MATHEMATICS SELF-EFFICACY AND ITS RELATION TO PROFICIENCY-PROMOTING BEHAVIOR AND PERFORMANCE

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ABSTRACT

Mathematics Self-Efficacy and Its Relation to
Proficiency-Promoting Behavior and Performance

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The purpose of this study was to verify Bandura's theory on the relationship of self-efficacy and performance particularly in mathematics among high school students. A rural school in the Philippines was selected for its homogenous student population, effectively reducing the effects of confounding variables such as race, ethnic and cultural backgrounds, socioeconomic status, and language.

It was shown that self-efficacy was a positive but minor predictor of future performance only for male students who previously had higher mathematics grades. The effects were different between genders. It was not a strong predictor for women regardless of previous grades, and men with weaker mathematics skills. On the other hand, mathematics self-efficacy was predicted by previous mathematics achievement for women; and also the number of siblings and parental education for the higher performing women. The use of a second language in the mathematics classroom negatively affected confidence and performance.

It was also found that there were differences in terms of academic behavior, peers, and family life between students with high and low self-efficacy. Positive behaviors were found for all female students regardless of self-efficacy levels and fewer were found among men. Negative behaviors were only found among low self-efficacy students. No differences were found in terms of the lives and families of the participants, but the interviews revealed that family members and their experiences of poverty affected educational goals and ambitions.

In terms of other dispositional factors, students expressed classroom and test anxieties, concerns of being embarrassed in front of their classmates, and beliefs that mathematics was naturally difficult and not enjoyable. The students who did not talk about any of these themes were better performing and had higher self-efficacy scores.

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Dedicated to my parents, Rene & Cathy,

Isa, Rap, Ina, Joe and Sebastian

CHAPTER 1

INTRODUCTION

1.1 NEED FOR THE STUDY

When a student says, "I can't do math," are performance and achievement necessarily affected? Many teachers and many more outside academia accept it to be true as evidenced by the ubiquity of the catchphrase "You can do it if you believe!" When Albert Bandura published his seminal work on self-efficacy in 1977, he proposed a theory through which this question might be viewed and resolved. As he defined it, "perceived self-efficacy refers to beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments." (Bandura, 1997) He hypothesized that this strong and powerful conviction raises achievement in a particular domain by causing behaviors that promote better performance, which in turn reciprocally increases self-efficacy (Bandura, 1997; Williams & Williams, 2010). Researchers have since then found evidence that it plays a role in many human pursuits including mathematics learning. Some findings imply a weak relationship (House, 2001; Norwich, 1987; Puklek Levpušček & Zupančič, 2009) while others were stronger (W. L. Fan, Suzanne F.; Arroyo-Giner, Christina A.; Wolters, Christopher A., 2009; Pajares & Kranzler, 1995; E. M. Skaalvik & S. Skaalvik, 2004).

The overall goal of this study was to explore the relationship between self-efficacy, academic behavior, and performance, which will pave the way for future studies on their causal relationship. There were several reasons why more research in this area was necessary. First, although this is an idea to which many teachers subscribe, it has not been studied comprehensively and some studies even point towards a moderate or weak predictive value. It is not clear if self-efficacy is a predictor of performance for all types of students and if it is a promising "lever" teachers can adjust to improve student learning. This study adds evidence and clarity to this relationship by using data from a small, rural and homogenous village in the Philippines where the effects of confounding variables such as race, socioeconomic status, language, ethnic backgrounds, school characteristics, and teacher effects are minimized. The mixed-methods approach, using both quantitative and qualitative data, also provided the necessary triangulation that validated the results of the study.

Second, more observational studies need to be conducted within real classroom settings using actual school data for it to be more relevant to teachers. It is more useful to know if students' beliefs affect performance in class rather than knowing the influence of self-efficacy beliefs on specific mathematics questions to their performance on the same set of items. Most of the previous studies employed overly task-specific instruments such as confidence in solving arithmetic problems (Bandura & Schunk, 1981), day-to-day applications of mathematics which were also arithmetic-intensive, and typical algebra word problems (Betz & Hackett, 1983) – just small subsets of what students actually learn in class. Although these studies were highly important to infer the relationship of self-efficacy and performance, and this specificity increased the predictive power of self-efficacy (Bandura, 1997), it somehow lost its relevance (Lent & Hackett, 1987; Pajares, 1997).

Third, there is a lack of information on how researchers chose the statistical methods they employed for their studies. Many assumptions were made that were not explained to readers such as the appropriate use of correlation coefficients and the development of regression models. This study was an attempt to clarify these details. With the proliferation of advanced statistical techniques such as structural equation modeling (SEM), there are still doubts whether these can actually shed light to this matter as opposed to simpler statistical tests and data gathering procedures (Freedman, 1987). In this research, the results of ethnography and regression analyses were found complementary to previous ones found through SEM.

Finally, there is a need to validate this theory for other cultural groups. Because studies have only concentrated mostly on American, primarily Caucasian (E. L. Usher, 2009), and European students, the applicability of these ideas to other populations has not been thoroughly verified. Previously, others have written that culture plays a role in the effectiveness of different psychological methods (Van de Vijver & Leung, 2000). There are literature that suggest the inappropriateness of using questionnaires to gather data – for instance for Filipinos who would only provide information within a "give-and-take" conversation and not a traditional interview or survey (Pe-Pua, 1989); and Chinese groups who value modest behavior and practice self-effacement as a way to present themselves to others (Chen, Bond, Chan, Tang, & Buchtel, 2009). It was also proposed that adolescents from Asian cultures have weaker self-efficacy compared to their "western" counterparts – a phenomenon common to societies valuing collectivism, those with large power distances, and strong uncertainty avoidance (Oettingen & Zosuls, 2006). Despite these nuances, this study adds to the growing body of evidence that the construct of self-efficacy is generalizable across different cultures (Pajares & Urdan, 2006).

1.2 PURPOSE OF THE STUDY

This study had four purposes: first, to collect information that supported Bandura's theory that self-efficacy is a predictor of proficiency-promoting behavior; second, to create a mathematics self-efficacy measurement that was more relevant to the classroom and students; third, to verify that this theory can be generalized to a different culture; and lastly, to propose a theory that explained why self-efficacy levels predicted performance in varying degrees across different groups.

The mixed-methods approach was a fundamental feature of this research. The ethnographic part of this study added to a previous investigation among American middle-school students, where semi-structured interviews were utilized to assess beliefs and examine the heuristics they used as they formed their mathematics self-efficacy (E. L. Usher, 2009). It was ideal to reveal the relevant behaviors that students with high self-efficacy developed to achieve competency (E. L. Usher, 2009). Using this methodology in the Philippines allowed for exploration on the complexities of this relationship and revealed the finer details of the factors that influenced achievement. This project can be used in the future as a template for more extensive investigations.

The research questions for this study were:

1. What is the relationship of mathematics self-efficacy and performance?
2. What are the differences between students with different levels of self-efficacy? The following areas will be compared:
    a. Academic behavior
        i. Amount of time spent on learning lessons and completing homework
        ii. Initiative to learn mathematics beyond what is required in class
        iii. Persistence when faced with challenging and uncommon mathematics problems

iv. Classroom participation

v. Help-seeking behavior

b. Peer group (close friends only)

i. Activities with friends

ii. Academic group discussions

iii. Activities related to school

iv. Expectations from friends

v. Academic beliefs of friends

c. Family life

i. Extra-curricular activities involvement

ii. Parental expectations and beliefs about education

iii. Sibling expectations and beliefs

3. What variables are related to mathematics self-efficacy?

1.3 PROCEDURES OF THE STUDY

An overview of the procedures is explained here according to the sequence of research questions outlined in the last section. Chapter 3 explains the details of this methodology.

What is the relationship of mathematics self-efficacy and performance?

Two hundred forty one 16-year old Filipino 4th year high school students were asked to assess their self-efficacy beliefs in mathematics using a questionnaire with items based on the curriculum of the Department of Education in the Philippines. The self-efficacy scores that were collected were analyzed together with the 1st Quarter Mathematics grades, the overall Third Year Mathematics Grades, and other information that were collected in the survey. Next, interviews were conducted for 9 selected students that were representative of the 241. Interviews were coded and analyzed according to themes that emerged. Both parts of the study revealed trends that supported the claim that self-efficacy is a predictor of school mathematics achievement.

What are the differences between students with varying levels of self-efficacy? What variables are related to mathematics self-efficacy?

Similar to the first question, both the survey and the interviews were used to gather data to answer these questions. The interviews were primarily used to compare students with varying levels of self-efficacy. These were semi-structured and the questions sufficiently open-ended that allowed for a dialogue between the researcher and the students. The design was based on the interview protocol (E. L. Usher, 2009) developed, which included 15 questions on the student's background, mathematics experiences and self-efficacy, mathematics learning environment, peers, affective and physiological response to math, and sources of self-efficacy in mathematics.

In addition, several days were spent observing classrooms and meeting with teachers. The time frame for data collection was two months, with the first weeks dedicated for "immersion" that allowed the researcher to build rapport with the teachers, staff, and students. They were also used to observe classroom dynamics, student extra-curricular activities, and the general atmosphere of the community.

CHAPTER 2

LITERATURE REVIEW

2.1 SELF-EFFICACY RESEARCH IN MATHEMATICS EDUCATION

Beliefs as a psychological construct was studied beginning at the turn of the 20th century but waned because of the rise of behaviorism (Leder, Pehkonen, Törner, & ebrary Inc., 2002), which deemed studying observable behavior in people the only appropriate method when studying the mind. This paradigm was replaced with the rise of cognitive psychology in the 1950's that aimed to comprehend this mind and its internal architecture using mechanistic analogies (Leder et al., 2002). With this trend, Mathematics Education researchers were also influenced in this direction using cognitivistic constructs to understand mathematical thinking. With this point of view, researchers placed non-cognitive factors – affective variables such as beliefs, emotions and moods – on the periphery (McLeod, 1992). In an attempt to change this trend, Silver in 1984 called for a "new wave of research" that will study affective variables and beliefs that affect mathematics learning and teaching (Silver, 1985).

Although research on beliefs, frequently grouped with other affective factors, was sparse at that time, there were a few investigators who conducted studies in this area. In 1956, Dyer, Kalin & Lord concluded that more information were necessary to explain what causes negative attitudes towards modern mathematics curricula (Aiken, 1970). Another investigator, R.L. Feierabend, wrote about attitudes on mathematics in an article titled "Review of Research of Psychological Problems in Mathematics Education" in 1960 (Aiken, 1970). In 1970, Aiken published a report on the progress of research in this area, and self-efficacy beliefs (self-confidence) were also studied. Crosswhite published his study on the correlation between different mathematics-related beliefs and performance in 1972 (Crosswhite, 1972). Again in 1976, Aiken reviewed key literature because of what he felt was the growing interest in this area (Aiken, 1976).

In 2002, as a result of a specialist international meeting held at the Mathematisches Forschungsinstitut Oberwolfach in November 1999, the book “Beliefs: A hidden variable in Mathematics Education?” was published (Leder et al., 2002). In it, authors expressed that this research area did not have any cohesion, lacked a comprehensive theory, and needed to be structured (Op 't Eynde, De Corte, & Verschaffel, 2002). Many researchers did not provide clearly operationalized constructs and definitions (Furinghetti & Pehkonen, 2002). In response, this working definition was proposed as a first attempt to describe the concept of beliefs:

> Students’ mathematics-related beliefs are the implicitly or explicitly held subjective conceptions students hold to be true about mathematics education, about themselves as mathematicians, and about the mathematics class context. These beliefs determine in close interaction with each other and with students’ prior knowledge their mathematical learning and problem solving in class (Op 't Eynde et al., 2002).

The definition categorizes beliefs into three areas – beliefs about mathematics education, self-beliefs, and beliefs about the environment where mathematics is learned. Self-efficacy beliefs – which have been misunderstood by other researchers as self-concept (Bandura, 1997) – were categorized under the second area. It may have been called self-confidence (Fennema, 1976), which has been confused with self-concept (Schoenfeld, 1989), other beliefs (Hammouri, 2004) and equated to an assessment of past achievement (Kloosterman, Raymond, & Emenaker, 1996). Some studies also combined other attitudes with self-efficacy (Hackett & Betz, 1989).

This reflects the fact that educational researchers have not fully dealt with the conceptual framework of beliefs until recently (Op 't Eynde et al., 2002). However, there has been a push to clarify many issues. As one author writes, “a discussion on the nature and structure of beliefs and their relation to knowledge can no longer be avoided (Op 't Eynde et al., 2002).” It was therefore beneficial that current researchers have adopted Bandura’s self-efficacy theory as a foundational base.

This development is advantageous because psychologists have been building up evidence and collecting data to support the details of this theory since the 1970’s. Through their efforts, they have operationalized and defined many constructs, and elaborated on models that explain the reciprocal causal relationship of self-efficacy beliefs and performance. Nevertheless, mathematics education researchers were also hypothesizing about the same ideas around that time – such as the effect of confidence to achievement and achievement to confidence (Reyes, 1984).

Clearly there were differences between the research activities and goals of mathematics education researchers and psychologists. Bandura even heeded educational researchers to ensure that what they were actually measuring was self-efficacy and not other constructs, and to use more specific belief assessments to increase predictability (Bandura, 1997). Bandura’s recommended methodology was to assess individuals’ self-efficacy on performing tasks, such as mathematics questions, and assessing performance on the same set of questions. As an example, he assessed self-efficacy in one of his earlier studies by flashing subtraction problems for 2 seconds, after which, students rated their perceived self-efficacy in answering the question (Bandura & Schunk, 1981). He then used the same questions to test performance. However, this may have been deficient for educators who may have found the relevance of these methods limited. As such, many of the studies conducted by educators including this one, have somewhat modified this assessment to make it more relevant to the context (Pajares & Urdan, 2006).

2.2 THEORY OF MATHEMATICS SELF-EFFICACY

Albert Bandura defined self-efficacy as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments." (Bandura, 1997) People who have high self-efficacy beliefs in a particular domain "act, think, and feel differently" from those with low self-efficacy (Bandura, 1984). They are more persistent, more effective, and more self-regulated (Magno, 2008; Pajares & Urdan, 2006). Bandura hypothesized that this belief is domain-specific, which means it cannot be expected that a person is self-efficacious in all human endeavors (Bandura, 1997).

Mathematics self-efficacy is the belief in a one's ability to learn and succeed in school mathematics. It is a student's conviction that adopting certain behaviors will result in achievement in the mathematics classroom however the student defines it. This belief was shown to predict mathematics performance better than any other mathematics-related belief construct (Liu, 2009; Pajares & Miller, 1994).

Self-efficacy is not merely a reflection of past achievements (Bandura, 1997). There are capable students with low and high self-efficacies, and there are less capable ones with varying levels of this belief (B. J. C. Zimmerman, Timothy J., 2006). Furthermore, high self-efficacy causes changes in behaviors that influence future performance regardless of previous achievement (B. J. C. Zimmerman, Timothy J., 2006). In a previous experiment, students were asked to answer a series of mathematics tests. After each test, a group of students were told that compared to the other students, they were performing poorly; another group was told that their performance was above the other students. This was regardless of their actual performance in these exams. The theory predicts that self-efficacy will be raised for the students who were told that their performance was better, and in turn, this will influence the results of the next exams. It turned out that their performance improved after inducing self-efficacy (Bandura & Schunk, 1981).

