

**An Investigation of the Factors that Motivate Students in Algebra II Math Class at a
Selected High School in Tennessee.**

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Abstract

The purpose of this study was to investigate the factors involved in motivating high school students in Algebra II math courses. The study, conducted at a selected high school in East Tennessee, consisted of 21 students enrolled in an Algebra II course at that high school. The students were given a 49-item survey about school life, prior experience with math, teacher and classroom characteristics, and motivation for academics in general. In addition, 4 students were interviewed with questions based on the same categories as the survey. The data collected were analyzed and the dominant themes were identified. The themes consisted of a) a student's sense of school belonging, at this school, had negligible or minor impact on their motivation in Algebra II. b) A student's previous experience(s) in math had a significant influence on the student's current motivation in Algebra II. c) Student motivation in Algebra II mathematics can be affected significantly by teacher characteristics, classroom environment and the presence or absence of student autonomy in the classroom. d) Motivation students have outside the mathematics classroom has little to no impact on the motivation inside the Algebra II classroom. The results suggest that Algebra II math teachers should make efforts to address the students' prior experiences with mathematics and/or their current classroom environment in their Algebra II course. Therefore, Algebra II math teachers should make efforts to address these factors in order to increase the motivation of their Algebra II students.

Keywords: motivation, math, Algebra II, survey, qualitative study.

Chapter 1

Introduction

Mathematics is a polarizing subject, there are those who love it and make the study of it their goal and purpose in life. There are also those who find it tedious, annoying, difficult, useless, and something they have no wish to study. Both of these people are readily seen in an average mathematics classroom, especially a high school one. However, mathematics itself remains one of the most useful tools we have, despite its difficulty and annoyingness to use; it is the gateway to both higher levels of academics in most every field and higher levels of professional excellence in most jobs (Jiang et al., 2020; Patall et al., 2018). Moreover, it is success and attainment in high school level math that opens the doors to those higher levels, and that success and attainment is, in large part, determined by their motivation in the mathematics classroom (Jiang et al., 2020; Patall et al., 2018).

So, what is motivation? Princeton University defines motivation as the psychological feature that arouses an organism to action toward a desired goal; the reason for the action; that which gives purpose and direction to behavior. Jiang et al. (2020) and Kim et al. (2015) separates motivation in math classrooms into two subgroups, the belief about your own abilities to complete the task, and the intrinsic value of the task itself. In other words, you are motivated in the math classroom to complete the work if you think you can do the work, or if you think the work is worth doing. Moreover Xie et al. (2021) says that motivation is malleable and can change over time, what they mean here is that the source the motivation springs from can change over time as well as the potency of the motivation received from that source. In other words, a student may look back at a past math test where they scored a 100% as a source of motivation in their ability to complete mathematical tasks, but, over time, as the math classes progress in

difficulty, that past score of 100% may not motivate the student as much as it did in the past. A newer high score in a more recent math class, that more closely aligns with the current difficulty the student is facing in math class with inspire a change in motivation from that old score to the newer one. As well, motivation can change for the worse (Gillen-O'Neel & Fuligni, 2013; Jiang et al., 2020; Kim et al., 2015; Patall et al., 2018; Xie et al., 2021). For example, if a student's motivation is encouraged by his perception of the intrinsic value of the task, and that perception changes over time, so too will his motivation (Xie et al., 2021). If the student no longer believes that the current level of math he is studying is worth learning, or will be useful to him later in life, his motivation drops accordingly (Gillen-O'Neel & Fuligni, 2013; Jiang et al., 2020; Xie et al., 2021). As well, the benefits of education are not always readily apparent to the students, and there is not always a direct correlation between content taught by the teacher and the knowledge gained by the students. Often, what the teachers try to impart is how to continually think, learn and grow in mathematics, but it is difficult to demonstrate immediate benefits of this work. As such, the result is a lack of motivation for the mathematical studies.

Motivation, however, is important, both for higher levels of mathematical accomplishments and professional advancement (Jiang et al., 2020; Patall et al., 2018), as well, we can see that motivation can change over time, adapting to become stronger or fading away (Gillen-O'Neel & Fuligni, 2013; Jiang et al., 2020; Kim et al., 2015; Patall et al., 2018; Xie et al., 2021). However, what factors effect motivation? What factors increase it; what factors decrease it? Limiting our study to only Algebra II classrooms, what factors increase motivation for Algebra II? Why do some students do the homework diligently and come to tutoring when they can? Is it motivation? Can it be replicated by inducing differing factors? Why and how does

a student's motivation to succeed in Algebra II come about? These are the questions that started this research into the factors that motivate students in a selected high school in Tennessee.

To guide this study into the factors that affect motivation in Algebra II, research on similar studies was done to see what factors had been identified as to be prominent in the motivation of students for high school mathematical and science related fields. Synthesized from the research, there are three major factors that contribute to the motivation of high school students in math and some related sciences, specifically, (1) the sense of school belongingness, (2) prior academic achievement, and (3) student autonomy in the classroom, these are the factors that are most present and most visible according to our current knowledge (Gillen-O'Neel & Fuligni, 2013; Kim et al., 2015; Patall et al., 2018; Xie et al., 2021).

School belongingness

School belongingness is how well a student fits in with their school, how well they associate themselves with the school, how well they see themselves as a part of that school, in essence it can also be how well they like that school and their position in it (Gillen-O'Neel & Fuligni, 2013; Xie et al., 2021). As a student's school belongingness increases, there is a corresponding increase in academic motivation and drive to succeed (Gillen-O'Neel & Fuligni, 2013; Xie et al., 2021), this increase is not just limited to mathematical motivation, but it is an increase across all subjects in that school, however it also effects the student's mathematical motivation as well. Conversely, when a student has a low sense of school belonging, that is to say, the student does not feel like a part of the school, then academic motivation falls, and mathematical motivation with it. This is especially visible in a virtual learning environment where the sense of school belonging is practically nonexistent, the students' motivation to achieve and succeed in mathematics fell correspondingly with the absence of school

belongingness (Kim et al., 2015). Another reason behind the link to motivation and school belongingness is theorized to be the peer support that accompanies the sense of school belongingness (Xie et al., 2021). As a student's sense of school belongingness increases, so too does their interaction and relationship with their peers who also have a sense of school belongingness, this gives rise to a sense of camaraderie and increases both the likelihood that a student will be motivated to ask for help from his peers or teachers, and that said peers or teachers will be motivated to reply in the positive. As such, a positive sense of school belongingness is especially important to maintaining positive motivation in mathematical academics.

Prior Academic Achievement

The next vital factor of motivation for high school students in math is prior academic achievement. That is to say, any prior achievement in math, or a positive association with past mathematical academic achievements. In essence, have they ever been good at math, or even thought they were good at math, even if it was just a few times it is enough to motivate attempts to reclaim the same degree as the prior achievement provided (Kim et al., 2015; Xie et al., 2021). The prior academic achievement needs not be consecutive, if the student scored well in eighth grade math, and average in 9th and 10th grade, they are still possessing an increase in mathematical motivation (Xie et al., 2021). This is especially visible in a virtual learning environment, as a sense of school belongingness fades due to the virtual environment and internet anonymity, the effects of prior academic achievement on mathematical motivation rise correspondingly (Kim et al., 2015). Even when you separate motivation into two subgroups, that of belief about your own abilities to complete the task, and that of the intrinsic value of the task in relation to your own interest, then in a virtual environment, a student's belief that the task is

worth doing, that intrinsic value, corresponds to the student's prior academic achievement, even if their current academic achievement is subpar (Kim et al., 2015). The belief that they can complete it, on the other hand, relies on the current academic achievement, that is to say, whether they have been able to complete similar work in the recent past. In other words, the presence of prior academic achievement bolsters motivation in mathematics even if the present grades and their situations are less than optimal. It is interesting to note that with a high enough sense of school belongingness mathematical motivation remains high even in the absence of any significant prior academic achievement (Gillen-O'Neel & Fuligni, 2013; Xie et al., 2021).

Student Autonomy in the Classroom

The third factor we will look at is student autonomy in the classroom, or how much choice and impact the student has in the structure, pace, and decision making of the classroom, from topics covered to activities to homework. When students felt like the teachers supported autonomy, with the offering of interesting activities, providing opportunity for the asking of questions, telling them the why behind the activities and why they were important, and considering their preferences in course activities, the students felt more motivated to complete the course work. Conversely, when the students felt like the teachers thwarted their autonomy by offering uninteresting activities, lecturing with no chance to ask questions, or not explaining the rationale behind the work, the students' motivation declined noticeably (Patall et al., 2018). The essence of this final factor we will look over is whether or not the students feel as if they have any say in the matter. If the teacher is going to lecture, assign activities and present problems regardless of whether the student is motivated, or even paying attention, the student, in their mind, has no reason to be mentally present. However, if the teacher offers the students choice, and presents the education as a cooperation between students and teacher, giving them choice in

which activities to choose (from a list) which topics to research, or even which set of problems to select as homework, then the student is more motivated and interested in the course and its activities due to them having a hand in how it affects themselves (Patall et al., 2018). Similarly, Gillen-O'Neel & Fuligni (2013) identifies student autonomy and choice as a factor to increase the sense of student belongingness in a school, which in turn increases motivation. As well, Xie et al. (2021) tells us that higher levels of student autonomy can give rise to higher levels of autonomous motivation, what they describe as a more intrinsic type of motivation.

High school math classes are the gateway to higher level opportunities in college and the professional field, as well, success in high school math classes is significantly a consequence of the student's motivation in those classes (Jiang et al., 2013; Patall et al., 2018). The three main factors research has found to impact the motivation of high school students in mathematical and science type fields are, in order of impact, a sense of school belongingness, prior academic achievement in that field, and student autonomy in the classroom. That is to say, whether or not the student feels like a part of the school, and to a lesser extent, part of the classroom (Gillen-O'Neel & Fuligni, 2013; Xie et al., 2021). Whether or not the student has achieved success in the mathematical fields in the past, it does not even have to be recent success, the student just needs to have the notion themselves that they can be great at math, with proof positive from their own past (Kim et al., 2015; Xie et al., 2021). Finally, whether or not they have any autonomy in their classroom, that is to say, whether or not their choices and decisions matter in the short term, with an increase in autonomy coinciding with an increase in motivation from the students (Gillen-O'Neel & Fuligni, 2013; Patall et al., 2018; Xie et al., 2021).

