr>
<tr>
<td>numeric relations in different contexts between amounts, lengths, measures,</td>
</tr>
<tr>
<td>and existence of various characters</td>
</tr>
<tr>
<td>Math is the study of patterns and relationships that are explained with a</td>
</tr>
<tr>
<td>set of commonly accepted rules.</td>
</tr>
<tr>
<td>abstract science of number, quantity and space</td>
</tr>
<tr>
<td>The study of numbers, properties, and relationships for the purpose of</td>
</tr>
<tr>
<td>problem solving.</td>
</tr>
<tr>
<td>Study of formulas and principles that apply to everyday situations to use</td>
</tr>
<tr>
<td>as predictors or as explanations for why things happen or should happen.</td>
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</table>
APPENDIX F

QUALITATIVE STUDENT DATA COLLECTED – MAY 2012
For me, mathematics is...

<table>
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<tr>
<th>What is your general attitude towards math?</th>
<th>Comment</th>
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<tbody>
<tr>
<td>Like a lot</td>
<td>fun</td>
</tr>
<tr>
<td></td>
<td>a very easy and fun class</td>
</tr>
<tr>
<td></td>
<td>for me, mathematics is my favorite subject.</td>
</tr>
<tr>
<td></td>
<td>Super fun, I really enjoy it.</td>
</tr>
<tr>
<td></td>
<td>easy because my teacher is good at explaining what we are learning.</td>
</tr>
<tr>
<td></td>
<td>the best subject ever.</td>
</tr>
<tr>
<td></td>
<td>a chance to show off my intellectual buffness</td>
</tr>
<tr>
<td></td>
<td>fun. I like my teacher and my class a lot.</td>
</tr>
<tr>
<td></td>
<td>A Fun, interesting and challenging subject that I love.</td>
</tr>
<tr>
<td></td>
<td>Important.</td>
</tr>
<tr>
<td></td>
<td>something I love. I love the challenge of math, having to work through a problem and solve it. I just don't like tests. I have to rush through them because I take too long and then don't reach my full potential.</td>
</tr>
<tr>
<td>Like</td>
<td>a little fun</td>
</tr>
<tr>
<td></td>
<td>Is a fun class but sometimes confusing</td>
</tr>
<tr>
<td></td>
<td>something I know that I understand</td>
</tr>
<tr>
<td></td>
<td>The abstract science of number, quantity, and space.</td>
</tr>
<tr>
<td></td>
<td>easy.</td>
</tr>
<tr>
<td></td>
<td>hard</td>
</tr>
<tr>
<td></td>
<td>Fun and easy when I have a good teacher that I like</td>
</tr>
<tr>
<td></td>
<td>A great tool if you know what you're doing.</td>
</tr>
<tr>
<td></td>
<td>Important in understanding how to input certain variables.</td>
</tr>
<tr>
<td></td>
<td>easy class as long as we don't have homework up to our ears.</td>
</tr>
<tr>
<td></td>
<td>Really easy and it comes naturally</td>
</tr>
<tr>
<td></td>
<td>Sometimes difficult but easy at times... depends on my teacher</td>
</tr>
<tr>
<td></td>
<td>Not too hard and fun</td>
</tr>
<tr>
<td></td>
<td>necessary for future jobs and life.</td>
</tr>
<tr>
<td></td>
<td>Really important, because my grandmother is a college professor. So math has been apart of me since I was really little.</td>
</tr>
<tr>
<td></td>
<td>an important life skill.</td>
</tr>
<tr>
<td></td>
<td>Very important to me. Its important in life. Its important to the things and people around me</td>
</tr>
<tr>
<td></td>
<td>Hard</td>
</tr>
<tr>
<td></td>
<td>Adding, subtracting, multiplying, dividing, fractions, decimals, graphing, quads, factoring, and algebra.</td>
</tr>
<tr>
<td>Its okay</td>
<td>Difficult, however necessary.</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>A normal everyday thing that I need to find a good job in my future.</td>
<td></td>
</tr>
<tr>
<td>Sometimes a struggle.</td>
<td></td>
</tr>
<tr>
<td>not all that important</td>
<td></td>
</tr>
<tr>
<td>Both confusing and fun. Sometimes I don't get things but other times it's fun</td>
<td></td>
</tr>
<tr>
<td>It's always been hard for me, when i was younger it was simple but as things got harder, i wasn't able to grasp how to do it.</td>
<td></td>
</tr>
<tr>
<td>A challenge</td>
<td></td>
</tr>
<tr>
<td>Easy at times... when taught right</td>
<td></td>
</tr>
<tr>
<td>confusing</td>
<td></td>
</tr>
<tr>
<td>For me, mathematics is my favorite subject in school. This is my favorite subject because even though it can be hard and annoying one day, there are also days that math becomes very fun and interesting.</td>