2.3 SOURCES OF SELF-EFFICACY

Bandura proposed four sources of self-efficacy: mastery experiences, vicarious experiences or modeling, persuasion, and physiological and affective factors (Bandura, 1997). This was later verified by other researchers (E. L. Usher, 2009; Ellen L. Usher & Pajares, 2009). Mastery experiences or the actual experience of succeeding is the most important and induces the most lasting self-efficacy beliefs (B. J. C. Zimmerman, Timothy J., 2006) especially for men (Zeldin, Britner, & Pajares, 2008). Success must be consistently experienced to actually induce self-efficacy, and sporadic success or failure events would not affect long-term confidence (B. J. C. Zimmerman, Timothy J., 2006).

Vicarious experiences or modeling are encountered through other people. When a student compares oneself to another, self-efficacy may increase depending on how the other person is viewed. If the other person is seen as somebody who is able to do a particular task, say mathematics, but is viewed as less capable, then the student would more likely believe that he or she is capable (Bandura, 1997). Students compare themselves to other peers whose capabilities are not too far from them. Self-efficacy is not induced if another person is viewed as superior;

therefore peer groups and classmates are important sources of self-efficacy among adolescent students.

Although persuasion is the commonly thought source of confidence, it is the least effective and at most, it only induces short-term self-efficacy (Pajares, 1996b; B. J. C. Zimmerman, Timothy J., 2006). It is not enough that students hear other people suggesting that they can do something; the experience of actually accomplishing the task is necessary. Nevertheless, there were studies that have shown that women were more affected by persuasion than men (Zeldin & Pajares, 2000).

2.4 SELF-EFFICACY AND MATHEMATICS PERFORMANCE

Most of the research on mathematics self-efficacy concluded that it influenced, or at least predicted, performance. Most quantitative studies have found only weak to moderate Pearson correlation values (Cooper, 1991; Hackett & Betz, 1989; House, 2001), and regression and path analysis coefficients (Caprara, Vecchione, Alessandri, Gerbino, & Barbaranelli, 2011; W. L. Fan, Suzanne F.; Arroyo-Giner, Christina A.; Wolters, Christopher A., 2009; Kitsantas, Ware, & Cheema, 2010), with some of the highest ones just above 0.60 (Pajares & Kranzler, 1995; Randhawa, Beamer, & Lundberg, 1993; E. M. Skaalvik & S. Skaalvik, 2004). Even so, psychologists and educators have never insisted that self-efficacy was the most important nor the most significant predictor of academic performance (Schunk, 2006). Therefore, despite the absence of a strong "linear" relationship between the two, most have concluded that self-efficacy was still essential. There were some studies where authors suggested that self-efficacy was an insignificant predictor of performance (Bandalos, Yates, & Thorndike-Christ, 1995; Norwich, 1987), but it was after admitting that the relationship was more complicated than previously thought or collinearity with another variable existed.

Self-efficacy studies have been conducted among elementary, middle school, high school, and college students. Research relevant to this study included those studies conducted with high school students, especially the international studies that showed that the construct can be used for other cultures. Despite the differences in terms of levels and cultures, a common theme that emerged was that women had lower self-efficacy levels than men (W. L. Fan, Suzanne F.; Arroyo-Giner, Christina A.; Wolters, Christopher A., 2009; S. Skaalvik & E. Skaalvik, 2004; Williams & Williams, 2010). Nonetheless, the positive relationship between performance and self-efficacy for both men and women was still present.

2.5 PEER GROUPS, FAMILY AND SELF-EFFICACY

Previous research in the United States has shown that factors aside from the school environment and the teacher affected academic performance. However, there are only a few studies that simultaneously examined the relationship of these groups to the students' academic self-efficacy (W. L. Fan, Suzanne F.; Arroyo-Giner, Christina A.; Wolters, Christopher A., 2009). Peers increased self-efficacy through modeling and persuasion, and potentially through the support that brings about achievement experiences such as group work (Oettingen, 1995). Those with high self-efficacy had close friends who valued academic success and also had high levels of these beliefs (W. L. Fan, Suzanne F.; Arroyo-Giner, Christina A.; Wolters, Christopher A., 2009).

In addition, parenting was related to academic self-efficacy (Adeyemo, 2005; Weiser & Riggio, 2010) and the parents' academic goals for their children may be slightly related to their confidence (W. Fan & Williams, 2009). Performance was also related to the quality of the homecare environment and neighborhood, with the presence of affluent and educated professionals increasing achievement (Dupere, Leventhal, Crosnoe, & Dion, 2010; Lareau, 2003). Despite the findings, there is reason to be cautious on assuming the generalizability of these studies to other countries because as other researchers have discovered, even among the different ethnic groups in the United States, the effects of peers and family life can be very different (Steinberg, Brown, & Dornbusch, 1996).

2.6 GENDER AND EDUCATION IN RURAL PHILIPPINES

As with any society, children are socialized into gender roles at an early age and it increasingly affects their education and personal lives. Although not as rigid compared to other cultures (Hindin, 2005; Illo, 1994), Filipinos have clearly-observable gender delineations. This is important because it was found that in countries where gender roles are less strict, there is a stronger relationship between women's education and labor force participation (Cameron, Dowling, & Worswick, 2001). In the rural areas, men provide for the needs of their family and their occupations constitute work done outside the home: farming, fishing, or paid employment (Illo, 1994). The role of women is primarily domestic – caring for the children and doing house chores; but it can overlap with men, for instance, when they start their own enterprises. They can also assist their husbands with typical male jobs but their roles would always be secondary.

Children regardless of gender are taught house chores at home, but as they get older, men less frequently do these chores and only at times when the wife is not able to (Illo, 1994).

Because of the women's focus on domestic responsibilities, most of their time is used up for this. Both wives and daughters have little leisure or free time, especially if the mothers are working outside the home and the daughters are forced to assume these tasks. Although the men can help out in these roles, they are not expected to. In one study, it was found that fathers more often withdrew their sons to help with farm work, while mothers did not. Nonetheless, she expected her daughters to go home as soon as school ends to help with domestic work (Cruz-Doña & Martina, 2000). This affects how much time is available for educational activities.

Certain stereotypes are widespread in these areas that affect educational goals and achievement. Like other cultures, men are expected to be aggressive and strong. In contrast to other cultures, the concept of masculinity is tied to marriage and being able to support the family (Rubio & Green, 2011). It affects school achievement because education is viewed as delaying the time to start earning a living, since among poorer Filipinos in rural areas, there is little economic incentive to attain more education (Cruz-Doña & Martina, 2000) (Appendix E). Women on the other hand are expected to be good mothers. They are expected to be more studious and intelligent (Illo, 1994), characteristics that might be viewed as feminine.

In previous research, it was found that parents push their daughters to attain more schooling as compared to men (Estudillo, Quisumbing, & Otsuka, 2001b). It would be more economical for men to go fishing or farming, than continue with school and delaying earning a living. On the other hand, women rarely become fishermen or farmers, and there is more economic incentive to finish school to become employed in the future as domestics, nurses and other service-oriented employees. In fact, it was found that in terms of wealth distribution activities of parents who owned land, men were more likely to have this land passed on to them than the women (Estudillo, Quisumbing, & Otsuka, 2001a; Estudillo et al., 2001b). It was expected that the sons would find better and more productive use of the land. To equalize this distribution, women received more support in educational financing.

This perhaps results to more men dropping out of school and more women attaining post-secondary education (Hindin, 2005). It was also found that there was a higher reported delinquency rate among males (SHOEMAKER, 1994). In one study, it was found that men were attracted to unskilled labor jobs and male-dominated careers that did not need higher educational attainments. Females on the other hand were more attracted to professions such as nursing, the arts, commerce or teaching (Primavera et al., 2010). Based on these findings, it becomes very clear that these preferences, beliefs and expectations play a big role in shaping the differences in male and female educational achievement and attainment.

2.7 BILINGUAL EDUCATION

English is the lingua franca for scholarly activities, government operations, and diplomacy in the Philippines (Pascasio, 1973). It was President William McKinley who mandated its use in all schools in 1900 during the early years of the American occupation (Bernardo, 2004). He first ordered teaching in the local languages, but it was later found to be difficult since the first teachers who worked in the new American public schools were all non-locals. It was also adopted to unite the different ethnic groups comprising the archipelago and to connect Filipinos to the international community. Nowadays, it is still the preferred language because it imparts social power, prestige (Gonzalez, 1998) and upward social and economic mobility (Young, 2002).

Although studies are limited, many researchers have found that this system systematically disadvantages many students (Bernardo, 1999), not only in the Philippines but also in other countries using a second language (L2) for mathematics such as Malaysia (Lim & Presmeg, 2011). Particularly in the rural areas, English exposure is very low (Young, 2002). This makes learning mathematics in this language very ineffective. A recent study found that it was more beneficial to use the first language (L1) in learning Mathematics, Reading, Filipino and the English language (Walter & Dekker, 2011). Three experimental and another three control groups were compared for this research, which found a 54% gain in grades if the local language was used. Higher gains, at 200%, were documented in another study by the same researcher. Even for learning Filipino and English, using the local language resulted to very large gains.

Previous research also show that students found mathematics word problem solving difficult not because of poor mathematics skills but difficulty in understanding the text (Bernardo, 1999). It was found that from 2^{nd} grade to 4^{th} grade, incremental improvements in test scores resulted from improving language proficiency and not better mathematical understanding. It was also found in the same study that high-achieving students did not have a problem, perhaps because mathematics skills are highly correlated with language skills, which meant that the weaker students had an extra disadvantage to deal with. The same author found that correct understanding was more likely if L1 was used and incorrect understanding was more likely for L2 (Bernardo, 2002). Students who were taught in L1 were also more likely to apply straight-forward procedures and produce expected answers (Bernardo & Calleja, 2005).

CHAPTER 3

METHODS AND IMPLEMENTATION OF THE STUDY

3.1 DESIGN OF THE STUDY

The methodology used for this investigation was mixed – combining the statistical analysis of questionnaire responses and ethnography. While collecting data, the assumptions and models used were constantly revised based on insights from the observations and interviews. At the same time, the results of the self-efficacy questionnaires were interpreted in terms of the qualitative findings. This was important because little is known about the links of mathematics self-efficacy and performance among rural students in the Philippines and Filipinos in general. The theory tested in this study relied strongly on others conducted in different countries, the majority of which came from the United States. Although many aspects would be similar, it was expected that the educational setting and cultural factors were different. Nevertheless, the construct of self-efficacy can be assumed to be universal based on previous findings (Oettingen, 1995).

Specific mathematics questions were used to measure this latent variable combined with general mathematics capability assessments. The self-efficacy items ranged from beliefs on the ability to answer specific word problems, to more general self-efficacy beliefs on fast arithmetic, successfully learning algebra, and solving fraction problems. The assumption made was that by using these varied items, this belief can be adequately measured.

It is known that socio-cultural and economic factors affect mathematics performance. This site in the Philippines was selected in an attempt to eliminate many confounding variables that would have otherwise been controlled statistically if the study was conducted in any other heterogeneous site. These factors were eliminated because all the students had the same backgrounds; parental educational attainments and occupations were almost similar; there was a single first language among the students; the culture, ethnic background, and the lifestyles of the students were similar; there was only one teacher with no differentiation of lessons except for the Honors section; and everybody lived in this small rural town. Job opportunities were all the same; and so were diet and health care. In effect, it more convincingly showed how self-efficacy affected achievement. It adds important evidence which is different from other observational studies that have not controlled for these variables.

3.2 SETTING AND CONTEXT

The school was located on the outskirts of a small rural town south of Manila. Although the residents of the town center were relatively affluent, the general perception was that outside this small area, the people were poor. There have been some improvements economically, but there remains a marked difference between town-center people and those outside, colloquially called “farm people,” although the name no longer implied they were farmers. This setup was a remnant of an old system where the elite owned much of the land, and the peasants worked for them. The elite were in the town-centers and the peasants were outside.

Poverty was salient in this area. The students had simple lives, going to school full-time while their parents worked as factory workers, servants, vendors, and other lower salaried employees. Much of their time outside school was spent either doing chores at home, or hanging out with friends in the local open market, in the town "plaza" in front of the Catholic church which was the center of the town, a computer shop where they had internet access, or the river or a field nearby. Common activities among peers would be "sound-trips" or listening to music, group singing, or basketball. Men commonly hung out with their male friends, while the women were expected to go back home right after school to help out with the chores.

Teachers were seen as authority figures not just by the students but also by the parents and the community. Although there were times it did not appear like it because of classroom management problems and PTA political squabbles, for the most part, they were highly respected, regarded, and sometimes feared. A common slang the students used was "terror teacher." These were instructors who were known to raise fear among the students because of the manner of speech, or threats of low grades and failing marks. This particular concept does not have any parallels among American students. The word "fear" is used here but the more accurate translation is an emotion between school anxiety and being terrified. Their mathematics teacher was thought to be a "terror teacher" at the beginning of the school year when classroom observations were being conducted. Students "feared" this teacher because of stories from upper classmen. Many of the fears expressed by the students were related to this.

There were many practices in this school that contrast to what American educators are acquainted with. For example, a teacher might openly disclose a student's misbehavior in front of other students. Exam scores may be ranked and announced to everyone, and low performing students may be interrogated or reprimanded inside the classroom. The teacher may even ask for reasons why such performance occurred. In one instance, the teacher checked a student's answer on a quiz and announced it to everyone. Among the students and teachers, there was no strong sense of individual privacy and there seems to be no problem with this way of thinking among them. Being embarrassed in front of everyone in class was something students did not particularly like but was considered a normal part of school.

Another very important aspect of the educational experience of the students was learning the adopted lingua franca of the society. When it came to communication, English was the language of prestige in this country. The elite and the most educated Filipinos spoke and wrote in this language. Illiteracy in English implied poverty, low-classness, and the lack of intelligence. Not being able to express oneself in English properly elicited heckling from other students. It was a source of embarrassment even in the mathematics classroom. In a few instances, it also triggered self-defacing statements and attitudes. This was despite the fact that only a miniscule number was fluent in the language.

The last point needed to be mentioned was the role of gender in this community. First, there was no pervasive belief that men were better in mathematics than women. In fact, there was no stereotype that they were better in school. In the 2011 Global Gender Gap Report, the Philippines ranked 7th in the world in terms of gender equality, and first, together with several other nations, in terms of equality in educational attainment (World Economic Forum.). However, there were clear differences in expectations from male and for female students. It was more acceptable for men to have low academic achievement than women. In one interview, a female student said that she had to do better in class recitations and be able to answer the teacher’s questions because she was already a grown-up woman. Initially, it was assumed that gender was an insignificant variable, but was later found to be related to mathematics performance and self-efficacy.