Statement of the Problem

The study of mathematics is a linear study, each lesson builds on the one before it as we reach higher and higher into the more detailed and more complicated levels of mathematics. Motivation is key here, as Jiang et al. (2020) says “One key determinant of students’ math and science achievement, course taking, and choices is students’ math and science motivational beliefs” (p 2137). If the student is unmotivated for even one day, leading to a lack of attention and decrease in comprehension (Gillen-O’Neel & Fuligni, 2013; Jiang et al., 2020; Kim et al., 2015; Patall et al., 2018; Xie et al., 2021), then they will have to work twice as hard the next day to both recoup what they missed and learn the next day’s lesson. However, motivation for mathematical study is declining as the students advance through secondary education (Patall et al., 2018; Xie et al., 2021). As the mathematics get harder and harder to understand, their scores fall if they don’t put more effort into them. As the studies get more and more esoteric and depart from subjects easily imagined for the use in their daily lives, students have trouble thinking of what their learning as useful for them, leading to a decrease in motivation and achievement in the higher levels of secondary education for mathematics and sciences (Patall et al., 2018; Xie et al., 2021). On the other hand, teachers of math know firsthand how useful math is, and how important high school math achievement and knowledge is to unlock higher levels of attainment in education and professional endeavors (Jiang et al., 2020; Patall et al., 2018). The math teachers know that if their students don’t have high enough levels of understanding and attainment in their subject then certain doors are closed to them in higher education and professional attainment. Yet the students do not understand this, especially for math subjects such as Algebra II, where it is harder for the students to score well with the same effort as previously and harder for them to see any intrinsic value in the subject for their daily lives (Jiang et al., 2020). As such, there is conflict in the desires and views of the math teachers who want to

teach what they view as an important and useful subject to their students, and the students who view higher levels of secondary math (Algebra II for example) as needlessly difficult and not at all useful to them. Given how important motivation is to math, and how important math is to higher levels of education and professions, the problem of this study is an investigation into the details of the factors that motivate high school students taking an Algebra II course. As well, how these factors were inspired and how they can be maintained so the motivation that follows can be maintained as long as needed.

Purpose of the Study

The purpose of this study is to identify the factors involved in motivating high school Algebra II students in their mathematical studies, and details into how and why these factors come about.

Significance of the Study

Student motivation is a problem for every teacher of every subject in every classroom. Each and every teacher faces the problem of getting the students motivated to do the work, or even review for the upcoming test or quiz. This is especially true in mathematics, and even more true for the higher levels of secondary mathematics. Motivation for mathematical study is declining as the students advance through secondary education (Patall et al., 2018; Xie et al., 2021). Motivation for math declines where it is most needed, for mathematics is a linear study, each lesson builds on the one before, missing one lesson, or not paying attention due to a lack of motivation, causes the student to fall behind. The student then has to work twice as hard to learn the topic that the teacher has already covered, as well as the topic the teacher is on now. If they do not, they fall further and further behind. As well, even if the student does not aspire to a STEM focused career, the study of math teaches the important ability of logical thinking and

problem solving, which is applicable in every field. Additionally, even if the student does not intend to go into STEM, having the option available to them is always a good thing. Finally, there is even more need to motivate students in math due to standardized tests and their results being so highly valued. Aside from end-of-curriculum testing, the ACT alone is quite important to high school students, as a good score opens all kinds of doors for college and scholarships. The students need to be motivated to learn the material as it is taught, and motivated to review the material when it is time for the test. As well, the student needs to be motivated to pay attention when the teacher covers large amounts of material in a short period of time for review. Knowing the factors responsible for effecting motivation in these high school students will allow teachers to attempt to induce them on purpose, or at least avoid those factors known to decrease motivation.

Limitations

The limitations of this study are that the surveys and interviews used to gather the data for this study were from just Algebra II students at a selected high school, as such the results are not necessarily valid for the entire population of high school math students. As well, the surveys and questionnaires used for this study were not validated.

Definitions of the terms

The following definitions were adopted for this study:

Motivation-the force that produces student interest and involvement in learning.

Prior Academic Achievement-the phrase used in this study to refer to a student's previous success or failure in prior mathematics classes.

School Belongingness-the phrase used in this study to refer to how well a student believes they belong in that school, or feels themselves to be a part of that school.

Student Autonomy in the Classroom-the phrase used in this study to refer to how much the choices made by the student in the classroom have an impact on the structure, pace and decision making of the classroom.

Conceptual Framework

From the research into factors that motivate students in high school math classes. Mathematical motivation is shown to arise with the following, (1) a sense of school belonging (Gillen-O'Neel & Fuligni, 2013; Xie et al., 2021), (2) prior academic achievement (Kim et al., 2015; Xie et al., 2021), and student autonomy in the classroom (Gillen-O'Neel & Fuligni, 2013; Patall et al., 2018; Xie et al., 2021). Increases in these 3 factors coincide with increases in motivation, and decreases in these factors coincide with decreases in motivation for math (Gillen-O'Neel & Fuligni, 2013; Kim et al., 2015; Patall et al., 2018; Xie et al., 2021). This study will have its survey and interview questions based on these factors in part, both to confirm past research and to ground this research on prior work.

Overview of the Study

This study consists of five chapters. Chapter One contains the introduction, statement of the problem, purpose of the study, significance of the study, limitations, definition of terms, conceptual framework, and overview of the study. Chapter Two is comprised of the related literature review. Chapter Three is the methodology and procedures, which consists of the population, sample, data collection instruments, procedures, and research questions and related hypothesis. Chapter Four contains the data analysis, with the collection of data, research questions and related hypothesis, and the research question analysis. Chapter Five consists of the summary of the findings, conclusions, and the recommendations and implications of the study.

Chapter 2

Review of the Literature

Introduction

Motivation is an aspect of any mathematics study, and can be the deciding factor for the students' success. It can affect behavior and achievement in all subjects, but in a such a linear subject as mathematics, it can truly demonstrate its effect. Increases in motivation show, and correspond, to increases in both academic achievement in mathematics as well as tending students toward a more positive attitude towards the study of mathematics (Kariuki & Wilson, 2002). This student motivation can be influenced by several factors: (1) a sense of school belongingness, (2) prior academic achievement and (3) student autonomy in the classroom. The following is the review of the literature on these factors and topics.

Motivation

Mathematics itself and related disciplines or sciences are important for many professions and are often the key to higher level professions. Success in high school level mathematics is a gateway to higher levels in college and related STEM fields (Jiang et al., 2020), so motivation to do the work and persevere in the mathematics is especially important. In addition, while ability for mathematics is important, it is not the defining quality for growth in mathematics, that quality is motivation (Schiefele & Csikszentmihalyi, 1995; Stipek et al., 1998). So, what is motivation? Escalante (1990) refers to it with the term 'ganas,' a Spanish term that can be translated to loosely mean desire, or a wish to succeed. Kariuki and Wilson (2002) use the definition that motivation is a force that drives students to learn, an internal state, or a condition that activates behavior and gives it direction. Middleton and Spanias (1999) describe it as what reasons individuals have for behaving in a given manner, for a given situation. Hannula (2006) makes the

additional distinction that motivation is the inclination to do certain things and avoid doing some other things. Whatever the exact definition, motivation remains an important influence in the mathematics classroom. Escalante (1990) searches out students with strong ‘ganas’ for his AP calculus course, because he says that motivation alone is the key. He believes any student can learn math, if motivated. Kariuki and Wilson (2002) note there were significant differences in both academic achievement and student attitude in the favor of motivated students as compared to less motivated students. Motivation is a reason behind why different children in the same class, taught by the same teacher, can have significant differences in both attitude and academics.

Motivation itself is an invisible force, but its effects are present and measurable in several different ways. Most readily, in terms of goals. As Hannula (2006) defined motivation as both the inclination to do and the inclination to avoid, what goals a student has can reveal their motivation. The actions a student takes, what are they achieving or what are they avoiding by these actions? This goal, either to reach something, or to avoid something, is what Martin et al. (2014) describes as ‘mastery orientation’ and ‘self-handicapping’. Either adjusting the skills you have (or mastered) and orienting them to a goal, or handicapping yourself to try and avoid something. Middleton and Spanias (1999) put it well when they provide that:

When one looks at the subtle ways in which motivations are formed, modified, and sustained, it becomes clear that there is no such thing as an unmotivated child. Children are motivated. Motivations help guide children’s activity; they provide a structure for evaluating the outcomes of activity; and they help determine whether or not children will engage in future mathematical activity. (p. 67)

As Martin et al. (2014) points out, the inclination to avoid some things can lead to what they call ‘self-handicapping’, student behavior that can act out or withdraw in order to lead to their goal of

avoiding doing math. These behaviors are readily apparent in any classroom and can also be modified by other goals. The goals to increase social standing, or even avoid decreasing social standing can come into conflict, or reinforce other goals the student has. Covington (1984) postulates a self-worth theory that states students will strive to be perceived as successful. This striving they do can go both ways; they can strive to be better at math to be perceived as successful. However, as Bishop (2012) suggests, if the student's identity in the school is one where being better at math would not be perceived as successful (such as class clown, or the 'too cool for school' type), then they may even strive to not be better at math, in order to be perceived as successful in their identity. Their motivation is to be perceived as unmotivated due to their identity being linked such as to generate perceived success for them in accordance with their decrease in academics. As Middleton and Spanias (1999) said, there is no such thing as an unmotivated child, it is just that Covington (1984), Martin et al. (2014) and Bishop (2012) all point out, sometimes the motivation is detrimental to the child's academic abilities.

There are several factors that contribute to the motivation, both positive and negative, of the high school students. To begin this discussion on these factors, we begin with the sense of school belongingness.

Sense of School Belongingness

School belongingness is how well a student fits in with their school, how well they associate themselves with the school, how well they see themselves as a part of that school, in essence it can also be how well they like that school and their position in it (Gillen-O'Neel & Fuligni, 2013; Xie et al., 2021). This can also incorporate the student's sense of self-worth (Covington 1984) and their social identity (Bishop 2012). The sense of perceived success that Covington (1984) addresses can be influenced by what the school the student belongs to

perceives as success. The social identities that Bishop (2012) uses can also be writ large and applied to the school identity itself (Eccles & Jacobs, 1986). If the school is known for, or thinks itself as, a school strong in mathematics, and the students know this too, then the sense of school belonging will bolster mathematics (Eccles & Jacobs, 1986). However, if the school is known for, or thinks itself as, a school weak in mathematics, and the students know this as well, then the sense of school belonging will stifle mathematics (Eccles & Jacobs, 1986). This is, of course, dependent on how well the student associates with the school though. A student with a weak sense of school belonging in a school whose identity is that of weak mathematics, may not necessarily have less motivation than a student with a strong sense of school belonging at a school whose identity is that of strong mathematics (Gillen-O'Neel et al., 2011). The school community, the school identity, has to be supportive and well put together for a strong sense of school belonging to translate into an increase in motivation and academic performance (Gillen-O'Neel et al., 2011).