<td></td>
</tr>
<tr>
<td>hard to remember the formulas</td>
<td></td>
</tr>
<tr>
<td>Confusing and hard</td>
<td></td>
</tr>
<tr>
<td>a place were we can learn something that we will use in our everday lives</td>
<td></td>
</tr>
<tr>
<td>okay</td>
<td></td>
</tr>
<tr>
<td>kind of confusing</td>
<td></td>
</tr>
<tr>
<td>hard at times but also very explanitory</td>
<td></td>
</tr>
<tr>
<td>Challenging if I don't have good instruction.</td>
<td></td>
</tr>
<tr>
<td>Time consuming.</td>
<td></td>
</tr>
<tr>
<td>challenging</td>
<td></td>
</tr>
<tr>
<td>ok if it I can see myself using it in real life but most of it is really confusing</td>
<td></td>
</tr>
<tr>
<td>boring</td>
<td></td>
</tr>
<tr>
<td>Very fun when everyone around me is participating and there is a competitive environment.</td>
<td></td>
</tr>
<tr>
<td>Learning how to solve problems with numbers.</td>
<td></td>
</tr>
<tr>
<td>kinda dull and confusing because the teachers dont directly awnser the question you ask</td>
<td></td>
</tr>
<tr>
<td>something that I'm good at, but don't neccessaraly enjoy.</td>
<td></td>
</tr>
<tr>
<td>important but not very much fun.</td>
<td></td>
</tr>
<tr>
<td>Sometimes difficult</td>
<td></td>
</tr>
<tr>
<td>No feelings one way or another</td>
<td></td>
</tr>
<tr>
<td>not going to lead into all carrers</td>
<td></td>
</tr>
<tr>
<td>sometimes pointless as this will not help us in our life.</td>
<td></td>
</tr>
<tr>
<td>hard at times, but some concepts are easy</td>
<td></td>
</tr>
<tr>
<td>Hard to comprehend and when will we really use this stuff in out life</td>
<td></td>
</tr>
<tr>
<td>No feelings one way or another</td>
<td>Easy and hard</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td></td>
<td>Very boring and takes strategic thinking</td>
</tr>
<tr>
<td></td>
<td>I do not really like it, but I think I will use it one day</td>
</tr>
<tr>
<td></td>
<td>Math has always been one of my harder subjects</td>
</tr>
<tr>
<td>Dislike</td>
<td>Not my best subject.</td>
</tr>
<tr>
<td></td>
<td>Not my favorite because I don't try hard in it.</td>
</tr>
<tr>
<td></td>
<td>Confusing</td>
</tr>
<tr>
<td></td>
<td>Boring</td>
</tr>
<tr>
<td></td>
<td>Hard when not explained well</td>
</tr>
<tr>
<td></td>
<td>It is hard I haven't found which way I learn in this subject, there are so many ways and steps I have to do things I can't comprehend.</td>
</tr>
<tr>
<td></td>
<td>Not the easiest subject</td>
</tr>
<tr>
<td></td>
<td>Confusing and too many tests each week or every other week.</td>
</tr>
<tr>
<td></td>
<td>Is one of my more difficult subjects to catch onto</td>
</tr>
<tr>
<td></td>
<td>Confusing.</td>
</tr>
<tr>
<td></td>
<td>Not used in life that much.</td>
</tr>
<tr>
<td></td>
<td>Not favorite subject</td>
</tr>
<tr>
<td></td>
<td>Stupid, pointless, and a huge waste of time!</td>
</tr>
<tr>
<td></td>
<td>Ridiculously hard: My mom actually had me tested for being mathematically challenged but I'm not.</td>
</tr>
<tr>
<td></td>
<td>Extremely boring.</td>
</tr>
<tr>
<td></td>
<td>Learning things I will not use in life, waste of time</td>
</tr>
<tr>
<td></td>
<td>Very important but not my best subject.</td>
</tr>
<tr>
<td></td>
<td>Hard.</td>
</tr>
<tr>
<td></td>
<td>Dumb, pointless, and a waste of time cause we will never need half the stuff we do.</td>
</tr>
<tr>
<td></td>
<td>Hard to grasp, moving too quickly</td>
</tr>
<tr>
<td></td>
<td>Boring.</td>
</tr>
<tr>
<td></td>
<td>Something that I do enjoy doing. But when your teacher sucks at teaching it, it gets frustrating and upsetting. I honestly use to be really good at math, but this year with my teacher, not so much.</td>
</tr>
<tr>
<td>Really hate</td>
<td>Mostly pointless stuff I'm never going to use, I think math should stop being taught at around 5th grade.</td>
</tr>
<tr>
<td></td>
<td>Boring.</td>
</tr>
<tr>
<td></td>
<td>Confusing</td>
</tr>
<tr>
<td></td>
<td>Very hard, and confusing, and it is not teaching me things I am going to need in the future.</td>
</tr>
<tr>
<td></td>
<td>For me, math is really hard at understanding! I have a hard time getting the problems through my mind, I always need lots of help! I need a class that takes math slowly for me step by step and not a math class that rushes all through the lesson!</td>
</tr>
</tbody>
</table>
Really hate