3.3 PARTICIPANTS

There were 390 4th year high school students in this school at the time of the study. Of the 390, 314 agreed and were allowed by their parents to participate in the survey. On the day the survey was administered, 241 students completed the questionnaire, representing a response rate of 62% for the whole fourth year class. The students were divided into 6 sections with around 65 students per classroom. There was one Honors (H), and five regular classes (R1 to R4). The students in the Honors section were placed there based on their overall average for all their classes. In total, there were 132 females, 55% of the participants, and 109 males, 45%. For the Honors class, there were 29 females and 25 males.

Section R3 had peculiarly fewer respondents compared to the others, 4 females and 3 males. This was because 54 parental consent forms were not collected from the students. On the other hand, R5 had 19 absences during that day explaining the lower number of students.

TABLE 1. NUMBER OF STUDENT PARTICIPANTS PER SECTION

		SECTION					
		R1	**H**	**R2**	**R3**	**R4**	**R5**
		Count	Count	Count	Count	Count	Count
GENDER	Female	23	29	25	4	24	27
	Male	24	25	24	3	16	17

3.4 SCHOOL AND CLASSROOM OBSERVATION

Two weeks were spent in the school to observe mathematics classes, talk to the principal, the teachers, and some members of the community. In total, three full days were spent observing 15 different fourth year high school classes with the same teacher. No audio or video recordings were made and observations were simply written down for each class. In general, the themes observed were on the interaction between the teacher and the students, student participation and behavior, the lesson, the teaching method, and the classroom setup.

Conversations with the principal, other teachers, and administrators from the Department of Education were also noted. Despite being unstructured, almost all the informal meetings were centered on mathematics because the research project was announced beforehand to other members of the school. The principal talked about general day-to-day administration, fund raising, the PTA, goals for the school, the politics of school administration, and her thoughts on mathematics education. The others also shared their insights on mathematics but were mostly curious about the research itself and its logistical aspect.

3.5 SELF-EFFICACY QUESTIONNAIRE

After the necessary consent forms were collected from the students, the self-efficacy questionnaire was administered in each of the 6 classes. All the students completed the survey in less than 20 minutes and everything was completed in one day.

The survey form included items on family background, parental education, the names of their closest friends, and the self-efficacy questions. In total, there were 15 mathematics self-efficacy and 3 non-mathematics items, which were included to guide the students in the rating process. The questions were based on what students have already learned and were taken from the curricula provided by the Department of Education. These items are listed below with those originally presented in Filipino marked "F." Each one was labeled from A to R, which were used to compute different self-efficacy scores.

A. I can run for 30 minutes. (***F***)

B. I can solve fractions. (***F)***

C. Bikes and cars are parked in front of the mall. You know that there are 16 in total, and if the number of wheels for all of them is counted, the total is 38. How many bikes are there? (***F***)

D. I can solve this: x+5=7. (***F***)

E. Determine whether each ordered pair is a solution of the system. $\begin{cases} \boldsymbol{x+y=2} \\ \boldsymbol{x-y=4} \end{cases}$

F. A cage contains birds and rabbits. There are sixteen heads and thirty-eight feet. How many birds are there in the cage?

G. I can learn how to answer quadratic equations like this: $\mathbf{x^2 + 10x + 25 = 0}$. (***F***)

H. I will finish reading a novel. (***F***)

I. I can do fast math in my head. (***F***)

J. In statistics, if the mean of 5 numbers is 4, the mode is 1, and the median is 5, what are those 5 numbers? (***F***)

K. I can do algebra. (***F***)

L. I can or I can learn how to change the tires of a vehicle. (***F***)

M. Exponential functions are functions where $f(x) = a^x + B$ where *a* is any constant and *B* is any expression. For example, $\mathbf{f(x) = e^{-x} - 1}$ is an exponential function.

N. I can learn the stuff we study in math class. (***F***)

O. I can or I can learn how to solve equations. (***F***)

P. Quadratic equations are functions that look like this: $ax^2 + by + c = 0$. The variables *a*, *b*, and *c* can be replaced by any number. For example, $\mathbf{5x^2+2y + 8 = 0}$. (***F***)

Q. What number can be substituted for x and y to make these equations true: $x + y = 10$ and $x – 7y = 5$? (***F***)

R. For a set of five whole numbers, the mean is 4, the mode is 1, and the median is 5. What are the five numbers?

The students were asked to approximate their belief on their capabilities to answer or learn each question and rate them with a score of 0 to 100. Bandura recommended this over the Likert scale because it measured the construct more precisely (Bandura, 2006). To calculate the general mathematics self-efficacy score (SELF_EFFICACY_TOTAL), the ratings for all the items except for A, H, and L were averaged.

It can be observed that questions C and F, and J and R are equivalent. The same self-efficacy questions were presented in both Filipino and English so comparisons can be made. The *Mathematics in Filipino self-efficacy score* (SELF-EFFICACY_FILIPINO) was calculated using C and J, and the *Mathematics in English self-efficacy score* (SELF-EFFICACY_ENGLISH) was F and R combined. Finally, item M was used as a self-efficacy score for an unfamiliar mathematics question.

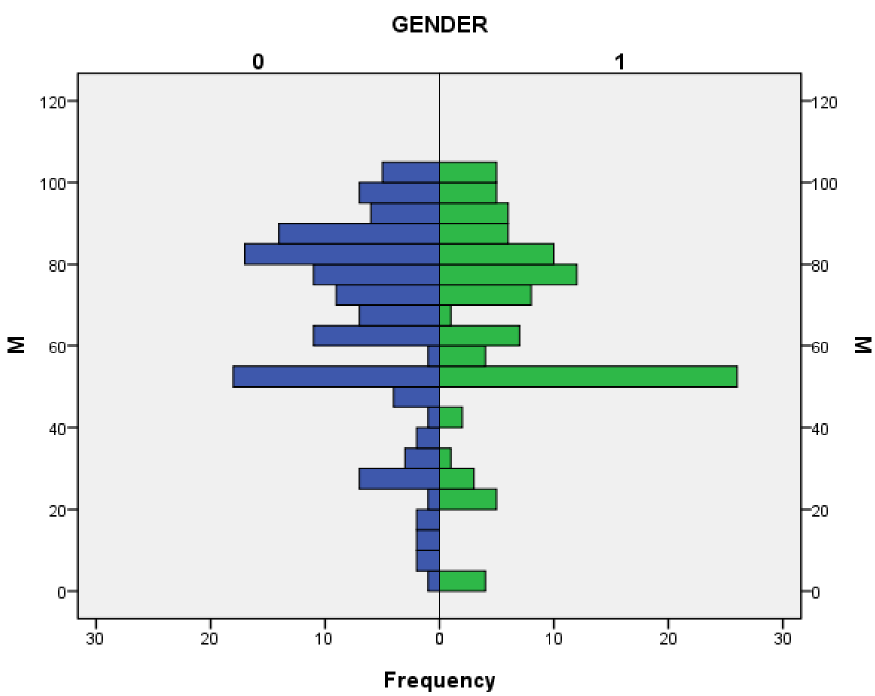
The instrument was reliable as indicated by its internal consistency with Cronbach's Alpha at 0.939. Out of the 241 sets of scores, 13 were excluded from its computation because of incomplete responses from the students. If any of the self-efficacy items were removed from the list, as shown on the Item-Total Statistics, it would not have made the questionnaire any more consistent; which meant it was not necessary to review or delete any questions. The two other sets of questions for self-efficacy in Filipino and in English had lower consistencies at 0.660 and 0.714 respectively, which was expected because fewer questions in a questionnaire tend to make the instrument less consistent.

TABLE 2. CRONBACH'S ALPHA IF INDIVIDUAL SELF-EFFICACY QUESTIONS WERE DELETED

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	**Cronbach's Alpha if Item Deleted**
B	1040.57	56138.674	.689	.519	**.935**
C	1039.32	55736.151	.586	.469	**.938**
D	1034.29	56263.718	.658	.527	**.936**
E	1040.65	55557.441	.667	.504	**.936**
F	1038.43	56345.939	.619	.517	**.937**
G	1035.29	55503.965	.735	.662	**.934**
I	1049.96	54929.979	.666	.534	**.936**
J	1051.60	54111.603	.705	.711	**.935**
K	1034.57	56069.287	.706	.627	**.935**
M	1050.00	54395.107	.762	.631	**.933**
N	1028.09	58130.942	.641	.655	**.937**
O	1030.34	56848.359	.725	.749	**.935**
P	1036.36	55430.929	.719	.610	**.935**
Q	1042.49	54556.781	.755	.629	**.934**
R	1049.14	53623.189	.784	.783	**.933**

Additional evidence for the questionnaire's reliability was the consistency between the results of the self-efficacy instrument and the findings from the student interviews. It was confirmed that the belief scores in the questionnaire matched what was found among those nine students. In most cases, students would rate an unfamiliar mathematics self-efficacy question at 50%, a "50-50" chance they would say, which was evident during the interviews. It can be seen that this matches the results of the survey. For self-efficacy item M which was unfamiliar to the students, the distribution (0 – female, 1 – male) revealed that most responses were at 50%. It shows that students understood and provided deliberate answers to the survey.

FIGURE 1. DISTRIBUTION OF SELF-EFFICACY ITEM M SCORES (UNFAMILIAR MATHEMATICS QUESTION)



The table below summarizes all the quantitative information gathered and their values:

TABLE 3. SUMMARY OF ALL QUANTITATIVE DATA FOR THE STUDY

LABEL	DATA	VALUES
SECTION	Class section	H (Honor class), R1 to R4 (Regular classes)
HONOR	Belonging to Honors Class	1 – Honor, 0 – Regular
GENDER	Male/ Female	1 – Male, 0 – Female
SIBLINGS	Number of siblings	1 to 14, *Mean* = 4.77, *Std Dev* = 2.16
FAMILY_RANK	Rank in the family	1 – First born
TRANSFER	Transferred from another school	1 – Yes, 0 – No
FIRSTQ4THYEARMATH	Grade for the 1st Quarter, 4th Year (June to August 2011)	70 to 92, *Mean* = 78.85, *Std Dev* = 4.60
FILIPINO, SCIENCE, AP, MAPEH, EP, ENGLISH, THIRDYEARMATH	Final grades for classes taken during the students' 3rd year (June 2010 – March 2011) *AP* – Araling Panlipunan (Social Studies) *MAPEH* – Music, Arts, Phys Ed, Health *MATH3YEAR* – 3rd Year Mathematics	The lowest grade is 70
FATHER_EDUC, MOTHER_EDUC, PARENTAL	Father's and Mother's highest educational attainment Parental is the higher between the two	Elementary – 1 High School – 2 Vocational – 3 Some College – 4 College – 5
A to R	Refers to questions A to R of self-efficacy instrument	0 to 100
SELF_EFFICACY_TOTAL	Mean of selected self-efficacy scores	*Mean* = 72.76, *Std Dev* = 18.00
SELF_EFFICACY_FILIPINO, SELF_EFFICACY_ENGLISH	Means of self-efficacy scores for questions presented in pairs, 1 version in Filipino, the other in English	$Mean_F$ = 67.91, $Std\ Dev_F$ = 23.25 $Mean_E$ = 69.98, $Std\ Dev_E$ = 21.66
HARDCLASSES	Mean of FILIPINO, SCIENCE, and AP	*Mean* = 80.83, *Std Dev* = 3.69

3.6 STATISTICAL ANALYSIS

The Least-Squares and Huber M-Estimator Robust Multiple Regression Techniques were used to analyze the collected data to accommodate the variables that affected mathematics performance. In all the regression analyses, the results of both were compared to assure that the coefficients and p-values were correct. Because the traditional Least-Squares method is not robust and is sensitive to outliers, non-normality, and heteroscedasticity, it was decided that using both would be better. In comparison to other studies, path analysis could not be conducted because the sample size was too small – having less than 200 if the number of exclusions due to missing data was taken into consideration. More importantly, a suitable model of mathematics achievement has not yet been determined for this specific setting. The refinement process for the regression model is detailed in the next section.

To test for interaction effects between the variables, the data was split instead of relying on a single regression model with interaction effects. The analysis was done in a quasi-factorial experiment fashion, with data being split by gender and previous performance, specifically a regression-discontinuity design – splitting of data based on performance was arbitrarily performed but still based on the cut-offs for Honors and Regular section students. This procedure gave more information regarding the influence of the several factors as moderated by these two variables. The disadvantage however was the loss of statistical power. It was acceptable for this research because of its exploratory nature but further studies would be needed to strengthen its findings.

3.7 MODEL DEVELOPMENT FOR MULTIPLE REGRESSION

The initial model included several of the variables that were hypothesized to affect mathematics achievement, reflected in the 1st quarter mathematics grades, FIRSTQ4THYEARMATH. First, being tracked into an Honors class was important because there was a difference in how the teacher taught in that class as opposed to a regular class. It was also necessary to include gender because of the different expectations and roles men and women were assigned in the community.

The family context was an important factor as well. Having more siblings meant more human resources to support the family unit. The higher the number of siblings, the more dispersed the responsibility of earning money to all the family members. The chances of studying full time were higher if there were more siblings. On the other hand, more responsibility might be given to the older children to take care of the others if the number of siblings was higher. There was also strong pressure for the older siblings to support the family more, financially, or through chores. It was reasonable to assume that the interaction between GENDER, FAMILY_RANK, and SIBLINGS was significant since the older female children were relegated more family responsibilities, reducing the time to study.

Parental education was also hypothesized to affect mathematics achievement. With higher education, parents were able to pass on more social and cultural capital to their children. They would have known how to navigate the educational and professional world. They would have had goals of college for their children, knowledge on scholarships and education financing, more capability to help their children, and higher-earning occupations which meant more resources for the children that will influence academic proficiency. Although the study was designed to minimize the effects of this confounding variable, it was found based on the survey that there were some differences in parental education among the students.