If the school does have a strong and supportive school identity, as a student's school belongingness increases, there is a corresponding increase in academic motivation and drive to succeed (Gillen-O'Neel & Fuligni, 2013; Xie et al., 2021), this increase is not just limited to mathematical motivation, but it is an increase across all subjects in that school, however it also effects the student's mathematical motivation as well. Conversely, when a student has a low sense of school belonging, that is to say, the student does not feel like a part of the school, then academic motivation falls, and mathematical motivation with it. This is especially visible in a virtual learning environment where the sense of school belonging is practically nonexistent, the students' motivation to achieve and succeed in mathematics fell correspondingly with the absence of school belongingness (Kim et al., 2015). Another reason behind the link to motivation

and school belongingness is theorized to be the peer support that accompanies the sense of school belongingness (Xie et al., 2021). As a student's sense of school belongingness increases, so too does their interaction and relationship with their peers who also have a sense of school belongingness, this gives rise to a sense of camaraderie and increases both the likelihood that a student will be motivated to ask for help from his peers or teachers, and that said peers or teachers will be motivated to reply in the positive. As such, a positive sense of school belongingness is especially important to maintaining positive motivation in mathematical academics.

This sense of school belongingness is not limited to solely the students, however. Both the teachers at the school and the parents of the students can contribute or take away from the sense of school belongingness felt by the students (Davis et al., 1990; Harackiewicz et al., 2012; Yildirim, 2012). Similar to Covington's (1984) sense of self-worth, which relies on perceived success, Yildirim (2012) says that a sense of school belonging can increase for the students can increase if they perceive the teachers to be helpful, regardless of whether they actually are, perception is what matters. As well, Yildirim also mentions that if the students perceive the teachers to be unhelpful, the sense of school belongingness will fall accordingly. Of course, one of the best ways to be perceived as helpful is to actually be helpful for the students (Yildirim, 2012). In addition, Davis et al. (1990) says this perception of helpfulness can be built, sustained, and empowered by the relationships between teacher and student. As they say:

As we build relations, our students learn to trust us. When the work is not as exciting as we'd like it to be or when they have low moments (as we all do), students will often persist in mathematical endeavors for their teacher. "Okay, if you say so." "I'll do it – just for you." (p. 191)

Similarly, parents can also affect the sense of school belongingness, more directly impacting Covington's (1984) sense of self-worth, this time by directly impacting what the students perceive as success (Harackiewicz et al., 2012). The example Harackiewicz et al. (2012) put forth was that of their research, which was to inform the parents of the students of the benefits of STEM associated careers and how high school level math and science would help with that. These parents then impacted the students' perception of success which led to an increase in math and science courses taken by the students. Harackiewicz et al. (2012) using the parents to adjust the students' perception of success, can, over time, adjust either the school sense of identity, or the students' own identity to be more in line with that of the school, depending on how STEM focused the school identity was.

Prior Academic Achievement

The next vital factor of motivation for high school students in math is prior academic achievement. That is to say, any prior achievement in math, or a positive association with past mathematical academic achievements. In essence, have they ever been good at math, or even thought they were good at math, even if it was just a few times it is enough to motivate attempts to reclaim the same degree as the prior achievement provided (Kim et al., 2015; Xie et al., 2021). The prior academic achievement needs not be consecutive, if the student scored well in eighth grade math, and average in 9th and 10th grade, they are still possessing an increase in mathematical motivation (Xie et al., 2021). This is especially visible in a virtual learning environment, as a sense of school belongingness fades due to the virtual environment and internet anonymity, the effects of prior academic achievement on mathematical motivation rise correspondingly (Kim et al., 2015).

Glynn et al. (2015) introduces a link between a student's motivation and their self-efficacy. They define self-efficacy to be a student's belief that they have the capability, or basic ability, to learn the subject, and learn it well. For mathematics specifically, it would be the belief that they could, if they put in the effort, learn, and master the mathematics being taught to them. Glynn et al. (2015) tells us that this self-efficacy, this belief, and a student's motivation are linked. When a student does not believe they can learn the math, due perhaps to having low prior academic experience in math, their motivation for the subject wanes. Conversely, when a student believes they are able to learn the math, due perhaps to having high prior academic experience in math, their motivation for the subject experiences a corresponding increase. This has interesting interactions in a virtual environment. The self-efficacy, that of belief about their own abilities to complete the task, and the intrinsic motivation of a student, their perception of the value of the task in relation to their own interest, become distinct and separate (Kim et al., 2015). In a virtual environment, a student's belief that the task is worth doing, that intrinsic motivation value, corresponds to the student's prior academic achievement, even if their current academic achievement is subpar (Kim et al., 2015). The belief that they can complete it, on the other hand, relies on the current academic achievement, that is to say, whether they have been able to complete similar work in the recent past. In other words, the presence of prior academic achievement bolsters motivation in mathematics even if the present grades and their situations are less than optimal. It is interesting to note that with a high enough sense of school belongingness mathematical motivation remains high even in the absence of any significant prior academic achievement (Gillen-O'Neel & Fuligni, 2013; Xie et al., 2021).

Student Autonomy in the Classroom

The third factor we will look at is student autonomy in the classroom, or how much choice and impact the student has in the structure, pace, and decision making of the classroom, from topics covered to activities to homework. When students felt like the teachers supported autonomy, with the offering of interesting activities, providing opportunity for the asking of questions, telling them the why behind the activities and why they were important, and considering their preferences in course activities, the students felt more motivated to complete the course work. Conversely, when the students felt like the teachers thwarted their autonomy by offering uninteresting activities, lecturing with no chance to ask questions, or not explaining the rationale behind the work, the students' motivation declined noticeably (Patall et al., 2018). The essence of this final factor we will look over is whether or not the students feel as if they have any say in the matter. Testone (2005) demonstrates this with his 'games' practice. He would prepare games for the students, mathematical variations of football, baseball, soccer, jeopardy, and bingo, to name a few, and let the students not only choose between which math game they could play, but whether they would play one at all, or simply do traditional studying. It is interesting to note that there were a few students who preferred traditional studying a few times instead of the games. It was the choice, though, that saw a significant increase in their motivation and drive to learn the mathematics (Testone, 2015).

Schweinle et al. (2006) maintains the importance of striking a rather delicate, evolving, balance for student autonomy. They agree and support both that an increase in student autonomy can result in an increase in motivation and that a decrease in student autonomy can decrease motivation. They suggest that a teacher can minimize external controls to increase student autonomy, these controls they mention consist of such things as deadlines, grades, and set solution paths. They recommend minimizing the importance and impact of these, but not getting

rid of them wholesale, as the difference between minimized controls and non-existent controls is quite large. Turner et al. (2011) agrees with this balance, they define the autonomy as a student self-initiating and self-regulating their own actions, which can lead to an increase in motivation and interest. However, as these students are, in the end, still children, the teacher must still be ready for the event when the student's self-initialization and self-regulation falls short of the standards required (Turner et al., 2011).

Murayama et al. (2013) further elaborates on autonomy, that it is less about the control a student has over their actions in the classroom, and more about the perceived control. To satisfy Schweinle et al. (2006) and Turner et al. (2011), the real control remains with the teacher, but giving enough autonomy to the students so they have a sense of perceived control, can increase their motivation as they seek to exercise their perceived control. This can hit a roadblock in some classes, especially mathematics. As Haladyna et al. (1983) says, "no matter what one does, mathematics is a disagreeable subject." (p. 21). This references what they term 'fatalism,' a tendency of motivation for mathematics to diminish for some students as they realize, that no matter how hard they try, there is always more and harder math next year. This goes up against and impacts the perceived control Murayama et al. (2013) puts forth for mathematics. No amount of perceived control for the classroom can overcome that at the end of the day, the student will still have to do math, which may lower motivation as perceived control goes up against the reality that is math (Haladyna et al., 1983).

Conclusion

As the students in high school proceed through the grades, the need for mathematics motivation rises in accord with the difficulty of the newer mathematics of each year. Specifically, a positive motivation towards mathematics, per Middleton and Spanias (1999),

there is no such thing as an unmotivated child, it is just that Covington (1984), Martin et al. (2014) and Bishop (2012) all point out, sometimes the motivation is detrimental to the child's academic abilities, a negative motivation towards mathematics. As well, as the concepts become more difficult and abstract, the problem-solving and deeper comprehension required necessitates higher levels of motivation to arise as well (Schiefele & Csikszentmihalyi, 1995). Success in these high school level mathematics is the gateway to the higher levels of education and professional development (Jiang et al., 2020). As such, it is absolutely important that students, teachers, and parents work together to adjust the factors that affect motivation for high school students so that they generate motivation to succeed in mathematics. A student who is motivated will be more successful and retain skills and concepts longer (Kariuki & Wilson, 2002).

Chapter 3

Research Methodology and Procedures

Introduction

Based on the review of the literature on the factors affecting motivation in high school mathematics students, research was conducted at a specific high school in Northeast Tennessee as to ascertain and assess the factors that motivate Algebra II math students at that particular school. The resulting information and results would assist and guide the teachers and administration at that specific school in creating and maintaining an environment that promotes motivation in Algebra II students in particular, and math students in general. This chapter contains information on research methodology and procedures used in this investigation. Specifically, information on the population, the sampling procedures and participants, the data collection procedures and instruments, the procedures for the investigation itself, and the initial research questions.

Population

The study was conducted at a public high school in Northeast Tennessee with approximately 1300 students. The area served was rural suburb with a significant presence of farms and children descended from, and associated with, farming professions. The school consisted of a majority of low to middle class income, Caucasian students, with a small presence of minority population. The gender ratio for this school was roughly 50/50 between males and females.

The graduation rate for students who entered the school as Freshmen, to graduate in 4 years, was about 95%, a score in the top 10% of its category in Tennessee. Around 35% of the students achieve proficiency in math, a score in the top 50% of its category in Tennessee. The

majority of the students start out in Algebra I for 9th grade, followed up with Geometry for 10th grade, Algebra II for 11th grade, and a choice of various advanced math courses for their 12th grade year. The students are required to take four years of math, and pass at least Algebra II to graduate. The full list of math courses offered at this school consist of: Algebra I, Geometry, Algebra II, Trigonometry, Pre-Calculus, Probability and Statistics, and A.P. Calculus. It should be noted that if a student does not pass Algebra II in their 11th grade, they will have to retake it for their 12th grade year in order to graduate. The students also have the opportunity to get experience in various vocational programs. Including agriculture, construction, health services, human services, information technology, and marketing.