- very ahrd for me to understand and not forgett it later on in the day since its fourth and not 7 hour thta its one of the less memorable subjects
- A repetitive, seemingly endless, and painful subject that does not interest me, nor does it pertain to my future plans (career).
- A complete waste of time.
- Boring. I don't get the point of it and how we will use it in the future.
- Boring. I know I will need addition, multiplication, division, and subtraction in the workplace, but I don't foresee going into a job that requires y = x^2+18x+131. It's not a total waste of time, just something I am not interested in.
- Difficult, frustrating, my grades are an embarrassment to my parents.
- Very confusing there are many many steps for one problem really hard, and hard to focus on.

If you included "other" in your ranking please describe your other definition of the word "relevancy."

- It makes me see a different perspective in life
- It's involved in alot of other classes
- life skill
- Impotents
- more interesting
- Some of the stuff we learn in math we will never use
- the questions are more interesting then other things; they attract my attention
- I think that some math that I learn in highschool can be and is probably going to be very useful to me but most of it I will never use and I think math teachers make it ridiculous because if I really needed the answer instead of remembering an equation, I could just google it or use a nifty thing called a calculator.
- None, math is not any of these to me.

In your experience, what types of math activities or math problems do you feel are most relevant to you? Please provide specific examples if possible.

<table>
<thead>
<tr>
<th>What is your</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

108
<table>
<thead>
<tr>
<th>general attitude towards math?</th>
<th>factorizing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Like a lot</td>
<td>ones that make you think, but you also have to have common sense to solve</td>
</tr>
<tr>
<td></td>
<td>Hands on is more useful in helping a better understanding of the work.</td>
</tr>
<tr>
<td></td>
<td>Math problems that relate to real world things are most relevant because they are useful.</td>
</tr>
<tr>
<td></td>
<td>Area of fencing needed for a pool or backyard</td>
</tr>
<tr>
<td></td>
<td>Finding the weight and volume of food to find best price</td>
</tr>
<tr>
<td></td>
<td>Math activities and problems that I can apply to the real world are the types of activities and problems that are the most relevant to me.</td>
</tr>
<tr>
<td></td>
<td>The problems that have long processes and the answers make sense. (Like trig.)</td>
</tr>
<tr>
<td></td>
<td>Really any math because I plan on being a chemist, so I believe future maths will help me more than Math topics 1-2.</td>
</tr>
<tr>
<td></td>
<td>Instead, I'll just which ones I don't. Series and sequences, polar coordinates, vectors (unless it's velocity and forces).</td>
</tr>
<tr>
<td>Like</td>
<td>I feel that the ones that are relevant are the ones I will actually use or do in real life.</td>
</tr>
<tr>
<td></td>
<td>im not sure</td>
</tr>
<tr>
<td></td>
<td>Solving algerbraicly</td>
</tr>
<tr>
<td></td>
<td>Finding the area of stuff. Learning how to use a calculator to solve, because in real life I will always have a calculator to help.</td>
</tr>
<tr>
<td></td>
<td>Word problems that solve daily life situations.</td>
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<tr>
<td></td>
<td>Mostly geometry that include radius and diameter and such for personal needs like fixing things.</td>
</tr>
<tr>
<td></td>