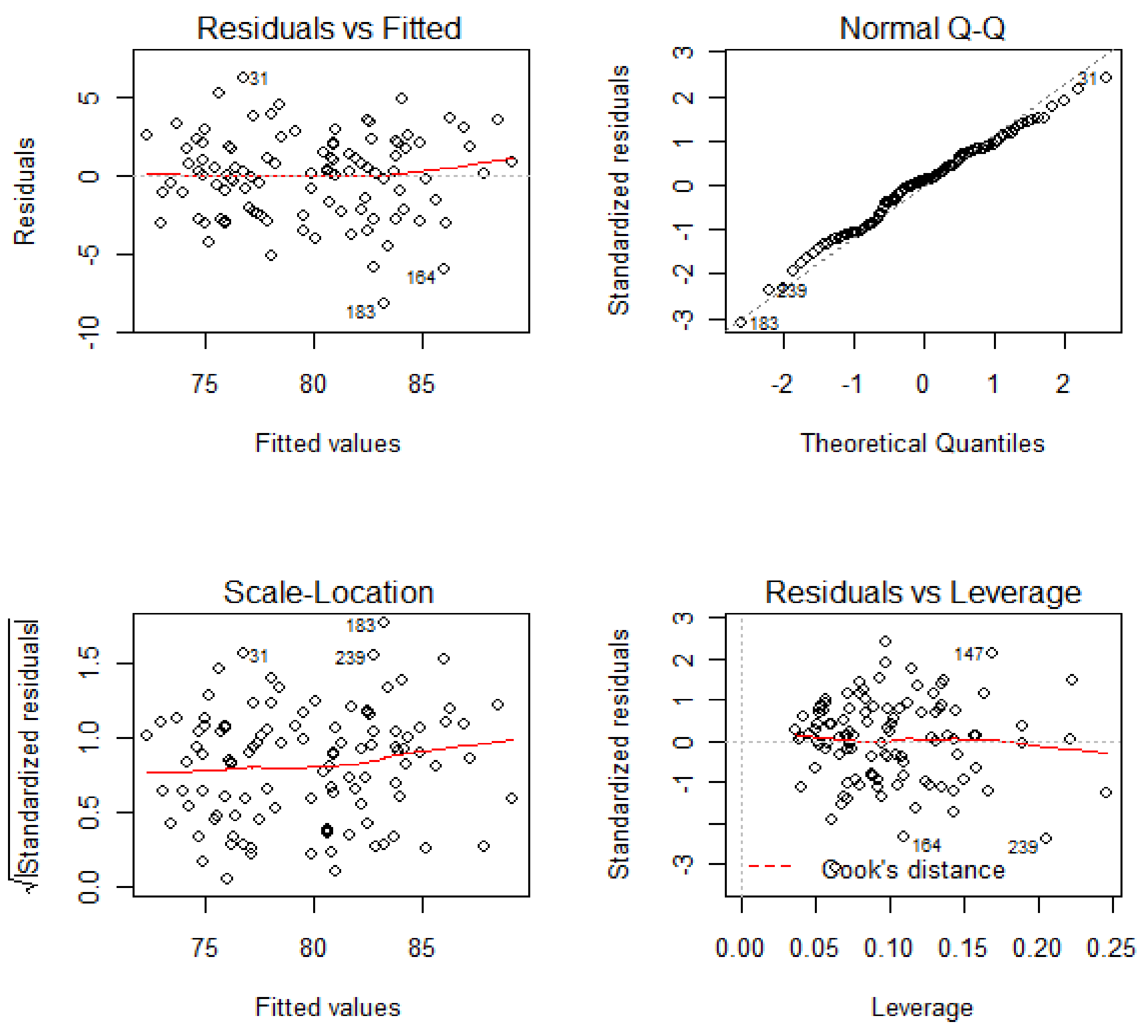
The most important factors were previously learned mathematics, a general aptitude for school, proficiency in English, and self-efficacy. The previous year's averages, THIRDYEARMATH, were good estimators for what the students knew beforehand especially because the syllabus was cyclical. This was also true for FIRSTQ4THYEARMATH, and ENGLISH. A limitation of using ENGLISH was that it was not determined whether English class grades – representing performance on grammar, writing, and formal language learning – can replace informal conversational English skills assessments. The initial model is shown below:

$$\begin{aligned} \mathrm{FIRSTQ4THYEARMATH} &= \beta_0 + \beta_1 \cdot HONOR + \beta_2 \cdot GENDER + \beta_3 \cdot SIBLINGS + \beta_4 \cdot FAMILY\_RANK + \beta_5 \\ &\cdot ENGLISH + \beta_6 \cdot FATHER\_EDUC + \beta_7 \cdot MOTHER\_EDUC + \beta_8 \\ &\cdot SELF\_EFFICACY\_TOTAL + \beta_9 \cdot HARDCLASSES + \beta_{10} \cdot THIRDYEARMATH + \varepsilon \end{aligned}$$

Critical assumptions on the randomness and normal distribution of residuals, homoscedasticity, and absence of variable collinearity are made whenever multiple regression analysis is performed. Slight heteroscedasticity was suspected because the residual plot showed a weak trend and exhibited a slight pattern of non-normality based on the Normal Q-Q plot, although the Breusch-Pagan test failed to provide evidence, with BP = 5.2033, *df* = 10, and *p-value* = 0.8772. Some outliers were also suspected, with some points having high leverage.

These outliers were not taken out of the analysis because there was no criterion determined to weed them out.

FIGURE 2. RESIDUAL PLOTS FOR ORIGINAL REGRESSION MODEL (OLS)



Further tests on the variables revealed that ENGLISH, HARDCLASSES (Science, Social Sciences, and Filipino), and THIRDYEARMATH, the students' grades for their classes for the previous year, were collinear. Students who had higher grades in high school tended to have high grades for all their classes, and the same is true for students who earned lower grades. This was supported by the high correlations found between the different class grades. This might be reflecting a general aptitude or general academic behavior which is beyond the scope of this study.

TABLE 4. CORRELATIONS OF STUDENTS' GRADES FOR DIFFERENT CLASSES

		FILIPINO	SCIENCE	AP	ENGLISH	MATH3YEAR
FILIPINO	Pearson Correlation	1	.868**	.834**	.886**	.807**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	171	171	171	164	168
SCIENCE	Pearson Correlation	.868**	1	.828**	.852**	.765**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	171	173	172	165	170
AP	Pearson Correlation	.834**	.828**	1	.790**	.722**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	171	172	172	164	169
ENGLISH	Pearson Correlation	.886**	.852**	.790**	1	.853**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	164	165	164	196	192
MATH3YEAR	Pearson Correlation	.807**	.765**	.722**	.853**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	168	170	169	192	203

**. Correlation is significant at the 0.01 level (2-tailed).

The collinearity between ENGLISH, HARDCLASSES, and THIRDYEARMATH was verified with the table of variance inflation factors (VIF), all less than 10, which some researchers have deemed acceptable. However, some statisticians suggested a more conservative threshold of 5, requiring further analysis on this matter.

TABLE 5. VARIANCE INFLATION FACTORS (VIF) FOR ENGLISH, HARDCLASSES, AND MATH3YEAR

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	T	Sig.	Tolerance	**VIF**
1	(Constant)	-24.721	6.187		-3.996	.000		
	ENGLISH	.116	.163	.079	.713	.477	.161	**6.225**
	HARDCLASSES	.662	.136	.501	4.877	.000	.189	**5.303**
	MATH3YEAR	.523	.151	.297	3.473	.001	.272	**3.677**

a. Dependent Variable: MATH1Q

SIBLINGS and FAMILY_RANK, and FATHER_EDUC and MOTHER_EDUC were also suspected of being collinear and redundant. The Huber M-Estimation Regression using the initial model revealed the problem when these variables were included. It was observed that the coefficients of SIBLINGS and FAMILY_RANK canceled out each other suggesting that they were redundant. It was assumed that FAMILY_RANK is a probabilistic function of SIBLINGS. The lower the number of siblings, the higher the chances of going up the family rank (Sulloway, 1995).

The same is also true for FATHER_EDUC and MOTHER_EDUC because their coefficients also canceled out each other. This makes sense because the parents’ highest educational attainments were probably correlated since people generally marry within their social class, assuming educational attainment reflected this. To combine the two information, a new variable PARENTAL was created indicating the highest educational attainment between the two parents.

FIGURE 3. HUBER M-EST REGRESSION RESULTS PREDICTING FIRSTQ4THYEARMATH (ORIGINAL MODEL)

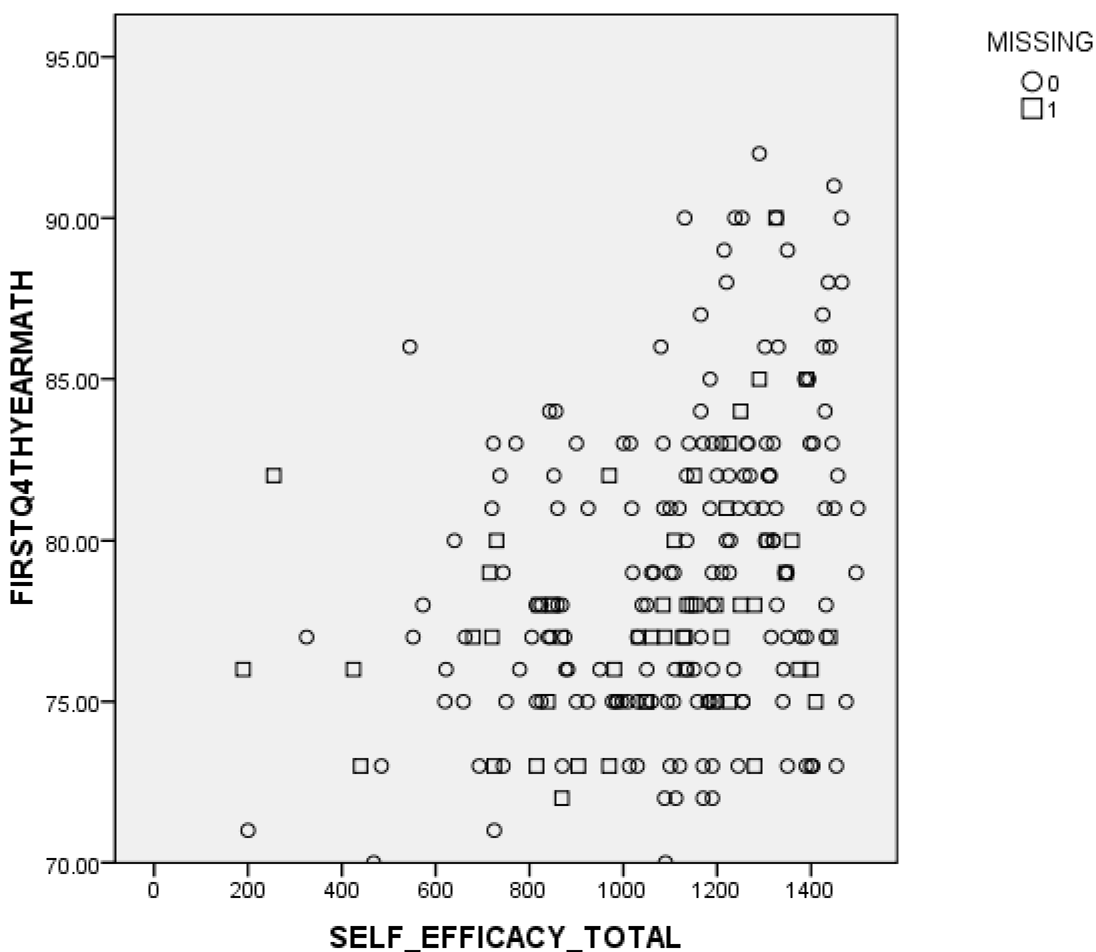
```
Residuals:
    Min      1Q  Median      3Q     Max
-8.4320 -2.1017  0.1732  1.8971  6.5463

Coefficients:
            Value    Std. Error t value
(Intercept) -38.8814  12.5055    -3.1091
HONOR        -0.5711   0.8898    -0.6418
GENDER        0.8102   0.6236     1.2992
SIBLINGS      0.4126   0.1736     2.3766
FAM_RANK     -0.4255   0.1938    -2.1956
ENGLISH       0.3357   0.2110     1.5911
F_EDUC        0.2280   0.2083     1.0946
M_EDUC       -0.2794   0.2070    -1.3495
TOTALMATH     0.0006   0.0012     0.5138
HARDCLASSES   0.4672   0.1720     2.7170
MATH3YEAR     0.6647   0.1890     3.5172

Residual standard error: 3.003 on 99 degrees of freedom
  (131 observations deleted due to missingness)
```

The initial model was modified to include only 6 variables. Even with the correction of collinearity issues, the combination of both Least-Squares and Huber M-Estimator Robust Regression were still used despite having evidence that suggested that the residuals were acceptably random and close to normal, and that heteroscedasticity was present but somehow minimal. This was to assure that the coefficients and the *p-values* were not affected by outliers.

$$\text{FIRSTQ4THYEARMATH} = \beta_0 + \beta_1 \cdot HONOR + \beta_2 \cdot GENDER + \beta_3 \cdot SIBLINGS + \beta_4 \cdot PARENTAL + \beta_5 \cdot SELF\_EFFICACY\_TOTAL + \beta_6 \cdot THIRDYEARMATH + \varepsilon$$

The last important point needed to be mentioned was the presence of missing data resulting to 68 cases not being included in the regression. The removal of those observations could have affected the results. Removal was caused by missing THIRDYEARMATH data if they were transferred students, FIRSTQ4THYEARMATH if they dropped out of school or the other variables if the students did not fill out those sections. Of those cases removed, 60 students were from regular sections (32% of all regular students) and 8 were from the honors class (17%). Around the same percentage of men and women were taken out. It seems there was no systematic removal of cases based on the scatter plot below.

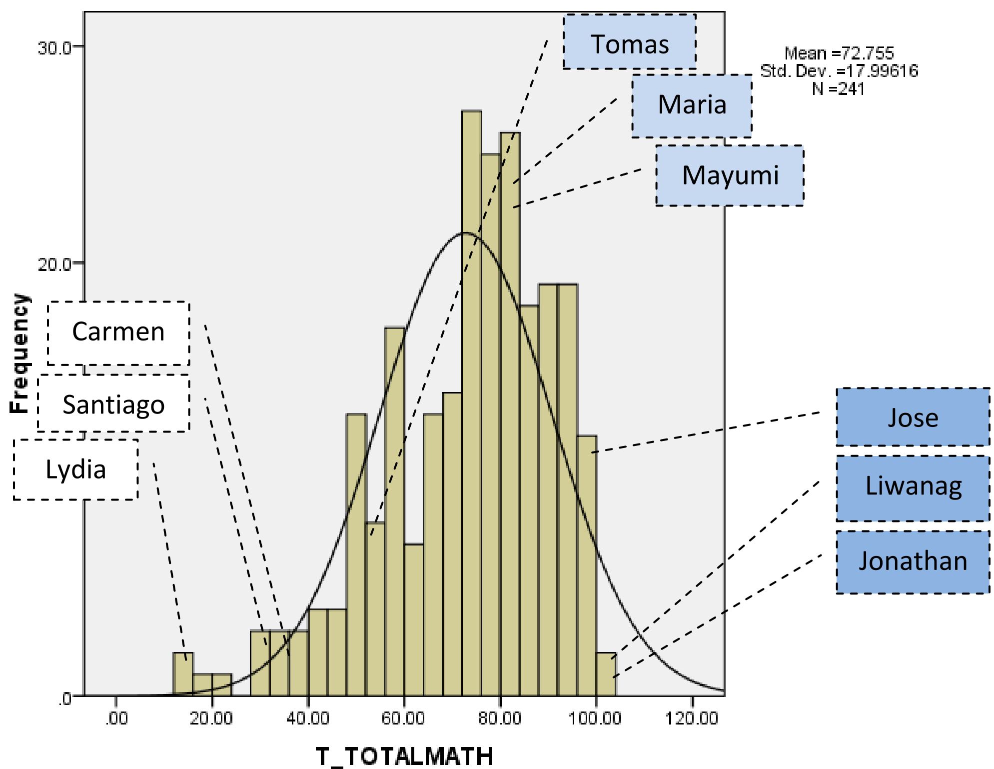
FIGURE 4. SCATTER PLOT OF CASES REMOVED FROM REGRESSION BECAUSE OF MISSING DATA



3.8 STUDENT INTERVIEW PROTOCOL

Nine students were selected for further interviews based on their mathematics self-efficacy scores. Carmen, Santiago, and Lydia represented low self-efficacy students; Tomas, Maria, and Mayumi were from the median; while Jose, Liwanag, and Jonathan had higher self-efficacy. This histogram shows the ranking of these students in terms of self-efficacy compared to their classmates.