Sampling Procedures and Participants:

The sample for this study included Algebra II students in three different Algebra II classes, taught by the same teacher, at the particular high school. Participation was voluntary and confidential. The sample was made up of approximately 75% female volunteers and 25% male volunteers. It should be noted that the school population was a roughly equal 50/50 split between males and females, however, as this study was voluntary the sample diverged from the population. The total possible sample size was 76 students from 3 different Algebra II classes taught by the same teacher, the students who volunteered for the study numbered 24, with 18 being female, and 6 being male, of these 24 who volunteered, 21 completed the survey.

Data Collection Procedures and Instruments

Each student who volunteered was administered a survey assessing the factors that affect motivation in mathematics class, specifically, Algebra II class. The survey consisted of 49 questions, 12 scaled items, 30 selected response items, and 7 free response items. The questions were organized into 4 categories: school life (9), academic achievement (4), classroom

environment (23), and motivation (13). The first three categories of questions were influenced by the review of the literature for their design, which indicated the categories of school belongingness, prior academic achievement, and student autonomy in the classroom as factors that affected the motivation of high school math students. The first three categories, therefore, were based on, and inspired by, these three factor categories indicated. The last category consisted of questions asking the students' own interpretation of their motivation. This instrument measured the opinions and attitudes of the students, resulting in themes and trends that were used to determine the factors that affect motivation.

In addition, 4 students of differing levels of current academic achievement and mathematical motivation were chosen to be interviewed in depth, in order to gain their perspectives as to what factors affected their motivation for Algebra II. These students varied from low motivation and achievement to middling motivation and achievement to high motivation and achievement. The interview questions were similar to the questions on the survey administered previously. They inquired about each of the 4 categories mentioned above; however, the questions were more open-ended, allowing these students to go into much more detail, and for their responses to be more thorough and extensive. Both the survey, and the framework of the interview, are listed in Appendix A.

Procedures:

Before the commencement of this study, permission to attempt the study and ask questions of the students, was obtained from Milligan's Institutional Review Board (IRB). A proposal of what was intended to be done and found out by this study was sent to the IRB, upon which they signed conditional approval for the study pending on the approval from the school in which the study was conducted. After permission from the high school administration was

obtained, the Milligan IRB gave full and final approval for the study to take place. Next, each student in three separate Algebra II classes was given a consent form and told the basics of the study, including what it consisted of, their part in it, should they accept, and how long of a time commitment it would take. After this information was given, the students were told to present the consent form to their parent or guardian for permission to participate in the study before he or she could participate. Each student was informed that participation in the study was completely voluntary, and all information obtained and used in the study would be kept confidential. As well, that each participant could withdraw from the study at any time without penalty.

Once permission and consent from the parents or guardians was obtained, the survey was given to all the students who volunteered and had permission from their parent or guardian. The students were given approximately 30 minutes to complete the survey. After the surveys were administered, 4 students of varying academic abilities and motivation were chosen for an in-depth interview into the factors affecting their motivation. The interviews were recorded, and notes were taken.

After the survey and interviews were complete, the information obtained was collected, organized, and analyzed. The interpretation of the data obtained resulted in themes of factors that affect the motivation of Algebra II math students at the selected high school in Northeast Tennessee.

Research Questions:

Research Question #1: What are the factors affecting motivation in Algebra II mathematics at a selected high school?

Chapter 4

Data Analysis

Introduction

The purpose of this study was to identify the factors involved in motivating high school students in an Algebra II mathematics course. The participants of this study were asked forty-nine different questions that assessed the influence of a sense of school belonging, prior academic experience, classroom environment and student autonomy, and motivation in general. Most of the questions were selected response questions, with twelve scaled items and seven free response items. In addition, four students who completed the survey were asked six open ended questions based on the same categories. These questions were more general and allowed for a wider range of responses.

Collection of Data:

The data for this study were collected from a total of twenty-one students, using a questionnaire format, further data were collected from four of these twenty-one students in the form of one-on-one interviews. The students were mostly in grade 11, with two students in grade 12. They were all in Algebra II, and represented a range of academic grades achieved. The questionnaire was given to the students via email, and the students were told their responses would be confidential, allowing them to be utterly honest with their responses. In the student interviews, the students were initially asked to list any questions from the survey that stood out to them and why. By asking this question first, the students could recall the survey better and get into a mindset beneficial to the interview. After this initial question, the students were asked general questions about the three categories of school belonging, prior academic achievement,

and student autonomy, as well as questions regarding motivation in general. Finally, each student was asked what factors they had experienced that led to increases or decreases in motivation, and for how long did those increases or decreases last. An addendum to this question was added when they answered, and asked could they think of any factors, even ones not previously experienced, that would impact their motivation in either positive or negative ways. The student questionnaire and interview questions are included in Appendix A.

Research Questions:

Four research questions were used to guide the analysis of the data. The following is an analysis of the student questionnaire data. The student interview data is discussed further at the end of the chapter.

Research Question 1: Does a student's sense of school belonging affect his or her motivation in Algebra II math class?

To answer research question 1, the response to questions 1-10 of part 1 of the survey and various answers from the student interviews were analyzed. These questions attempted to identify trends as to expectations and supports the students received from school culture and peer groups, and the effect that support may have on the student's motivation in Algebra II. Themes from the responses to these questions show that the school culture and peer groups are lacking in support and help for mathematical motivation. Of the twenty-one students surveyed, 57% were not involved in any student or after school organizations. The 43% who were involved in student or after school organizations only 4% were involved in organizations that can provide help with math. The 57% who were not involved in these organizations, were not involved due to having work after school, varying from 1-10 hours per week (10%), to more than 20 hours per week (19%), leaving them with no school culture or peer groups to help with mathematical motivation. For the school culture during school hours, the majority of most responses to questions about school and school community were answered with neutrality (48%), with agreement being the close follow-up (38%), and the remainder being divided between disagreement, strong disagreement, and strong agreement. Notably, those who answered in neutral, tended to be those who had work after school. In essence, the majority of students were either fine with the state of affairs, or did not care. From the student interviews, only two of the four had any support from

the school culture or personal peer groups, and of those two, only one had it with any regularity.

A summary of student responses in the interviews is included in Appendix D.

Figure 1

The Number of Students in Student Organizations or Afterschool Programs

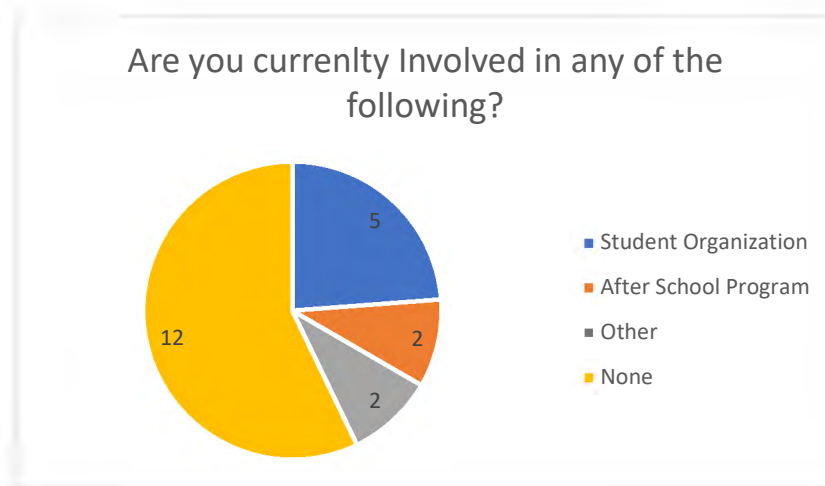


Figure 2

The Number of Hours Worked by Students

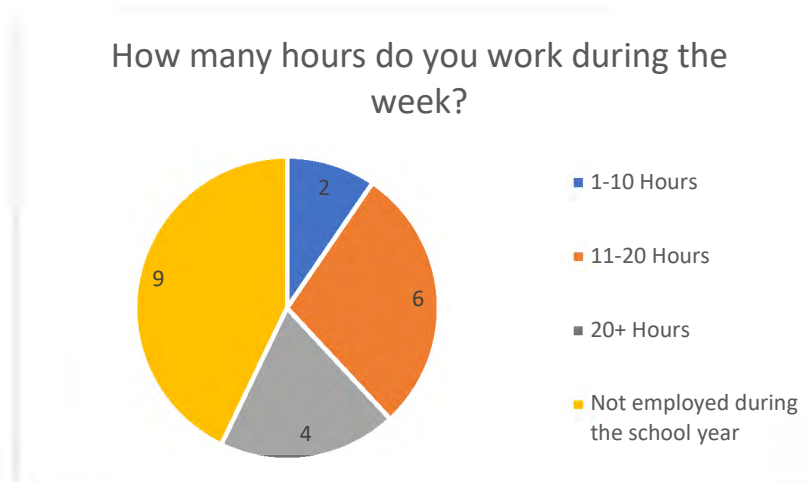
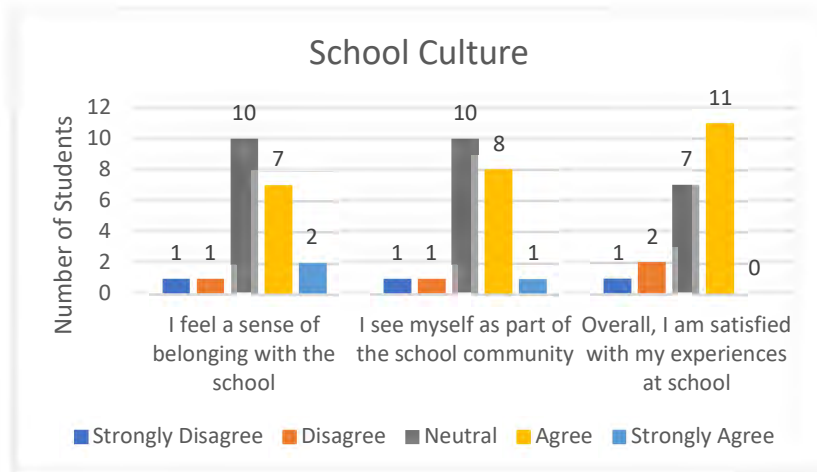


Figure 3*Student View of School Culture*

Research Question #2: Does a student's prior academic achievement in mathematics affect his or her motivation in Algebra II math class?