<td>Square Root problems and Quadratic formula</td>
</tr>
<tr>
<td></td>
<td>Adding subtracting Multiplying dividing Ratios inequalities story problems</td>
</tr>
<tr>
<td></td>
<td>The equations that make you think hard like the problems related to sport and figuring out how many laps to go etc.</td>
</tr>
<tr>
<td></td>
<td>Slope</td>
</tr>
<tr>
<td>Like</td>
<td>I believe that almost all the activities are either making us better thinking, heightening our ability to look at things from a logical perspective, which can go a long way in life. The problems that are most immediately useful to me are actually almost all of the content, minus some things, because of my involvement in programming, which is very math demanding.</td>
</tr>
<tr>
<td></td>
<td>Simple multiplication, division, subtraction and addition.</td>
</tr>
<tr>
<td>Like</td>
<td>Ones that relate to our lives right now. Like ones about saving money or spending it. Multiplication/division/addition/subtraction because you use it even when you don't notice your using it.</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Its okay</td>
<td>Activities where the teacher can say what the skill would help with later in life. Realistic problems also help too. the slope intercept form</td>
</tr>
<tr>
<td>I feel like the most relevant problem that we talk about in math are word problem because when you grow up it is not very often that you are faced with a problem that is one dimensional, with the equation already set up for you.</td>
<td></td>
</tr>
<tr>
<td>Something that I can use, like having to do with money. Ones that involve graphing, plotting, and in general diagraming of money. I learn in a visual way best and therefore like to express on a visual way and money is always relevant due to the fact that very soon I will have a job</td>
<td></td>
</tr>
<tr>
<td>Adding,subtracting,dividing,and multiplying because there the most common forms of math.</td>
<td></td>
</tr>
<tr>
<td>All math problems are relevant to me. Some are more relevant than others.</td>
<td></td>
</tr>
<tr>
<td>ones that will help ME for the future</td>
<td></td>
</tr>
<tr>
<td>Adding positive numbers so i can keep track of goals in soccer</td>
<td></td>
</tr>
<tr>
<td>Group projects and life applacations are relevant because they can appeal to a large unspecified carear classes, but the social aspect motivates students to work as a team, where everyone has a mission to accomplish.</td>
<td></td>
</tr>
<tr>
<td>I believe that solving problems using the quadratic formula helps me understand solving problems in both the class room and real life.</td>
<td></td>
</tr>
<tr>
<td>Quadratic formula</td>
<td></td>
</tr>
<tr>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>I think math problems are the most relevant because you use those in everday life</td>
<td></td>
</tr>
<tr>
<td>Really any math problems or lessons that i know will be helpful to me or better me some how in the future</td>
<td></td>
</tr>
<tr>
<td>Measuring things, counting, adding, multiplying, subtracting, and dividing</td>
<td></td>
</tr>
<tr>
<td>Measuring me cause I'm going to become a nurse</td>
<td></td>
</tr>
<tr>
<td>Hands on activities</td>
<td></td>
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<tr>
<td>Add subtract</td>
<td></td>
</tr>
<tr>
<td>No feelings one way or another</td>
<td></td>
</tr>
<tr>
<td>factoring</td>
<td></td>
</tr>
<tr>
<td>Word problems with real life situations</td>
<td></td>
</tr>
<tr>
<td>problems that I know will be important for me to know how to solve in the future</td>
<td></td>
</tr>
</tbody>
</table>
### No feelings one way or another