FIGURE 5. STUDENTS INTERVIEWED WITH THEIR CLASS RANK BASED ON SELF-EFFICACY SCORES



Interviews were scheduled 5 weeks after the survey. These lasted for an hour for each student. They were all conducted in Filipino.

1. Background
    a. Tell me about yourself.
        i. Personality
        ii. Likes/ Dislikes
        iii. Hobbies
        iv. Career plans
        v. Dreams
    b. Tell me about your family.
        i. Brothers and sisters
            1. What do they say about you?
        ii. Parents
            1. What do they say about you?
            2. What are their dreams for you?
        iii. What do you enjoy doing with family?
        iv. What do you do together?
    c. Describe your friends.
        i. What are your activities?
        ii. What do you talk about?
2. Mathematics experiences and self-efficacy
    a. Do you enjoy school?
    b. What's your favorite class?

    c. How are you doing in class?
    d. Do you feel you can understand many of the things taught to you?
    e. Can you get high grades?
    f. Can you force yourself to focus in class? To study?

3. Mathematics learning environment
    a. What happens inside the classroom?
    b. Do all your classmates participate? How about you?
    c. Tell me about your teachers.
        i. What do they do that helps you the most?
        ii. What do you like about them?
        iii. What don't you like about them?
        iv. Who's your favorite teacher?
    d. What do you enjoy in class? What do you not enjoy?
    e. Under what conditions do you learn the best?
4. Close friends
    a. Do your friends tell you you're good in a certain class?
    b. Do they help you in school? Outside school?
5. Affective and physiological response to mathematics
    a. What do you feel in class?
    b. What do you feel when taking an exam?
6. Sources of self-efficacy in mathematics
    a. How would you rate your confidence in class?
    b. What makes you feel confident with what you do?

CHAPTER 4

RESULTS OF THE STUDY

4.1 INTRODUCTION

This chapter represents the synthesis of findings from classroom observations, conversations with teachers, student interviews, and the statistical analyses of the survey results. It begins by laying out the research questions and then provides a gist of the findings for each. The details are then explained throughout the chapter. As a guide for readers, the table of variables used for the regression model is presented again.

The following are the research questions for this study:

1. What is the relationship of mathematics self-efficacy and performance?
   - Self-efficacy was a positive but minor predictor of future performance (4^{th} year grades) only for male students who previously had higher mathematics grades (3^{rd} year grades).
   - It was not a strong predictor of performance for women regardless of previous grades, and men with weaker mathematics skills.
   - Mathematics self-efficacy was predicted by previous mathematics achievement for women; and also the number of siblings and parental education for the higher performing women.

2. What are the differences in terms of academic behavior, peers, and family life between students with different levels of self-efficacy?
    - Positive behaviors were found for all female students regardless of self-efficacy levels. Fewer behaviors were found in men.
    - Negative behaviors were only found among low self-efficacy students.
    - Family members and their experiences of poverty affected educational goals and ambitions.

3. What variables are related to mathematics self-efficacy?
    - The variable most strongly linked to self-efficacy was actual mastery experience.
    - The use of a second language in the mathematics classroom negatively affected confidence and performance.
    - The number of siblings and parental education were significant predictors of self-efficacy only for women.
    - Classroom and test anxieties and negative beliefs about mathematics were found for the students with lower self-efficacy.

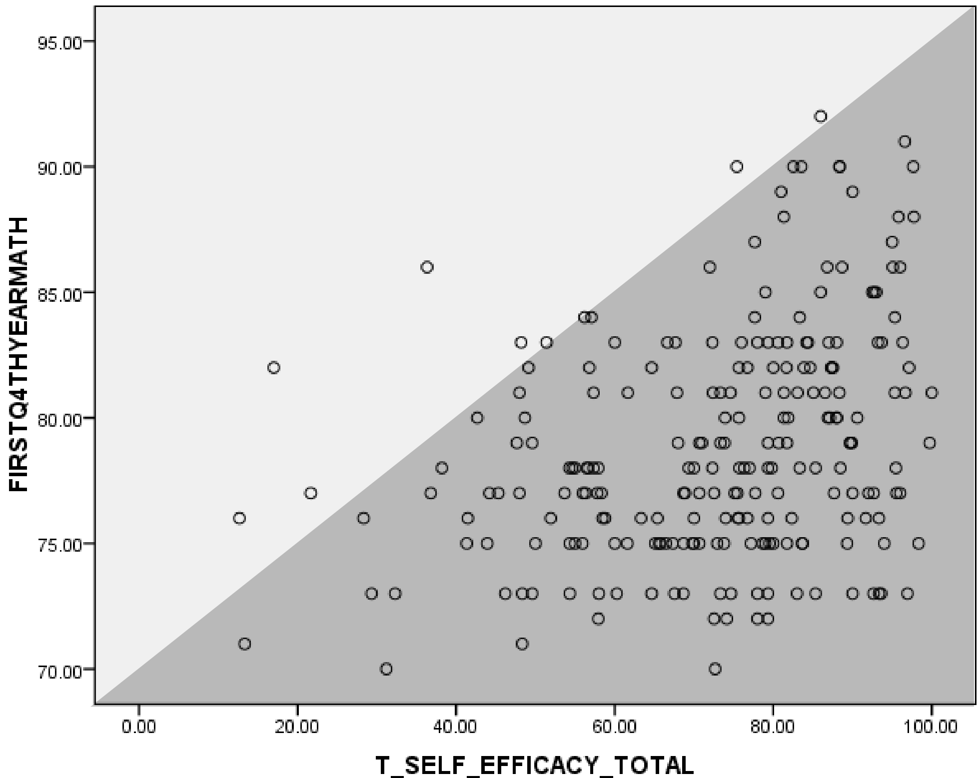
TABLE 6. SUMMARY OF VARIABLES USED FOR THE REGRESSION ANALYSIS

LABEL	DATA	VALUES
HONOR	Belonging to Honors Class	1 – Honor, 0 – Regular
GENDER	Male/ Female	1 – Male, 0 – Female
SIBLINGS	Number of siblings	1 to 14, *Mean* = 4.77, *Std Dev* = 2.16
FIRSTQ4THYEARMATH	Grade for the 1st Quarter, 4th Year (June to August 2011)	70 to 92, *Mean* = 78.85, *Std Dev* = 4.60
FATHER_EDUC, MOTHER_EDUC, PARENTAL	Father's and Mother's highest educational attainment Parental is the higher between the two	Elementary – 1 High School – 2 Vocational – 3 Some College – 4 College – 5
THIRDYEARMATH	Third year mathematics grade	75 to 88
SELF_EFFICACY_TOTAL	Mean of selected self-efficacy scores	*Mean* = 72.76, *Std Dev* = 18.00
SELF_EFFICACY_FILIPINO, SELF_EFFICACY_ENGLISH	Means of self-efficacy scores for questions presented in pairs, 1 version in Filipino, the other in English	$Mean_F$ = 67.91, $Std\ Dev_F$ = 23.25 $Mean_E$ = 69.98, $Std\ Dev_E$ = 21.66
TOPLOW		1 - if THIRDYEARMATH ≥ 80 0 - if THIRDYEARMATH < 80

4.2 WHAT IS THE RELATIONSHIP OF MATHEMATICS SELF-EFFICACY AND PERFORMANCE?

A scatter plot *(figure 6)* of self-efficacy and future mathematics performance revealed that the relationship was not linear. There was an obvious heteroscedasticity which implied that the bivariate model, ($FIRSTQ4THYEARMATH = \beta_0 + \beta_1 \cdot SELF\_EFFICACY\_TOTAL + \varepsilon$), was not appropriate. This meant that the correlation coefficients between the two, *Pearson = 0.335*, and *Kendall's tau-b = 0.235*, both statistically significant and similar to what other researchers have found, were irrelevant. The regression-discontinuous designed analyses (multiple regressions for the split data set) for the subsets revealed more detailed findings regarding this relationship.

FIGURE 6. SCATTER PLOT BETWEEN SELF-EFFICACY AND FIRST QUARTER MATHEMATICS GRADES



Before splitting the data into subsets, the whole data set was analyzed using the following model. Both the Huber and Least-Squares methods were used and produced the same results.

$$\text{FIRSTQ4THYEARMATH} = \beta_0 + \beta_1 \cdot HONOR + \beta_2 \cdot GENDER + \beta_3 \cdot SIBLINGS + \beta_4 \cdot PARENTAL + \beta_5 \cdot SELF\_EFFICACY\_TOTAL + \beta_6 \cdot THIRDYEARMATH + \varepsilon$$

The output of the Huber robust regression showed that third year mathematics grades (*p-value < 0.0001*), self-efficacy (*p-value = 0.0511*), and belonging to the Honors section (*p-value = 0.0515*) were statistically significant predictors of 4^{th} year mathematics performance. It showed that for every point increase in the previous mathematics grade, there was a 1.16 point increase in future scores assuming all the other factors were kept the same. The HONOR variable was expected because the criterion for being tracked in the Honors class was based on the previous year's performance. Despite the statistical significance, self-efficacy had a negligible coefficient of *0.0288*.

FIGURE 7. REGRESSION RESULTS (R OUTPUT, HUBER) PREDICTING FIRSTQ4THYEARMATH

```
Call: rlm(formula = FIRSTQ4THYEARMATH ~ HONOR + GENDER + SIBLINGS +
    PARENTAL + T_SELF_EFFICACY_TOTAL + THIRDYEARMATH, data = data)
Residuals:
      Min        1Q    Median        3Q       Max
-10.91194  -2.03652  -0.09779   2.18194   7.37986

Coefficients:
                      Value    Std. Error t value
(Intercept)           -13.0820  10.5487    -1.2402
HONOR                   1.5138   0.7719     1.9612
GENDER                 -0.4057   0.5252    -0.7725
SIBLINGS               -0.1012   0.1107    -0.9139
PARENTAL               -0.0271   0.1575    -0.1718
T_SELF_EFFICACY_TOTAL   0.0288   0.0147     1.9648
THIRDYEARMATH           1.1563   0.1378     8.3922

Residual standard error: 3.2 on 166 degrees of freedom
  (68 observations deleted due to missingness)
```

The Least-Squares results were the same but the variables only accounted for just about half of the variance, with an adjusted $R^2 = 0.592$. Similarly, there was evidence that 3^{rd} year mathematics grades, self-efficacy, and to a moderate degree, belonging in the Honors section predicted future grades. With every point increase in THIRDYEARMATH, there was an increase of between 0.85 to 1.4 points to the future grade. Again, self-efficacy had almost no effect with a coefficient of 0.032. The evidence for the effects of belonging to the Honors class was very weak with *p-value = 0.070* and the 95% confidence interval is from -0.115 to 2.920. Similar to the robust regression model, no evidence was produced to show that parental education, the number of siblings, and gender were related to FIRSTQ4THYEARMATH.

TABLE 7. MODEL SUMMARY FOR REGRESSION MODEL (OLS)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.779[a]	.606	.592	3.09637

a. Predictors: (Constant), T_SELF_EFFICACY_TOTAL, PARENTAL, GENDER, SIBLINGS, HONOR, THIRDYEARMATH

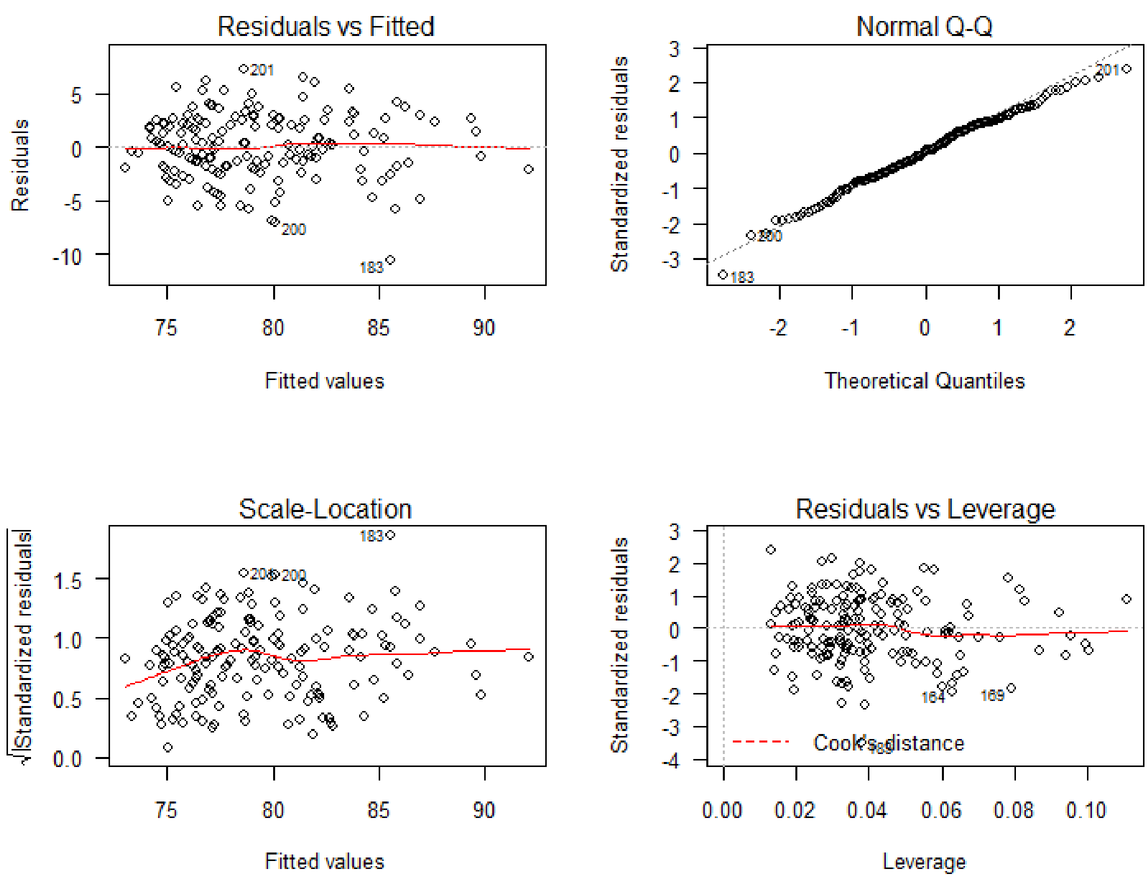
TABLE 8. REGRESSION OUTPUT (OLS)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-10.788	10.503		-1.027	.306	-31.525	9.949
	HONOR	1.402	.769	.128	1.825	.070	-.115	2.920
	GENDER	-.473	.523	-.048	-.905	.367	-1.506	.559
	SIBLINGS	-.084	.110	-.038	-.761	.448	-.301	.134
	PARENTAL	-.059	.157	-.019	-.376	.708	-.369	.251
	THIRDYEARMATH	1.124	.137	.627	8.191	.000	.853	1.395
	T_SELF_EFFICACY_TOTAL	.032	.015	.115	2.214	.028	.003	.061

a. Dependent Variable: FIRSTQ4THYEARMATH

The model's appropriateness was assessed by checking for heteroscedasticity and non-normality. There was no apparent trend in the residual versus predicted plot, nor was there significant deviation from the normal distribution. No evidence for heteroscedasticity was found using the Breusch-Pagan test, with *BP = 6.7047, df = 6, p-value = 0.349*. This confirms that the regression model was appropriate together with the robust regression.