To answer research question 2, the first four questions of the second part of the student survey were analyzed and various answers from the student interview as well. These questions attempted to identify any trends to the change in attitude towards mathematics as the students had progressed through past grade levels. There was a total of four dominant trends that were identified from these four questions. The first trend identified showed that the students' ability to do math decreased as they progressed throughout the grade levels. With the largest impact and decrease happening when the students entered the high school curriculum (ninth grade). The data showed a decline in the number of students who rated their own math ability as above average or excellent (from 48% to 12%), as well as an increase in the number of students who rated their abilities in mathematics as average or below average (from 44% to 80%) as the students progressed along the grade levels. Additionally, the number of students who labeled themselves as excellent decreased (20% to 4%) upon entering high school (grade 9). Accordingly, the number of students who labeled themselves as below average did not change, at this time, most of the students who no longer labeled themselves as excellent, now labeled themselves as average students. The second trend discovered is one that shows a decrease in the perceived usefulness of math learned as they progress through the grade levels. The majority of students were able to say that the math they learned in grades K-5 was "Very" useful or "Somewhat" useful. This majority (64% to 68%) did not change until the start of high school. "Very" useful and "Somewhat" useful fell sharply (to 32%), and "Not Much" usefulness rose sharply as well (0% to 24%). This trend continued after their freshmen year (grade 9) into their current year (grade 11), with "Not Much" use and "Not at all" useful growing to 40% of responses in their

current year. The third trend showed a small decline in the number of students who described themselves as enjoying math and math class over the years. Overall, the number of students who described themselves as enjoying math to certain extents remained relatively consistent over the years, the number of students who described themselves as those who “Very Much” or “Somewhat” enjoyed math fell over time (from 40% to 16%). The final trend identified, showed that substandard performance and good performance of the students’ past academic achievements are related. When asked to describe an experience, good or bad, that had an impact on their feelings towards mathematics, students tended to give answers that indicated that their present feelings on math were highly dependent on their own past experiences in the subject. Good experiences and superior performance continued to build upon itself, while bad experiences and performances left a lasting mark that lasted for years. As well, good experiences typically consisted of having understanding teachers and getting problems correct, while bad experiences tended to consist of endless, meaningless (from their perspective) repetition of hard math, punishment for mistakes, and ridicule. Specific student responses are listed in Appendix B.

Figure 4

Student Rating of Math Ability in Various Grades

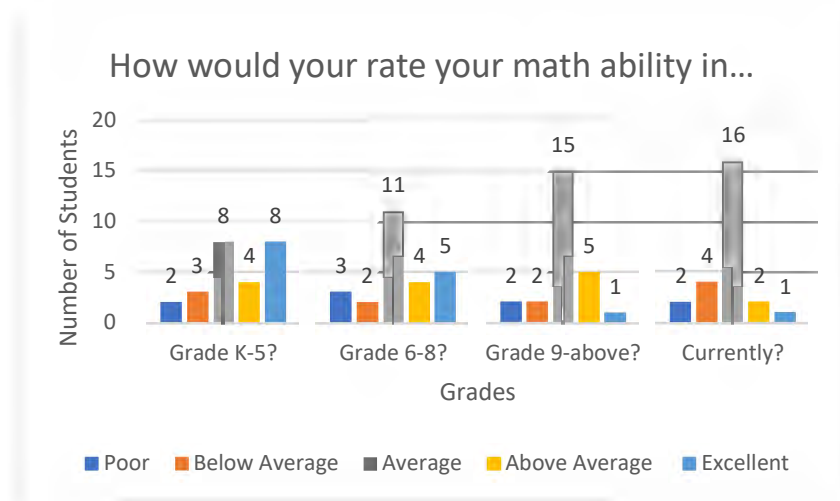


Figure 5

Student Rating of Math Usefulness in Various Grades

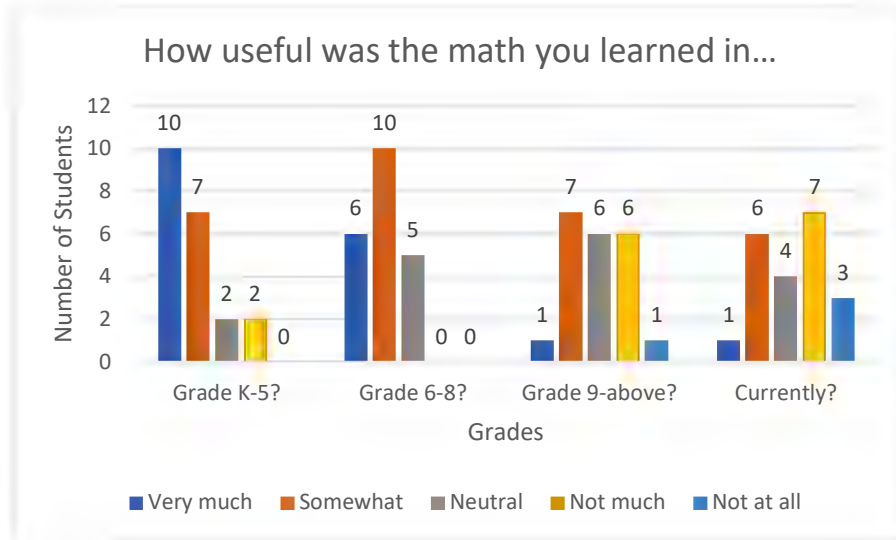
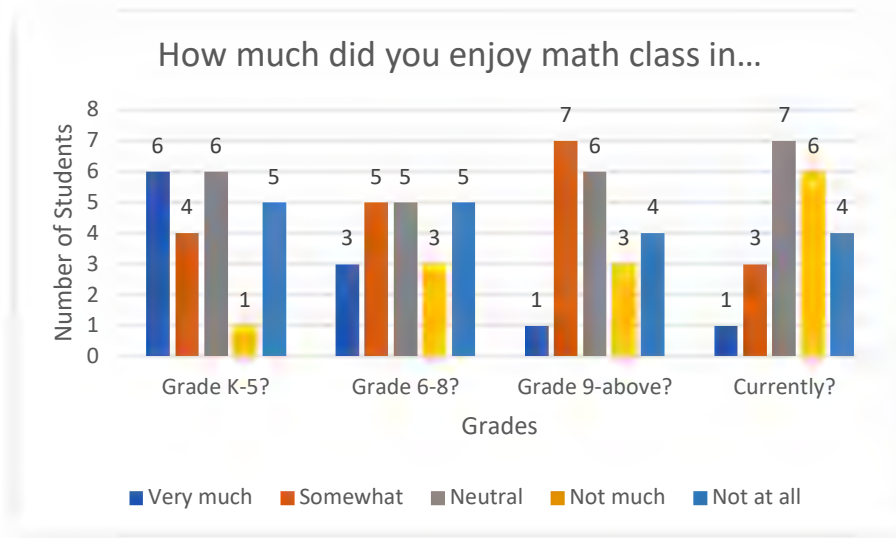


Figure 6

Student Rating of Math Enjoyment in Various Grades



Research Question #3: Is a student’s motivation in Algebra II math class influenced by the characteristics of the teacher, the classroom environment, and the availability of student autonomy?

To answer research question 3, the response to questions 1-23 of part 3 of the survey, and various questions from the student interviews were analyzed. These agree/disagree questions attempted to identify trends as to the effects that classroom environment, teacher characteristics, and the availability of student autonomy has on the students’ motivation in Algebra II math class. To save space on the figures below, abbreviations were used for each section, the full names and questions are available in Appendix A. The first trend found is one that shows that the students describe their Algebra II class as “Habitual, same thing every day” the most often, with 71% of the students using this description. “Fun” and “Engaging” tied for the second place, with 10% each, and “Lame” and “Boring” tied for third, with 5% each. The second trend shows that while the majority of students understand the necessity of and the importance of the math, they also find it, boring, uninteresting, the same thing repeatedly. Tending to decline in motivation.