- Addition subtraction division multiplication fractions and percents

  **Why do you need some things that is taught**
  
  Well problems that are most relevant to me are probably interest rate math problems and solving things like learning about money

  i am involved in Student Council where we do projects that involved number of students compared to a budget so doing the project with the t shirts was very useful because during that time we were talking about making class colored t shirts for spirit and the shirts helped the calculations to be correct

### Dislike

- I think that the quadratic formula because it makes the most sense to me. yeah.

  Group activities they are entertaining, and help me understand. Especially visual activities.

  The sum of eight times a number and five is 37. Find the number. and On a map, 1 inch represents 40 miles. The measured distance on the map is 31/8 inches. Find the actual distance (in miles). are the most relevant

  i dont know

  adding subtracting multiplying not very good with variables and more than 3 or 4 steps of work confuses me

  when we are in groups or play math games

  Ones that deal with money or interest. Problems with division and angles (For Game Design).

  Money problems. No example known.

  the square roots make sense because its simple and it makes sense and it nice and clear.

  The simple stuff, like adding, subtracting, multiplying, division and a few other simple things.

  I feel that math that applies to taxes, insurance, and day to day stuff but not silly stuff about the gym and how much it is to get in or how many calories they burn and how many sit ups they have to do but actual necessary things.

  Adding, Subtracting, Multiplication, Division, Average speed.

  basic math, mult, dividing, adding and subtracting

  Algebra expressions or equations

  Word problems are the best ways for me to solve.

  None really. I just do what I am suppose to do. I mean yeah, some of them can help me in life. But not all of it. I think the math that can help in life most is just fractions, decimals, and percentages

### Really hate

- Anything pertaining to real-world use; The purpose of school in general is to adequately prepare us for college and in some cases, to enter the work force immediately.
<table>
<thead>
<tr>
<th>Really hate</th>
<th>Adding, Subtracting, Multiplying, and Dividing.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ones that involve graphing or other spatial problems. Also, problems such as the T-shirt activity we did a few weeks ago, are important because they are relevant to a future career.</td>
<td></td>
</tr>
<tr>
<td>Math problems that I can see myself actually doing in the future.</td>
<td></td>
</tr>
<tr>
<td>$2(2x+3x-5)$</td>
<td></td>
</tr>
<tr>
<td>the math problems that are related to the real world and when we can use it in the future.</td>
<td></td>
</tr>
<tr>
<td>Ones where they're talking about banking and how much I need to save for a car and concert tickets</td>
<td></td>
</tr>
<tr>
<td>Measuring with rulers, tape measures, feet, inches... Balancing a checkbook, bank statements, Reading a map feet, distance, meters... Learning how to compare sales in grocery stores, MULTIPLY AND DIVIDE !!!!!</td>
<td></td>
</tr>
<tr>
<td>I think the ones that use today's things that our generation would find fun for example food, iPhone things in today's society like CVHS</td>
<td></td>
</tr>
<tr>
<td>like handling money know what to add and subtract and know the numbers</td>
<td></td>
</tr>
</tbody>
</table>