FIGURE 8. RESIDUAL PLOTS FOR NEW REGRESSION MODEL (OLS)



Despite these results, it was still known that gender affected performance. The following histograms show that there was no difference between the distributions of self-efficacy scores between males and females (0 – female, 1 – male) despite the fact that there were more men who had lower grades than women. The charts also reveal that the few top performing students were males, but the bottom of the list was also dominated by males. This finding was also confirmed in previously done research (W. L. Fan, Suzanne F.; Arroyo-Giner, Christina A.; Wolters, Christopher A., 2009).

FIGURE 9. DISTRIBUTION OF MATHEMATICS SELF-EFFICACY SCORES PER GENDER

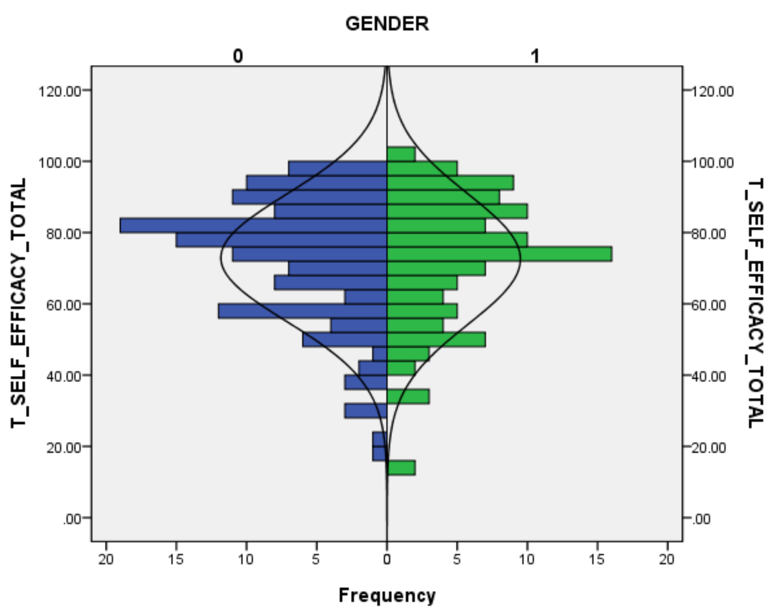
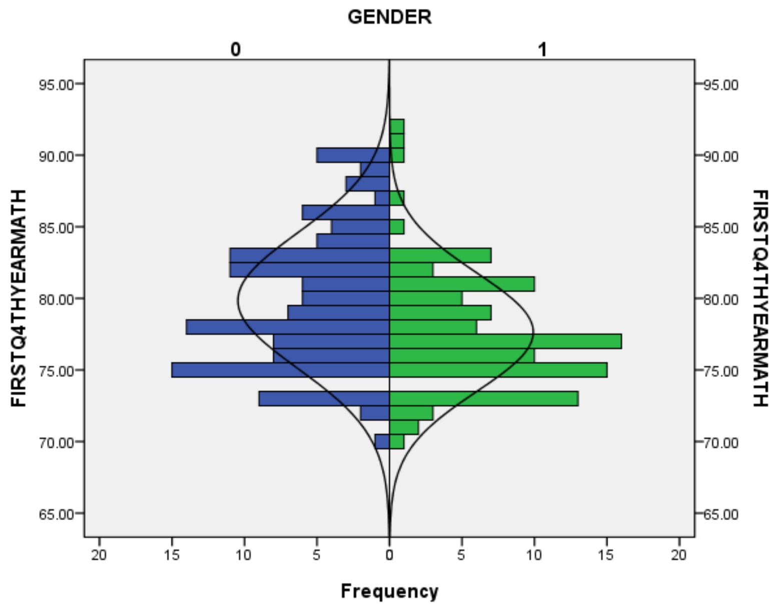


FIGURE 10. DISTRIBUTION OF 4th YEAR 1st QUARTER MATHEMATICS GRADES PER GENDER



A *t*-test *(table 9)* provided evidence that there was a difference in the means of 1st Quarter grades between males and females but no difference in self-efficacy. This suggests that the men had slightly stronger positive beliefs about their mathematical capabilities, which were inconsistent with their performance.

TABLE 9. T-TEST RESULTS FOR THE DIFFERENCE IN MATHEMATICS GRADES AND SELF-EFFICACY BETWEEN GENDERS

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
FIRSTQ4THYEARMATH	Equal variances assumed	4.849	.029	-3.698	225	.000	-2.20600	.59646	-3.38136	-1.03063
	Equal variances not assumed			-3.744	224.344	.000	-2.20600	.58922	-3.36710	-1.04489
T_SELF_EFFICACY_TOTAL	Equal variances assumed	.002	.961	-.160	239	.873	-.37409	2.33384	-4.97162	4.22344
	Equal variances not assumed			-.160	227.921	.873	-.37409	2.34014	-4.98516	4.23698

Because gender and the previous year's mathematics grades (3^{rd} year grades) affected performance, their interaction with other variables was investigated by splitting the data into a 2x2 grouping (gender and high-low performance) and performing a quasi-factorial experiment analysis. First, students were categorized into high-performing and low-performing groups in terms of these grades. Out of 241 students, only 203 had previous mathematics grades so the regression results only included these participants. The cut-off grade selected was 80 and 24.9% of the students fell into this high-performing group. This grade was chosen because most of the Honor students got grades equal to or higher than this. The next table summarizes the breakdown of students per group.

TABLE 10. NUMBER OF STUDENTS PER (GENDER x PREVIOUS GRADE) GROUP

	HIGH-PERFORMING (3rd Year Math Grade >= 80)	**LOW-PERFORMING** (3rd Year Math Grade < 80)
MALE	18, **7.5%** of 241 students	71, **29.5%** of 241 students
FEMALE	42, **17.4%** of 241 students	72, **29.9%** of 241 students

This procedure provided evidence that different variables affected mathematics performance for the different groups. The results of these analyses are detailed in Appendix C and this next table summarizes the most pertinent findings.

TABLE 11. MULTIPLE REGRESSION COEFFICIENTS AND P-VALUES FOR SIGNFICANT PREDICTORS OF 4th YEAR 1st QUARTER MATHEMATICS GRADES

	TOP (Third Year Mathematics Grade ≥ 80)	**LOW** (Third Year Mathematics Grade < 80)	**ALL** (Regardless of Grade)
MEN	**Self-Efficacy** β = 0.0577, *p-value = 0.0108* **Third Year Math** β = 1.3602, *p-value < 0.0001*	**Third Year Math** β = 1.0653, *p-value = 0.0058*	**Self-Efficacy** β = 0.0382, *p-value = 0.0593* **Third Year Math** β = 1.2635, *p-value < 0.0001*
WOMEN	**Siblings** β = -0.7580, *p-value = 0.0175* **Third Year Math** β = 0.6862, *p-value = 0.0785*	**Third Year Math** β = 1.3793, *p-value = 0.0021*	**Third Year Math** β = 1.0940, *p-value < 0.0001*
ALL (Regardless of Gender)	**Siblings** β = -0.5042, *p-value = 0.0106* **Third Year Math** β = 0.9306, *p-value = 0.0002*	**Third Year Math** β = 1.2444, *p-value < 0.0001*	

This shows that previous grades (3rd year) were the best predictors of future mathematics performance (4th year grades) for men and women regardless of previous performance (3rd year). Mathematics self-efficacy was not an important predictor and in fact only had a $\beta = 0.0577$ for the top-performing males. It also did not provide evidence that belonging to the Honors class and the levels of parental education were related to performance. However for the top-performing women, the number of siblings had a negative relationship with grades. An increase in the number of children in the household is associated with a decrease in the 1st Quarter grade. All of these specific findings were also reflected in the multiple regression analysis with interaction variables *(figure 11)*. For this single multiple regression output, the significant variables were THIRDYEARMATH and the interaction between SIBLINGS and TOPLOW, or belonging to either the top-performing or the low-performing group. The p-values for the two were *0.0011* and *0.0042* respectively.

FIGURE 11. REGRESSION OUTPUT (HUBER) WITH INTERACTION VARIABLES PREDICTING MATHEMATICS GRADES

```
Call: rlm(formula = FIRSTQ4THYEARMATH ~ HONOR + GENDER + SIBLINGS +
    PARENTAL + T_SELF_EFFICACY_TOTAL + THIRDYEARMATH + TOPLOW +
    GENDER * TOPLOW + GENDER * SIBLINGS + GENDER * PARENTAL +
    GENDER * T_SELF_EFFICACY_TOTAL + GENDER * THIRDYEARMATH +
    TOPLOW * SIBLINGS + TOPLOW * PARENTAL + TOPLOW * T_SELF_EFFICACY_TOTAL +
    TOPLOW * THIRDYEARMATH + GENDER * HONOR + TOPLOW * HONOR,
    data = All)
Residuals:
      Min        1Q    Median        3Q       Max
-11.40431  -1.67974  -0.07996   1.95905   7.56506

Coefficients:
                             Value    Std. Error t value
(Intercept)                   -7.5938  24.5819    -0.3089
HONOR                          0.5819   2.4614     0.2364
GENDER                       -28.4266  27.9233    -1.0180
SIBLINGS                       0.0255   0.1688     0.1510
PARENTAL                       0.1390   0.2511     0.5537
T_SELF_EFFICACY_TOTAL          0.0092   0.0241     0.3829
THIRDYEARMATH                  1.0892   0.3264     3.3367
TOPLOW                        23.6740  28.3773     0.8343
GENDER:TOPLOW                 -2.4073   2.8578    -0.8424
GENDER:SIBLINGS                0.3682   0.2280     1.6147
GENDER:PARENTAL               -0.0430   0.3426    -0.1255
GENDER:T_SELF_EFFICACY_TOTAL   0.0309   0.0309     0.9983
GENDER:THIRDYEARMATH           0.3174   0.3695     0.8589
SIBLINGS:TOPLOW               -0.7028   0.2420    -2.9044
PARENTAL:TOPLOW               -0.3485   0.3554    -0.9807
T_SELF_EFFICACY_TOTAL:TOPLOW   0.0134   0.0349     0.3837
THIRDYEARMATH:TOPLOW          -0.2423   0.3699    -0.6551
HONOR:GENDER                   1.0054   2.4921     0.4034
HONOR:TOPLOW                   0.6235   2.5019     0.2492

Residual standard error: 2.759 on 154 degrees of freedom
  (68 observations deleted due to missingness)
```

Bandura theorized that the relationship of self-efficacy and performance goes both ways. Turning self-efficacy into the response variable and using the other information as independent factors, the regression output for this new model revealed the inadequacy of these variables to significantly explain the levels of this belief. Again, the data was split by gender and previous performance and the next table summarizes the results.

$$T\_SELF\_EFFICACY\_TOTAL = \beta_0 + \beta_1 \cdot HONOR + \beta_2 \cdot GENDER + \beta_3 \cdot SIBLINGS + \beta_4 \cdot PARENTAL + \beta_5 \cdot THIRDYEARMATH + \varepsilon$$

TABLE 12. MULTIPLE REGRESSION COEFFICIENTS AND P-VALUES FOR SIGNFICANT PREDICTORS OF SELF-EFFICACY

	TOP (Third Year Mathematics Grade ≥ 80)	**LOW (Third Year Mathematics Grade < 80)**	**ALL (Regardless of Grade)**
MEN	*None*	*none*	Coefficients not significant based on ANOVA *p-value = 0 .137*
WOMEN	**Siblings** β = -3.1227, *p-value = 0.0115* **Parental** β = 2.7696, *p-value = 0.0691* **Third Year Math** β = 2.6191, *p-value = 0.0703*	**Third Year Math** β = 5.4844, *p-value = 0.0035*	**Third Year Math** β = 2.3352, *p-value = 0.0092*
ALL (Regardless of Gender)	Coefficients not significant based on ANOVA *p-value = 0.092*	**Third Year Math** β = 3.5504, *p-value = 0.0074*	

This table and the histograms previously shown *(figures 9 & 10)* imply the same idea that men, regardless of mathematics grades, had the same self-efficacy as women. It was not a good predictor of male self-efficacy. For women, previous performance had a stronger relationship with self-efficacy. Aside from this, the number of siblings and the levels of parental education were significant variables for top-performing women. The more children in the household, the lower the level of self-efficacy; and the higher the educational levels of the parents, the higher this level of belief. It was likely that parents assigned more responsibilities, such as taking care of their siblings, to their 'brighter' daughters. This was why it was only significant for this group. In addition, parental education was related because parents were directing the lives of their daughters more than their sons. This may be influencing the levels of self-efficacy for these students.

The evidence on the effects of parental education was only strong for the top performing women. It was not significant when gender and performance were not controlled. When the 1st Quarter mathematics grades and self-efficacy were compared for each level of parental education, no evidence was produced to suggest that the means were different. Both the ANOVA and the Kruskal-Wallis non-parametric test failed to produce evidence *(tables 14 & 15)*. The averages themselves were inconsistent – students with parents who finished college had lower mathematics grades and self-efficacy scores compared to those whose parents finished 6th grade *(table 13)*.

TABLE 13. MEANS OF MATHEMATICS GRADES AND SELF-EFFICACY PER PARENTAL EDUCATION LEVELS

	PARENTAL	N	Mean Rank
1st Quarter Mathematics Grade	Elementary	44	101.48
	High School	101	104.90
	Vocational	2	61.00
	Some College	4	98.00
	College	54	102.62
	Total	205	
Self-Efficacy	Elementary	45	115.36
	High School	111	105.19
	Vocational	2	59.50
	Some College	4	138.50
	College	56	113.05
	Total	218	

TABLE 14. ANOVA FOR MEANS OF MATHEMATICS GRADES AND SELF-EFFICACY PER PARENTAL EDUCATION LEVELS

		Sum of Squares	Df	Mean Square	F	Sig.
FIRSTQ4THYEARMATH	Between Groups	39.844	5	7.969	.358	.877
	Within Groups	4475.151	201	22.264		
	Total	4514.995	206			
SELF_EFFICACY_TOTAL	Between Groups	1564.455	5	312.891	.977	.433
	Within Groups	68541.397	214	320.287		
	Total	70105.852	219			

TABLE 15. KRUSKAL-WALLIS TEST FOR MEANS OF MATHEMATICS GRADES AND SELF-EFFICACY PER PARENTAL EDUCATION LEVELS

Test Statistics [a, b]

	MATH1Q	TOTALMATH
Chi-Square	1.173	3.187
Df	4	4
Asymp. Sig.	.882	.527

a. Kruskal Wallis Test

b. Grouping Variable: PARENTAL

These results were fully congruent with the evidence provided by a single multiple regression model for the whole data set including the interaction variables *(figure 12)*. The p-value for THIRDYEARMATH in this output was *0.0119*.