Figure 7

Student Descriptions of Math Class

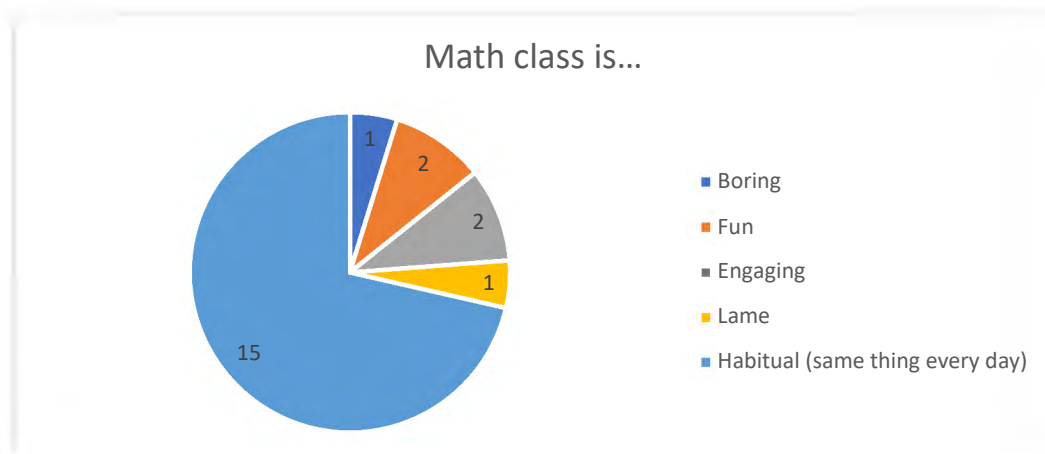


Figure 8

Student Description of Classroom Environment Part 1

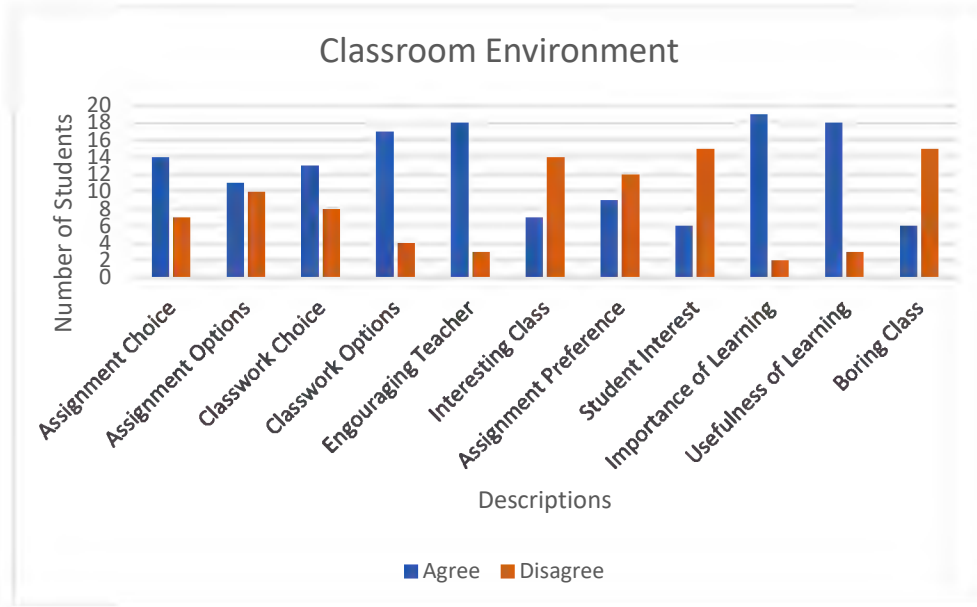
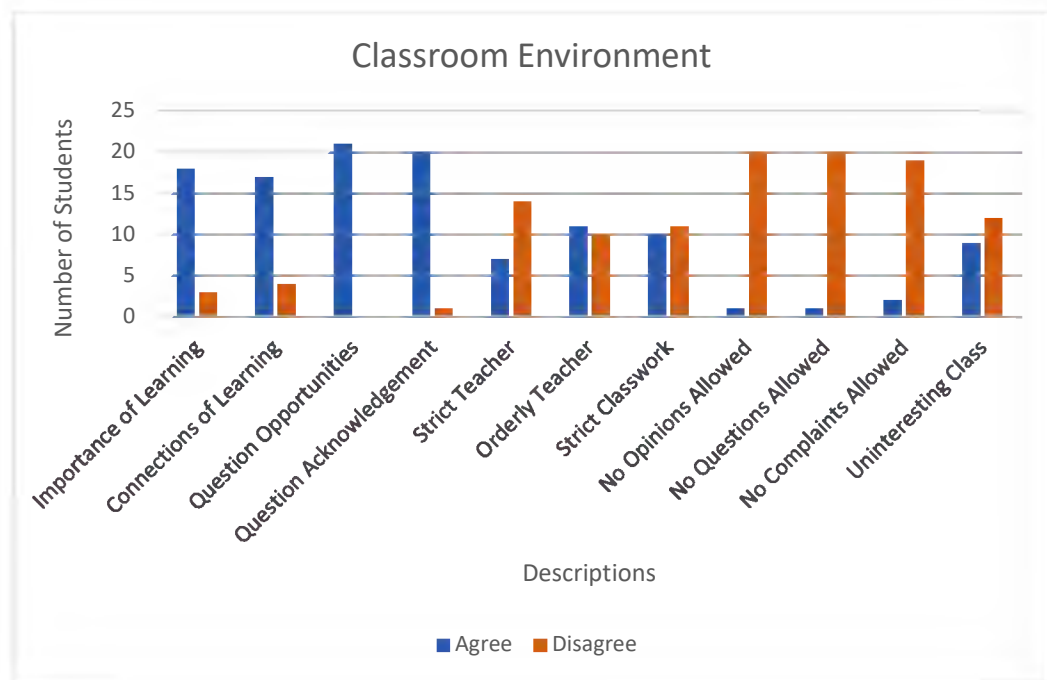


Figure 9

Student Description of Classroom Environment Part 2

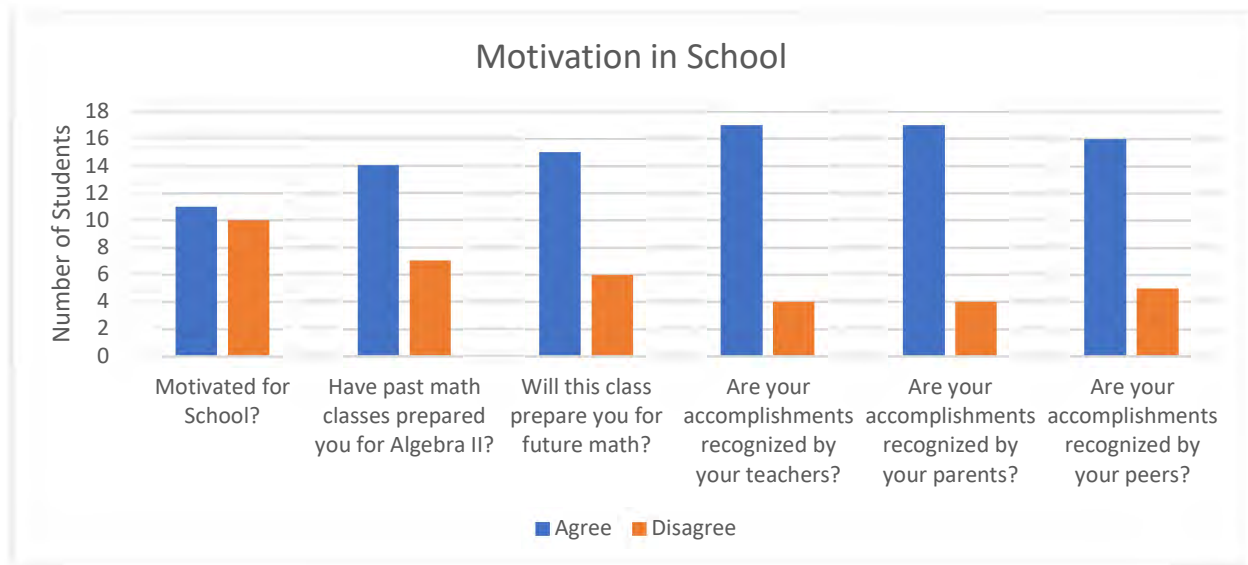


Research Question #4: Does student motivation outside the Algebra II classroom affect student motivation inside the Algebra II classroom?

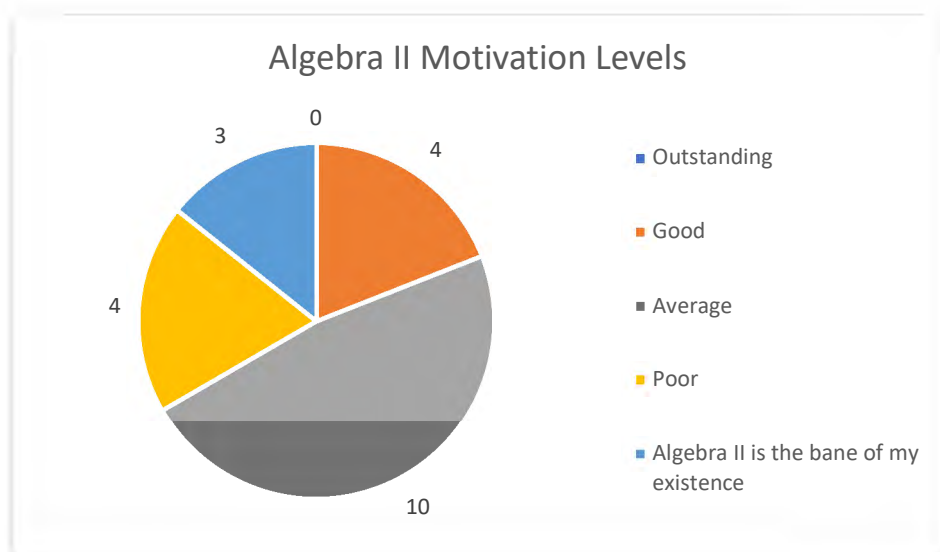
To answer research question 4, the responses to questions 1-13 of part 4 of the survey and various questions from the student interviews were analyzed. These questions attempted to identify trends in student motivation outside the Algebra II classroom. Sample responses for questions 2, 8, 9, and 11 are displayed in Appendix C. The first trend here was that most (66% to 71%) students felt that previous math classes had prepared them for Algebra II, and that Algebra II would prepare them for future math classes. As well, the majority (81% to 76%) of students felt that their accomplishments in math and other school subjects were being appropriately acknowledged by their teachers, parents, and their peers. However, despite all this, the second trend is that still only around half (52%) described themselves as motivated to come to school. In addition, when asked for motivation for Algebra II in particular, rather than school in general, 0% of them said they were “Outstandingly” motivated for Algebra II, 48% described themselves as “Average” in motivation. The number of students who described their motivation for Algebra II as “Good” or “Poor” were 19% each. Finally, 14% of students choose the option “Algebra II is the bane of my existence” indicating that they had extraordinarily little motivation for Algebra II. The third trend from the open-ended questions in Appendix C is that, of those who said they had any level of motivation for Algebra II, the majority of it was to avoid failing, or not have to take it again.

Figure 10

Factors that Impact Motivation in School

**Figure 11**

Student Description of Their Motivation Levels for Algebra II



Student Interview:

The themes identified in the student interviews were similar to those identified in the survey these students took previously. All four students were motivated by at least one of the three major categories identified. That is, a sense of school belonging, prior academic achievement, and student autonomy in the classroom. These factors were identified in the review of the literature and used as a guideline for the survey and interview questions. In addition, three students interviewed mentioned familial ties being a source of motivation at times, and the fourth mentioned a previous math teacher they really respected giving them motivation. The efforts of family members and teachers personally make to increase the motivation of students would include: assistance one on one, verbal encouragement, and showing an interest in the student's success. A summary of the students' responses is included in Appendix D.

Chapter 5

Summary of Findings, Recommendations, and Conclusion

Introduction

This chapter includes a summary of the findings, a conclusion in regards to the findings, recommendations for further study, and recommendations for the practice. This research study was based on the review of the literature that identified several factors that affect the motivation of high school Algebra II students. The results of the study were also based on the data analysis described in Chapter 4.

Summary of Findings:

There were several themes that emerged from this research that were significant. The first significant theme suggested that a student's sense of school belonging, at this school, had negligible or minor impact on their motivation in the Algebra II classroom. There existed several students who had a strong sense of school belonging, and very little motivation for Algebra II, as well as students who had very little sense of school belonging, and a large amount of motivation for Algebra II. For example, in response to a question on the survey as to what motivates the student to come to school, the replies were in the vein of, "Friends, too tired for school", "My friends", "Only my friends." These were the most common replies. As well, in regards to a question on the survey on what motivates them in Algebra II, the majority of the responses were in the vein of, "Nothing much", "Not much", "Getting a good grade in the course", "Keeping a good grade in the course." These examples of student replies show that while a sense of school belonging and friendship amongst the students may lead to an increase in motivation to come to school itself, for the specific motivation of Algebra II and its assorted activities, a sense of school belonging has minimal impact at this particular school. As well, of the student interviews, only

one student mentioned that a sense of school belonging helped them with motivation in Algebra II. Specifically, that they had a friend group that got together and did math together to get it all out of the way. While two of the other interviewed students said it was the opposite for them, as their friend groups had a dislike of math and their motivation to achieve in math decreased around them. It should be noted that these last two students mentioned here were the low scoring student and high scoring student. This information suggests that, while there may be a strong connection between sense of school belonging and motivation for school in general, that connection falls off when we get to math in general, and falls off even more when we get to Algebra II in specific. At least, it does at this particular school. This result is in accordance with the review of the literature, which found that the sense of school belonging can influence the student in the direction the school perceives itself to be. Specifically, if the school is known for, or thinks itself as, a school weak in mathematics, and the students know this as well, then the sense of school belonging will stifle mathematics (Eccles & Jacobs, 1986). This particular school has a sense of school belonging in its students that sees their time in Algebra II as time better spent elsewhere for the majority of students. As evidenced by the 81% of students from the survey who rate their motivation for Algebra II as Average or below, and evidenced even more by the 14% of students who went as far as to label the selection ‘Algebra II is the bane of my existence.’

The second theme of this study suggested that a student’s previous experience(s) in math had a significant influence on the student’s current motivation in Algebra II math class. Positive interactions with previous math teachers or positive experiences in previous math classes led to an increase in motivation, while negative interactions and experiences tended to lead to less motivation for Algebra II math class. For example, one student in the study said, “I struggled

forever in math when I was younger, and it's never been my favorite subject." Another said, "I have had good math teachers which is the only reason it made math good." A third said, "Freshmen year I had Mrs. H***. She's like a math Nazi. She is so mean and rude, and she really made me detest math. And same with my 5-8 grade teachers. I've never had a good experience in math class. I just felt like if I couldn't be good at it then why should I really try?"

These are three examples of the statements given by students that showed that prior good experiences led to an increase in motivation, while prior negative experiences led to a decrease in motivation. In addition to this, as the students proceeded through the grade levels, their math ability, their math enjoyment, and their perceived usefulness of the math they learned all declined noticeably. This information suggests that there is a strong connection between ability to succeed in Algebra II and motivation in Algebra II math class. The point of largest decline of math ability, math enjoyment, and perception of math usefulness was most apparent to be between the 8th and 9th grades. In other words, the start of high school. This is consistent with the review of literature, which found that motivation for students in math had a tendency to decline when the students reached high school due to the math becoming more and more abstract at that level (Schiefele & Csikszentmihalyi, 1995).

The third theme showed that student motivation in Algebra II mathematics can be affected significantly by teacher characteristics, classroom environment and the presence or absence of student autonomy in the classroom. The review of the literature suggested that student motivation increased when presented with the opportunity to choose, or the presence of student autonomy, in regards to class lessons, assignments, and activities (Testone, 2015). As well, the review of the literature suggested that student motivation would also increase if the classroom environment was one where the students felt free to ask questions and make mistakes (Stipek et

al., 1998). The data from this study showed that the majority of students feel comfortable with both asking questions and making mistakes. However, the factor that appeared to affect motivation the most was the classroom environment and daily experiences in the mathematics classroom. 71% of students described the math class as 'habitual, same thing every day', indicating that even though they could ask questions and make mistakes, math class was the same every day, with the same lack or minimization of student autonomy. For example, one student said in response to a question on student autonomy in the classroom, "I don't know, never had it before, it might help." Other students made similar comments about student autonomy, that it might help, but that they are not sure because math class is the same thing every day, habitual.

The final theme of this study was that motivation students have outside the mathematics classroom has little to no impact on the motivation inside the Algebra II mathematics classroom. Only around half of the students surveyed even said they were motivated for school at all, and of those who said they were motivated for school, very few (19%) described their motivation for Algebra II as anything above 'Average', and 33% described it as 'Poor' or below. As well, of those who said they were motivated to come to school, the vast majority of their reasons were their friends, and peer groups. A few times it was other classes, never Algebra II.

A couple of factors may have affected the responses of the students involved in this study, and their answers in the interviews or survey. Firstly, the survey and interviews were administered near the end of the fall semester, with holiday break coming very soon after. It has been noted that students tend to sometimes become less motivated at the end of the year or semester. As well, students may also become a bit more motivated at the end of the semester in an attempt to bring their grades up before the grades are finalized. Also, while students were told

their responses would be held in confidence, some may not have believed it and edited their responses to be more in line with what they think they should have said instead of what they really meant.

Conclusion:

The results of this study confirmed that there are many factors that can affect the students' individual motivation in a high school Algebra II class. Most significantly, students seemed to have been affected by prior academic experiences in other math classes and the classroom environment of their current class. To a lesser extent, a sense of school belonging and motivation outside the classroom has an effect as well. To quote Jamie Escalante, "Students learn better when they are having a good time." The most significant impacts on a student's motivation were, in essence, whether they had a good time in math class previously, and whether they are having a good time in math class now. Escalante also noted that, to be a successful teacher, you must be aware of the students' needs and respond to those needs (Escalante & Dirmann, 1990). The results of this study tended to agree with him, having the class be more fun, or including more student autonomy, would break up the 'habitual' response from the students and may increase motivation. As well, and possibly more importantly, the students would have this class experience going forward to be a positive prior academic experience with math. Making them more positively inclined to mathematics in the future. As such, the most significant factors that affect student motivation in an Algebra II classroom appear to be prior academic experience in mathematics, and the current classroom environment of their mathematics classroom.

Recommendations for Further Study:

1: Future research should include a wider selection of math classes from a wider selection of math teachers to get a better understanding of the factors that affect the motivation of students of math in general. Multiple Schools should be considered as well.

2: Further research should experiment, using varying methods, to see if there are ways to lessen the impact of poor prior academic experiences. To see if there is a way to increase the motivation of students who have had previous negative experiences in the math classroom. As well, to see if there are ways to reinforce or compound the impact of positive prior academic experiences.

3: Further research should consider including an additional survey or interviews for the parents/guardians of the students to get their own insights into their children's motivation, this should be explored as well.

4: Further research should explore what type of classroom environment will help the students the most, to see which has the most beneficial effect on student motivation.

Recommendations for Practice:

1: High school Algebra II teachers should identify or locate some way to address the feelings students may have towards mathematics due to their prior experiences in previous math classes. Especially if these feelings are negative and the prior experiences were also negative, in order to lessen the effect that these experiences may have on the students' motivation in their current Algebra II class.

2: All math teachers should attempt to avoid having their class as 'habitual, same thing every day' and strive to keep the students engaged and interested in the lessons day by day. This may require making the lessons 'fun' or at least varying them, so they don't become habitual.

3: High school math teachers should also be aware that there exists many other factors that can affect the students' motivation for math. As such, they should take every chance they can to prevent factors such as sense of school belonging, peer groups, or lack of motivation outside the classroom from affecting their students' motivation and desire to succeed.

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Appendix A
Student Motivation Survey

School life:

- 1) What year are you in?
- 2) Are you currently involved in any of the following?
 - a) A student organization (please say which one)
 - b) An after schools' program (please say which one)
 - c) Other (with fellow students)
- 3) What was your reason for joining your answer for question 2?
 - a) It matched my interests.
 - b) To make new friends
 - c) To build a resume
 - d) To gain leadership skills/experience
 - e) Professional networking
 - f) N/A
- 4) What was your reason for not joining something from question 2?
 - a) Not enough time
 - b) Focused on academics
 - c) Focused on work commitments
 - d) Long commute/inconvenience of schedule
 - e) Family commitments
- 5) How many hours do you work a week?
 - a) 1-10 hours.

- b) 11-20 hours.
- c) 20+ hours.
- d) Not employed during the academic year.
- 6) Which of the following most accurately describes your school experience?
- a) I feel involved with others at the school.
- b) I have a good relationship with the school faculty
- c) I have a good relationship with the school students
- d) I feel that I am a member of the school community
- e) I recognize people at school
- 7) I feel a sense of belonging with the school.
- 1: Strongly agree 2: Agree 3: Neutral 4: Disagree 5: Strongly disagree
- 8) I see myself as part of the school community.
- 1: Strongly agree 2: Agree 3: Neutral 4: Disagree 5: Strongly disagree
- 9) Overall, I am satisfied with my experiences at the school.
- 1: Strongly agree 2: Agree 3: Neutral 4: Disagree 5: Strongly disagree

Academic Achievement

	Excellent	Above average	Average	Below Average	Poor
1) How would you rate your math ability in...					
a) Grade K-5?	5	4	3	2	1
b) Grade 6-8?	5	4	3	2	1
c) Grade 9-above?	5	4	3	2	1
d) Currently?	5	4	3	2	1

- | | Very | Somewhat | Neutral | Not much | Not at all |
|---|------|----------|---------|----------|------------|
| 2) How useful is the math you learned in... | | | | | |
| a) Grade K-5? | 5 | 4 | 3 | 2 | 1 |
| b) Grade 6-8? | 5 | 4 | 3 | 2 | 1 |
| c) Grade 9-above? | 5 | 4 | 3 | 2 | 1 |
| d) Currently? | 5 | 4 | 3 | 2 | 1 |
| 3) How much did you enjoy math class in... | Very | Somewhat | Neutral | Not much | Not at all |
| a) Grade K-5? | 5 | 4 | 3 | 2 | 1 |
| b) Grade 6-8? | 5 | 4 | 3 | 2 | 1 |
| c) Grade 9-above? | 5 | 4 | 3 | 2 | 1 |
| d) Currently? | 5 | 4 | 3 | 2 | 1 |
| 4) Describe an experience, good or bad, that you feel made an important impact on your personal feelings towards mathematics. | | | | | |

Classroom

- 1) Circle the characteristic below that describes your math class.

Supportive	Boring	Fun	Engaging
Competitive	Exciting	Lame	Habitual (same thing every day)

For the questions below, select AGREE or DISAGREE next to each sub part.

- 2) Provision of Choice
- a) My teacher allows me to choose which questions or parts of an assignment to work on. AGREE / DISAGREE

b) My teacher provided options for the kinds of assignments or activities I could do.