FIGURE 12. REGRESSION OUTPUT (HUBER) WITH INTERACTION VARIABLES PREDICTING SELF-EFFICACY

```
Call: rlm(formula = T_SELF_EFFICACY_TOTAL ~ HONOR + GENDER + SIBLINGS +
    PARENTAL + THIRDYEARMATH + TOPLOW + GENDER * TOPLOW + GENDER *
    SIBLINGS + GENDER * PARENTAL + GENDER * THIRDYEARMATH + TOPLOW *
    SIBLINGS + TOPLOW * PARENTAL + TOPLOW * THIRDYEARMATH + GENDER *
    HONOR + TOPLOW * HONOR, data = All)
Residuals:
    Min      1Q  Median      3Q     Max
-53.810 -11.571   2.510  10.312  32.147

Coefficients:
                     Value     Std. Error t value
(Intercept)          -248.5724  127.3193    -1.9524
HONOR                   1.8555   13.8116     0.1343
GENDER                 36.7571  148.4605     0.2476
SIBLINGS               -0.0705    0.9418    -0.0749
PARENTAL               -0.7039    1.4019    -0.5021
THIRDYEARMATH           4.1973    1.6501     2.5436
TOPLOW                 98.1133  149.9097     0.6545
GENDER:TOPLOW           6.0873   15.9273     0.3822
GENDER:SIBLINGS         0.4670    1.2622     0.3700
GENDER:PARENTAL         0.3881    1.8688     0.2077
GENDER:THIRDYEARMATH   -0.4906    1.9236    -0.2550
SIBLINGS:TOPLOW        -1.4913    1.3360    -1.1162
PARENTAL:TOPLOW         2.5659    1.9362     1.3252
THIRDYEARMATH:TOPLOW   -1.3489    1.8942    -0.7121
HONOR:GENDER           -0.2930   13.9732    -0.0210
HONOR:TOPLOW           -4.0506   14.0059    -0.2892

Residual standard error: 15.57 on 168 degrees of freedom
  (57 observations deleted due to missingness)
```

4.3 WHAT ARE THE DIFFERENCES, IN TERMS OF ACADEMIC BEHAVIOR, PEERS, AND FAMILY, BETWEEN STUDENTS WITH DIFFERENT LEVELS OF SELF-EFFICACY?

The interview protocol explained in Chapter 3 was used for the student interviews, which were coded and analyzed to discover themes that were common among low, middle, and high self-efficacy students. The questions were centered on these three: academic behavior, peers and family. Throughout this section, the tables will follow the same format, presenting the findings per student arranged by self-efficacy levels. The first three would be the low self-efficacy group and the last would be the high self-efficacy students.

For academic behavior, students were asked about particular activities that might have affected mathematics performance. These included asking for help, spending time on homework, participating in class, and being persistent in studying hard topics. All of these were categorized as positive behavior. Those showing the opposite of these behaviors were categorized as negative. These responses were statements or narratives from the interviews that were spontaneously provided without cue, unambiguous and specific.

After compiling these stories, what emerged was that positive behaviors were more common for women than men and that negative behaviors were only found among the lower self-efficacy students. The findings were slightly different but still consistent with Bandura's theory that self-efficacy affected performance because people with high levels of this belief engaged in behaviors that promoted proficiency in a certain activity. In this setting, it was shown that students with high mathematics self-efficacy did not engage in negative behaviors that hampered performance. In addition, the finding that women showed more positive behaviors regardless of self-efficacy levels is congruent with previous research (Pajares, 2002) and the results of the multiple regression analysis showing that self-efficacy was not a predictor of performance. If the women engaged in proficiency-promoting behavior despite the self-efficacy levels, then self-efficacy would not be related to future grades.

TABLE 16. POSITIVE AND NEGATIVE MATHEMATICS BEHAVIORS PER STUDENT

	POSITIVE BEHAVIORS	NEGATIVE BEHAVIORS
LYDIA	Asked help from her parents	- Did not participate when she did not know the answer - She tried 'just a little'
SANTIAGO		- Does homework sometimes - Said he has never experienced getting better at anything
CARMEN	Solved equations with her friend	Had a belief that if she persisted in learning something, it might make it worse for her
MARIA	- Asked help from the teacher and persisted in analyzing a problem - Asked help from her classmate	Admitted she was lazy and said she 'can't do it'
TOMAS		Said he has never experienced forcing himself to learn or understand something
MAYUMI	- Stayed up late to finish homework - Studied surface area problem on her own	

LIWANAG	Searched for a book to learn about a mathematics problem, Studied geometry on her own, Asked classmate for help	
JONATHAN	Studied during lunch breaks, reviewed his notes and practiced to understand a specific concept	
JOSE		

In terms of peer groups, it was hypothesized that they affected self-efficacy and performance but insufficient evidence was collected to validate or refute this theory. The assumption that the students' peer groups were also from the same school was found to be false. The students' social circles included classmates in school and friends close to home. What emerged from the interviews was the role class group work played in increasing confidence among students who had lower self-efficacy *(table 17)*. Most of the students expressed that group work increased their confidence and made learning easier inside the classroom.

Clearly, the students were specifically thinking of the times when the teacher would ask them to answer and present mathematics problems in class. It was not general self-efficacy for learning mathematics but rather the belief that they would be able to answer the given questions. The "fear" created by explaining their answers in front of everybody greatly affected their ability to work on the problems. Group work served as relief because this burden was minimized.

TABLE 17. STUDENTS WHO BELIEVED GROUP WORK INCREASED THEIR CONFIDENCE OR MADE LEARNING EASIER

	BELIEVED GROUP WORK INCREASED THEIR CONFIDENCE OR MADE LEARNING EASIER
LYDIA	✓
SANTIAGO	✓
CARMEN	✓
MARIA	✓
TOMAS	✓
MAYUMI	
LIWANAG	
JONATHAN	✓
JOSE	

Finally, the lives the students lived were fairly similar except for the fact that three of the higher self-efficacy students had college plans after high school. A critical finding was that the mothers of the female students controlled the lives of their daughters more deliberately than the male students, directing them on what to do after high school. It can be hypothesized that this is related to the fact that mathematics self-efficacy for women, and not for men, was predicted by the levels of parental education as was shown in the previous regression results. The table below shows the students' plans after high school except for Carmen and Mayumi who did not mention any.

TABLE 18. STUDENTS' PLANS AFTER HIGH SCHOOL

	COLLEGE PLANS	IMMEDIATELY WORK AFTER HS
LYDIA		✓
SANTIAGO		✓
CARMEN		
MARIA	✓	
TOMAS		✓
MAYUMI		
LIWANAG	✓	
JONATHAN	✓	
JOSE		✓

To shed light on the lives of the students and how it affected performance and self-efficacy, general educational goals and activities were asked from them instead of narrowing specifically on mathematics. It also made the conversations more natural. What was revealed was the link between the educational performance of the students and the poverty the families experienced. Both male and female students perceived their parents' expectations of doing well in school within the context of getting a good job afterwards to be able to support the family until the time they are married and had their own. This was the purpose of education for them, and excellent scholastic performance was strongly linked to their future ability to financially assist their parents, younger siblings, and themselves.

Several examples supported this. For instance, Lydia's goal was to do well in school so she can get a good job that would allow her to see a doctor for a medical condition she disclosed. A more extreme case was that of Maria, who was threatened to be kicked out of the house if she did not do well in school and get a job in the future that will enable her to provide financial support for her family. Tomas' statements were more melancholic as he stated,

> "I think their dream for me would be to finish school, because in our family, two finished, the oldest, he finished college. But he wasn't able to help because he married too soon. The second was also able to finish high school, he was able to help out, but it wasn't enough. He also married early. The next one didn't finish high school. He's just a bum. I'm the next one. That's why they're counting on me."

During the course of the interviews, students shared some details about their families, which despite not being part of the interview protocol, gave a glimpse on how extreme scholastic achievement, poverty, and the yearning for a successful future were interrelated. Both Maria and Tomas have siblings who were "semi-adopted," allowed by their parents to live with uncles who took care of them, sending them to school and paying for their education. Carmen was also adopted by her aunt when she was a year old because her parents could not afford her education and they were forced to give her up. Fortunately, her aunt lived close to her parents' house and they still get the chance to be together. It can only be hypothesized that these struggles and the actions of the parents continuously influence their persistence in school, affect their educational performance, and influence self-efficacy beliefs.

In contrast, Jonathan who was one of the top performers in class and who had one of the highest self-efficacy scores gave the most upbeat statements when he talked about his parents' goals for himself. His mother wanted him to do well in school to be successful in life. She wanted him to pursue a professional career, but gave him the freedom to choose which, as long as he would be able to help the family.

When the students talked about their families, it also became apparent that the accomplishments of their siblings possibly had an effect in their educational goals. Liwanag's older sister finished college and she tried get into the same institution to major in the same field. Carmen's older sister completed an Engineering degree, was working for a local company, at which she also wanted to be employed someday. Jose also had older brothers who went to college. Jose and Liwanag both had high mathematics self-efficacy scores.

Finally, there was a clear pattern of parents deciding on college plans or work after high school for their children only if they were female. None of the men stated that their plans were being dictated by their parents, but all the women clearly expressed that it was their mothers deciding for them. This was part of the culture in this community, where women's future educational and professional plans were being decided on by people other than themselves. Future research would be able to reveal if this affects general academic and mathematics self-efficacy.

4.4 WHAT VARIABLES ARE RELATED TO MATHEMATICS SELF-EFFICACY?

According to Bandura, there are four sources of self-efficacy: mastery experience, vicarious experience or modeling, verbal persuasion, and physiological and affective factors. The most important of these is mastery experience. As was expected, the regression results showed that the best predictor of self-efficacy was previous mathematics performance. In the interviews, students also described numerous instances when doing well in mathematics increased their confidence. What emerged in the interviews was that mathematics performance beliefs were always linked to past accomplishments.

TABLE 19. MULTIPLE REGRESSION COEFFICIENTS AND P-VALUES FOR SIGNFICANT PREDICTORS OF SELF-EFFICACY

	TOP (Third Year Mathematics Grade ≥ 80)	**LOW (Third Year Mathematics Grade < 80)**	**ALL (Regardless of Grade)**
MEN	*None*	*none*	Coefficients not significant based on ANOVA *p-value = 0 .137*
WOMEN	**Siblings** β = -3.1227, *p-value = 0.0115* **Parental** β = 2.7696, *p-value = 0.0691* **Third Year Math** β = 2.6191, *p-value = 0.0703*	**Third Year Math** β = 5.4844, *p-value = 0.0035*	**Third Year Math** β = 2.3352, *p-value = 0.0092*
ALL (Regardless of Gender)	Coefficients not significant based on ANOVA *p-value = 0.092*	**Third Year Math** β = 3.5504, *p-value = 0.0074*	

It was clear that the students' self-efficacy beliefs were strongly based on previous experience because many took a frequentist approach in assessing their beliefs; treating the 0 to 100 rating in the self-efficacy instrument as percentages of the times they were able to accomplish a certain mathematics task even if this was not the original purpose of the measurement.

The next table summarizes the evidence for three sources of self-efficacy. Some were positive statements (✓), meaning the student talked about an increase in self-efficacy, or negative (✗), which was when a student talked about a decrease in confidence. Both cases supported the theory that these sources influence self-efficacy beliefs.

TABLE 20. SOURCES OF SELF-EFFICACY BELIEFS PER STUDENT

	Mastery Experience	Modeling (Other People)	Verbal Persuasion (Encouragement)
Lydia			
Santiago	✗		✓
Carmen			✓
Maria	✗✓		
Tomas	✓	✓	✓
Mayumi	✓		
Liwanag	✓		✓
Jonathan	✓	✓	✓
Jose	✗✓		

For the first source, Lydia, Santiago, and Carmen did not describe any experience that positively influenced their self-efficacy beliefs. This was in contrast to the other students who expressed greater and more varied experiences. For instance, Maria recollected past situations for every item on the self-efficacy questionnaire to assess beliefs. In one part of the interview she said, "*It's like 50-50. Sometimes I get confused, and sometimes it's easy to answer…. I forget sometimes.*" Then for another item she rated 100 she claimed, "*I've done it before…. I can already do it.*"

Tomas and Mayumi, when asked how their beliefs might be changed expressed that if the teacher was able to teach a concept well, they would feel strongly that they would be able to do it. Tomas said, "*I think… it's not really that easy… but maybe, if it was taught to me properly, I would be able to do it.*" This is equivalent to what Mayumi expressed, "*Sometimes she (teacher) would tell us, 'it's easy.' Then, she would say it again, 'it's easy.' Then she explains it further… why the answer was like that … and she really does it step by step. And if she needs to use colored chalk, she would.*"

Jonathan and Jose added a new dimension to self-efficacy beliefs. They were the only students who connected liking or enjoying a topic to self-efficacy. When Jonathan was asked why he believed he can answer a certain question, he replies, "*Hmmm… if I get the chance to study it, and I like it… I would be able to answer it.*" This contrasted with Jose's explanation:

> \- What about J? Statistics?
>
> **Jose**: Here, close to 0.
>
> \- Why did you put it there?
>
> **Jose**: Mmm… I don't feel any fondness for that topic… Statistics.
>
> \- Ahhh… but you haven't studied it yet?
>
> **Jose**: Not yet

For the second source of self-efficacy, Tomas and Jonathan mentioned instances when comparing themselves with other students influenced their self-efficacy beliefs. These situations were in the context of competition. Tomas, when asked what increased his self-efficacy in mathematics explained, "*Maybe my friends in the room. Because sometimes, we try to outperform each other in Math. To raise my scores, I study very hard, just to make it higher.*" Similarly, Jonathan described self-comparison with other students and expressed pleasure when somebody asked him for help.

> - How about your classmates, do you think they help add to your confidence?
>
> **Jonathan**: Yeah… when for instance, like with my classmates, if I see that they are good, I must do good as well. It adds to my confidence.
>
> - When… what do you feel when your classmates ask for help from you?
>
> **Jonathan**: When what I teach them is correct, it feels good. But when I'm doing something and they keep on nagging, sometimes I feel irritated.

Finally, verbal persuasion appeared to be common among students regardless of self-efficacy levels, which suggested that it did not significantly influence self-efficacy beliefs in this population. There were basically two types of answers: the first was encouragement from friends and the second was affirmation from the teacher or parents. Liwanag and Santiago mentioned becoming more confident after the teacher praised them; Jonathan expressed elation when praised by his parents; and Carmen and Tomas described how their classmates inspired them and provided encouraging words. These experiences were probably still very valuable for the students. Nevertheless, the strongest inducer of self-efficacy was still mastery experience.

Another important factor that influenced mastery experience was the use of a second language in the mathematics class. This in turn affected self-efficacy. During classroom observations, it was noticed that the teacher code switched between Filipino and English to explain some concepts and to clarify questions for the students. At times, students were not able to articulate well what they wanted to say when they were called on to answer these questions. It was later confirmed from the teacher that based on her experience, students had difficulty speaking and understanding English. Nevertheless, she was required to teach in this second language because it was mandated by the government.

The interviews revealed among the students a common negative opinion regarding English use *(table 20)*. Some students expressed combinations of neutral statements, saying it was fine, and positive and negative opinions scattered throughout the length of the conversation. Some clearly felt that English was not beneficial for them, and the male students' statements were more strongly expressed. The women's responses were more mixed; there were positives, negatives, and combinations. Nonetheless, most had reservations on its use in the mathematics classroom.