AGREE / DISAGREE

c) My teacher allowed me to choose how to do my work in the classroom.

AGREE / DISAGREE

d) My teacher allowed me to choose how to use my time for studying and classwork.

AGREE / DISAGREE

e) My teacher encouraged me to work in my own way.

AGREE / DISAGREE

3) Consideration for Student Interests and Preferences

a) My teacher structured class activities around my interests.

AGREE / DISAGREE

b) My teacher took my preferences into consideration for assignments.

AGREE / DISAGREE

c) My teacher worked my interests into his or her lesson(s).

AGREE / DISAGREE

4) Rationales Identifying Usefulness, Importance, and Relevance of Activities

a) My teacher explained how what we were learning is important.

AGREE / DISAGREE

b) My teacher demonstrated how what we were learning is useful.

AGREE / DISAGREE

c) My teacher explained how the course assignments were important.

AGREE / DISAGREE

- d) My teacher talked about the connection between what we are studying in school and real life.

AGREE / DISAGREE

5) Student Question Opportunities

- a) My teacher provided opportunities for me to ask questions.

AGREE / DISAGREE

- b) My teacher acknowledged and responded to my questions in class.

AGREE / DISAGREE

6) Controlling Messages

- a) My teacher was strict about me doing everything in his or her way.

AGREE / DISAGREE

- b) The language my teacher used included how I “should” or “ought” to do things.

AGREE / DISAGREE

- c) My teacher told me to work on the assignments because she or he said so.

AGREE / DISAGREE

7) Suppression of Student Perspectives and Controlling Activities

- a) My teacher stopped me from expressing my opinions in class.

AGREE / DISAGREE

- b) My teacher stopped me from asking questions in class.

AGREE / DISAGREE

- c) My teacher prevented me from expressing complaints or talking about my negative feelings during class.

AGREE / DISAGREE

8) Meaningless or Uninteresting Activities

- a) My teacher forced me to study boring topics.

AGREE / DISAGREE

- b) My teacher forced me to do uninteresting activities in class

AGREE / DISAGREE

Motivation

- 1) Are you motivated to come to school? AGREE / DISAGREE

- 2) What motivates you to come to school?

- 3) Do you feel like you past math classes prepared you for Algebra II?

AGREE / DISAGREE

- 4) Do you feel like this math class will prepare you for future math classes?

AGREE / DISAGREE

- 5) Are your accomplishments recognized by your teachers?

AGREE / DISAGREE

- 6) Are your accomplishments recognized by your parents/guardians?

AGREE / DISAGREE

- 7) Are your accomplishments recognized by your peers?

AGREE / DISAGREE

- 8) What inspires you in school?

- 9) Do you have a role model in life? If so who (please explain)?
- 10) How would you rate your level of motivation for Algebra II?
- a) Outstanding
 - b) Good
 - c) Average
 - d) Poor
- 11) What do you feel motivates you in Algebra II?
- 12) What do you feel is lacking, that by its presence would motivate you in Algebra II?
- 13) Do you intend to pursue higher levels of mathematics after high school?

The initial interview questions are below:

- 1) Did any questions from the survey stand out to you? Why?
- 2) Of the categories of school belonging, prior academic achievement and student autonomy, which impacts you the most?
- 3) Are you, in general, motivated for math? For school?

- 4) Can you think of any incident which increased your motivation by a large amount? By a small amount? For how long?
- 5) Can you think of any incident which decreased your motivation by a large amount? By a small amount? For how long?
- 6) Can you think of any factors that would increase/decrease you motivation by a lot/little?
Do you seek out these factors?

Appendix B

Student Responses to Part 2, Question 4 of Survey

Question 4: 4) Describe an experience, good or bad, that you feel made an important impact on your personal feelings towards mathematics.

“I struggled forever in math when I was younger, and it's never been my favorite subject”

“Well towards the beginning of the year I cried because I was stressed due to the fact I could not understand it. But as the semester progressed, I got better at it and improved drastically. I feel like allowing for corrections on tests and quizzes is something that made me enjoy it a little better. Knowing I could correct my mistakes without punishment.”

“My math teacher 8th grade year gave me a good experience with math he was just a really nice guy and was able to teach the material where I could understand it.”

“personally, I realized that math didn't interest me, so I haven't really enjoyed it. if I don't find it interesting, I'm not going to succeed as much as in something I do. I love English so I succeed in it more than math.”

“I have had good math teachers which is the only reason it made math good”

“N/A” “None” “Growing up”

“the struggles I went through in middle school”

“Freshman year I had Mrs. H***. She's like a math Nazi. She is so mean and rude, and she really made me detest math. And same with my 5-8 grade teachers. I've never had a good experience in math class. I just felt like if I couldn't be good at it then why should I really try.”

“I struggle very much in math, but I put in a great amount of effort and my grades show for it.”

“I have always had math teachers that spent good quality time making sure that I understood everything and never made me feel like I was dumb when I didn't know something. I have honestly just been blessed with great math teachers k-11 grade.”

“Usually when I get stuck on a skill, I have to take extra time to understand it and some teachers do not slow down for no one. So, some teachers make it seem like just because you don't understand it the first time that you're dumb.”

“Studying for a test the night before and moments before the test helps me”

Appendix C

Student Responses to Part 4, Questions 2, 8, 9, and 11 of Survey

Question 2: What motivates you to come to school?

“Friends, too tired for school”

“I just come because I have to. But I also am concerned about my future, so I tell myself to keep going and keep trying.”

“To get it done with and to not fall behind.”

“apush. Advanced Placement U.S History”

“To graduate” “My future” “Finishing the class with a decent grade and getting closer to graduation.”

“My friends” “only my friends”

“Get good grades to make it college on a scholarship because I don't have money for college.”

Question 8: What inspires you in school?

“I'm a workaholic so nothing inspires me at school I'm too busy for inspiration”

“My close friends”

“Friends, academic achievement”

“Getting good grades so I can end up going to a nice college”

“Graduation and making my family proud.”

“my third period teacher and dance team <3”

“The thing that inspires me at school is a teacher that I have for 3 periods, Mrs. P*****. She always no matter what she is going through comes to school with a smile on her face and with a caring, loving attitude, which makes working in the classroom a much better environment.”

“nothing”

“My friends talking to me throughout the day”

Question 9: Do you have a role model in life? If so, who?

“Mom, she was a helicopter pilot in the coast guard , Major and Master Gunny, they are very helpful in my ROTC career”

“My grandma because she raised me and taught me that I should always look for the good in people and give second chances.”

“Yes, my older sister and my dad. They both strive every day to work their absolute hardest regardless of how difficult it gets, and I have always looked up to them for that. They have strong work ethic and dedication.”

“Yes, my mom. My mother has raised me as a single mom, supported us with more than one job, and put herself through school again. She inspires me when it comes to support. No matter what she’s always provided. I hope that when I’m of age, with a family that I’ll be as supportive, giving, and loving as my mom is.”

“Yes, my mother and sister. My sister is the first person in my family to go to college, and my mom is the only female general manager of a K**** dealership in the southeastern united states.”

Question 11: What do you feel motivates you in Algebra II?

“Nothing much”

“Wanting better grades for my future” “ending it with a good grade” “To pass so I don't have to take it anymore”

“I want expand my knowledge.”

“the fear of failing math.”

“not much”

“Getting a good grade in the course.” “Keeping a good grade”

Appendix D

Summary of Student Interviews

1. Did any questions from the survey stand out to you? Why?

S1. The one question where it was like ‘who inspires you/who do you look up to, something like that’ I hadn’t really thought about that and it just kind of took me a minute, I couldn’t think of anything. I think I put, I might have put my mom, I’m not sure, I might have put no one, I can’t remember.

S2. Yeah, one answer, a question was ‘how interested are you in math?’ and one of the answer options was ‘math is the bane of my existence’ and that was the one I picked.

S3. The one about bad or good experiences with math, I had a good math teacher in 8th grade, just a really nice guy (good experience). My freshmen year, was just constant GMM work I didn’t understand, almost failed because of it (bad experience).

S4. One that I remember was something like ‘what motivates us to do well in the class’ or something like that, and I said graduation. When something gets hard, I just think about the end goal.

2. Of the categories of school belonging, prior academic achievement, and student autonomy, which impacts you the most?

S1. Probably the one, where I was good at math before, and I am trying to keep that pace (Prior academics).

S2. I don’t know, nah not really.

S3. Probably the prior academics one, a problem in 8th grade, I was the only one who got it right, that is the only one I can think of.

S4. A bit of two, I think my friends help me and when I did good on a quiz, it makes me want to pay close attention in class so I can do good on the next quiz, something like that.

3. Are you, in general, motivated for math? For school?

S1. Yes, most of the time.

S2. Motivated to not fail, other than that, no.

S3. Yes, just so I could pass it and be done. And get my GPA high/higher.

S4. For graduation. When something gets hard, I just think about the end goal.

4. Can you think of any incident which increased your motivation by a large amount?

By a small amount? For how long?

S1. When I get a test grade back, when I get good grades, it makes me feel better. And when I understand the math real well, I like doing it. Stuff like that. Lasts for a day or so.

S2. I don't know, probably if my grandma threatened that she would whoop my A** if I don't pass, that kind of motivated me. Lasted until I was passing.

S3. None by a lot, I can't think of or a little

S4. I don't know honestly, probably just everyone telling me that I'll do good, not to worry, stuff like that. It had an effect. Just for a bit though.

5. Can you think of any incident which decreased your motivation by a large amount?

By a small amount? For how long?

S1. If I got lower test grades, or didn't understand what was going on it would decrease it a little bit, but I understand I would have to study and do my corrections and all that.

S2. Waking up in the morning can decrease my motivation by a lot. Same with coming here, having to deal with people. Depends on how long, could be all day, could be an hour or so.

S3. Doing poorly over and over, that would decrease it, like freshmen year with GMM.
Would really last until it is over, however long that takes.

S4. just excessive amount of work or, I don't know honestly, maybe if my friends aren't here a certain day.

6. Can you think of any factors that would increase/decrease you motivation by a lot/little? Do you seek out these factors?

S1. Not really, maybe if I had more friends interested in math it would increase.

S2. I said it before, Algebra II is the bane of my existence, can't get better or worse much.

S3. failing a test, one instance is a little, if it happens again and again, it lowers motivation by a lot.

S4. Sometimes, I have friends help me out to avoid getting overwhelmed. That would help.