TABLE 21. OPINIONS ON THE USE OF ENGLISH IN THE MATHEMATICS CLASS PER STUDENT

	POSITIVE (ENGLISH)	NEUTRAL (*“IT’S FINE.”*)	NEGATIVE (NO ENGLISH)
LYDIA		✓	
SANTIAGO			✓
CARMEN			✓
MARIA	✓		✓
TOMAS		✓	✓
MAYUMI	✓		
LIWANAG		✓	
JONATHAN			✓
JOSE		✓	✓

Students expressed neutral statements because they had never experienced listening to and discussing mathematics in Filipino. This meant there was no clear basis for comparison. Liwanag hints in our conversation:

> - Do you think it would be easier to understand Physics or Math if Filipino is used … or English?
>
> **Liwanag**: We’re already used to English… so it’s English.
>
> - Ah… but you don’t get confused because of English?
>
> **Liwanag**: Not really.

The men were quite unanimous with their negative opinion on English use. All of them expressed that it was confusing, and that it would be beneficial if the lessons were conducted in Filipino. Santiago, when asked if it was helpful that English was being used in the classroom replied that it was not because he did not understand. He stated that English statements should be translated. When Jonathan and Jose were asked in which exam they believed they would get a higher grade: a Math exam in Filipino or one in English, both replied that they would get higher scores in the Filipino exam. Despite this, Jonathan was more critical of his opinion because he admitted he has never experienced taking a test in Filipino. Jose also ended his reply saying, "*… in English… there are some unfamiliar words which I don't understand…. I get confused … but it's okay, using English in Math class is fine.*" Tomas shared the same sentiments when he said, "*Yes…. I would understand it better in Tagalog, because kids are not really fond of English, because at home, they speak Tagalog. They can't relate to English.*"

Carmen expressed herself more vividly when she commented on this topic, "*… because … if everything the teacher says is in English… it's like… it turns your brains into mush. It's a good thing my teacher teaches in Tagalog… so that things are well understood.*" This is in contrast to Maria and Mayumi's opinions which leaned towards the more positive, albeit with some negatives as well. When Maria was asked in which exam she believed she would get a higher score, she answered the one in English. However, when she talked about the two sets of identical word problems given to her, she was more confident with the Filipino problems because she understood them better. Towards the end of the interview, she still expressed that it was easier when Tagalog was used because she and her classmates would understand the lessons better. These contrasts were also evident in the interview with Mayumi:

<ON SELF-EFFICACY RANKING for EACH SUBJECT>

- So what's the last one?

Mayumi: Ah… what do you call this…? English.

- English… why English?

Mayumi: Because, really, sometimes, English can be confusing… the parts.

- What's confusing with English?

Mayumi: Ah… the parts of the sentences, you really can't help but get confused… and I'm not really that good in English.

<DIRECTLY ASKING ABOUT ENGLISH USE IN CLASS>

- What do you feel about English use in Math?

Mayumi: It's okay. It's more appropriate than Tagalog.

- If it's in Tagalog, what do you feel?

Mayumi: If it's Tagalog, it's like it would take longer, the explanations will be longer.

- But if you take an English and a Filipino exam, in which one would you get a higher score?

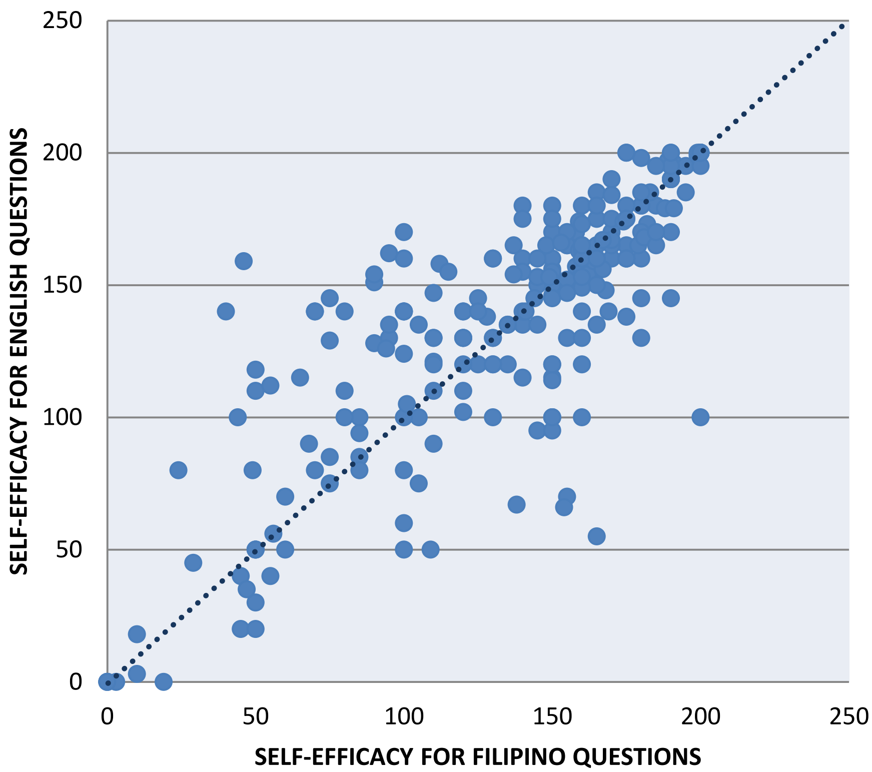
Mayumi: Maybe English

- Still English… because you're used to it?

Mayumi: Yes

The pattern that emerged in these interviews was that classroom instruction in English had an effect in the dynamics of classroom learning. This was similar to what a researcher found among Latino/a students in the United States, except that in the cases described in the study, teachers found ways to compensate for the lack of proficiency in English by promoting discussion in the primary language (Gutiérrez, 2002). In this classroom, the teacher was able to compensate by code-switching – explaining concepts in English first, then translating her statements. Nevertheless, at the current mathematical levels and language competencies of the students, no evidence was found that they would be more confident in a Filipino mathematics test than an English one. This was tested by presenting the two questions twice, in Filipino and in English, and self-efficacy was rated for both. The two self-efficacy scores, SELF_EFFICACY_FILIPINO and SELF_EFFICACY_ENGLISH had no difference as seen in the clustering on the $y = x$ line visible on their scatter plot.

FIGURE 13. SCATTER PLOT OF SELF-EFFICACY FOR FILIPINO WORD PROBLEMS VS SELF-EFFICACY FOR ENGLISH WORD PROBLEMS



A t-test also failed to provide evidence that the Filipino questions resulted to higher self-efficacy responses. Surprisingly, the results showed that the mean of self-efficacy scores for the English questions were actually higher, but nevertheless insignificant at $p = 0.183$.

TABLE 22. T-TEST RESULTS FOR THE DIFFERENCE BETWEEN SELF-EFFICACY FOR FILIPINO WORD PROBLEMS AND SELF-EFFICACY FOR ENGLISH WORD PROBLEMS

		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		T	Df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	FIL_PROB - ENG_PROB	-2.579	29.968	1.930	-6.382	1.224	-1.336	240	.183

Finally, a recurring theme that surfaced during the interviews was mathematics anxiety *(table 22)*. Except for two, all the students talked about feeling nervous in class. They expressed test-taking fears; concerns of being embarrassed in front of their classmates; fears of not knowing the answer; and certain beliefs about mathematics that were reinforced by the people around them. Those two students who did not talk about any of these emotions were better performing and had higher self-efficacy scores.

TABLE 23. EXPERIENCE OF ANXIETY AND BOREDOM IN THE MATHEMATICS CLASS PER STUDENT

	FEELING ANXIOUS INSIDE THE CLASSROOM	FEELING ANXIOUS WHILE TAKING A TEST	BOREDOM
LYDIA	✓	✓	
SANTIAGO	✓		✓
CARMEN	✓	✓	
MARIA	✓	✓	
TOMAS	✓		✓
MAYUMI	✓	✓	
LIWANAG	✓	✓	
JONATHAN			
JOSE			

In this school, asking students to answer questions in front of the class either by using the board, or just expounding on a certain question in front of everyone was a commonly used classroom strategy. The teacher called on the students to answer questions and sometimes made students work on problems on the board. When students were not able to answer the questions, they felt embarrassed in front of their peers. Interestingly, both Santiago and Jonathan expressed feeling good in class, specifically because they were able to answer these questions. Test anxiety was only mentioned by the women and not the men despite both expressing classroom anxiety. In a previous study, it was also observed that women experienced more anxiety than men (Hembree, 1990).

Aside from anxiety, certain beliefs about mathematics were expressed by Carmen, Maria, Tomas, and Mayumi that are important to mention because they were probably shared by many of the students in this school. The main themes of the beliefs were:

1. Mathematics is naturally not enjoyable, hard or confusing, and I cannot do anything about it.
2. Numbers are naturally difficult to understand and everybody knows it is.
3. Mathematics is like a series of trials one has to overcome.

These beliefs were best described by Carmen when she said with certainty, "*Isn't it true that math is difficult* <There is a sentence structure in Filipino that implies that the idea being conveyed is already known to the other person>*... even if you ask anyone.*" Later she spoke about the third belief when she described the subject, "*There's a lot… like trials… like in Math. There are so many trials… it's just like a maze. You have to go to the starting point, (and move) until the year ends.*" Mayumi talked about the second belief. Using the same word structure implying that the other person already agrees with the statement, she commented on why mathematics was more difficult, "*It's numbers ….*"

The same views were also shared by some school personnel saying, "*Filipinos are more like Balagtas (a poet) than mathematicians*" and "*We're (Filipinos) naturally not good in Math.*" It seemed that these beliefs were prevalent and pervasive even within the school environment and it was clear that their effects to self-efficacy were significant. Educators have suggested that productive disposition, "the tendency to see sense in mathematics, to perceive it as both useful and worthwhile, to believe that steady effort in learning mathematics pays off, and to see oneself as an effective learner and doer of mathematics," is a component of mathematical proficiency (Kilpatrick, Swafford, Findell, & ebrary Inc., 2001). The interviews revealed that students were lacking in this productive disposition because the adults around them may not have it either.

CHAPTER 5

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 SUMMARY

The purpose of this study was to verify Bandura's theory on the relationship of self-efficacy and performance particularly in mathematics among high school students. The objectives were to determine if they were related using statistical and ethnographic data, to find the differences in academic proficiency-promoting behavior, peer dynamics, and family life between students of varying self-efficacy levels, and to find variables that were significant predictors of self-efficacy.

In addition, another goal was to improve the methodologies of other studies by using real school data such as actual grades, actual classroom observations, and interviews with students which makes the study more useful for teachers. Also, it was aimed to add evidence to the generalizability of self-efficacy theory across different cultures and societies and to provide an explanation as to why there might be potential differences in the results of different studies done with different populations. To accomplish this, a rural school in the Philippines was selected for its homogenous student population – effectively reducing the effects of confounding variables such as race, ethnic and cultural backgrounds, socioeconomic status, and language.

Through this study, it was shown that self-efficacy was a positive but minor predictor of future performance (4th year grades) only for male students who previously had higher mathematics grades (3rd year grades). The effects were different between genders. It was not a strong predictor for women regardless of previous grades, and men with weaker mathematics skills. On the other hand, mathematics self-efficacy was predicted by previous mathematics achievement for women; and also the number of siblings and parental education for the higher performing women. None of the variables included in the regression model predicted men's self-efficacy.

It was also found that there were differences in terms of academic behavior, peers, and family life between students with high and low self-efficacy. Positive behavior such as asking for help from peers and parents were found for all female students regardless of self-efficacy levels and only a few were found among men. Negative behaviors such as lack of persistence were only found among low self-efficacy students. There was no evidence collected that points to differences in peer groups, but instead group work in class was found to be preferred by students with lower self-efficacy. Similarly, no differences were found in terms of the lives and families of the students, but the interviews revealed that family members and their experiences of poverty affected educational goals and ambitions.

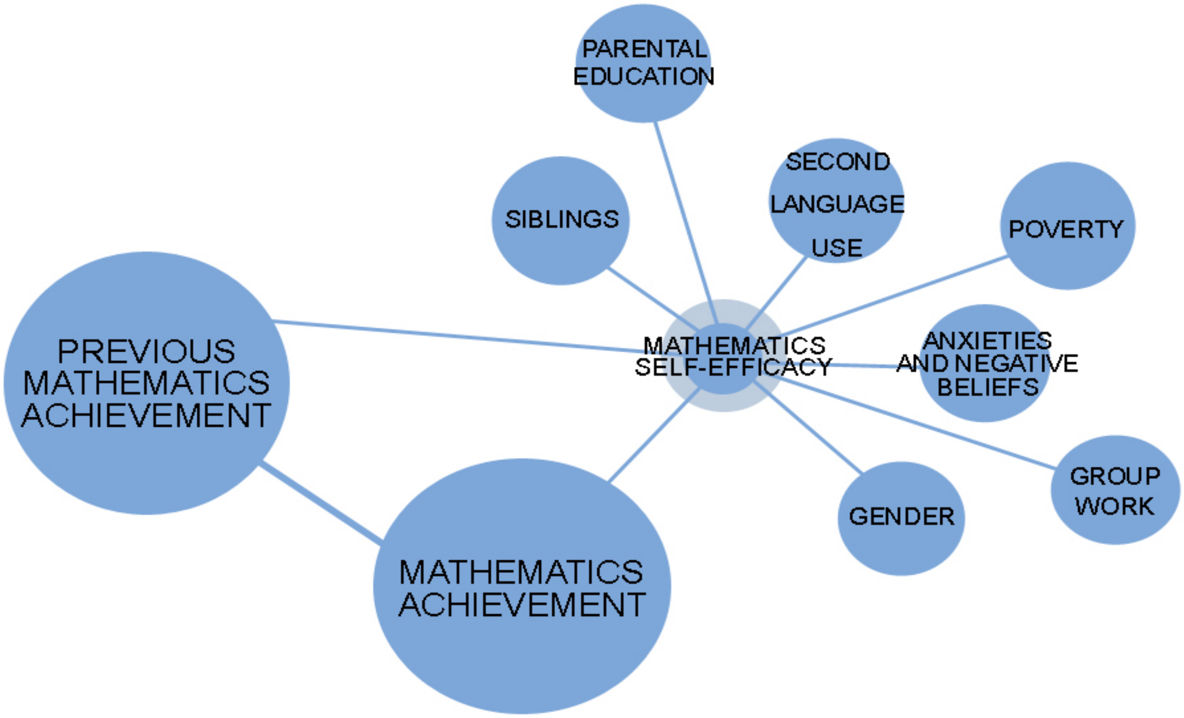
In terms of other dispositional factors, students expressed classroom and test anxieties, concerns of being embarrassed in front of their classmates, and beliefs that mathematics was naturally difficult and not enjoyable. The students who did not talk about any of these themes were better performing and had higher self-efficacy scores. Consistent with this finding, other studies have shown that anxiety levels were related to self-efficacy (Bandura, 1988).

The variable most strongly linked to self-efficacy was actual mastery experience. Modeling was also related, which in men manifested itself in competition. Verbal persuasion was common to all the students which implied that it did not influence self-efficacy – an idea consistent with Bandura's theory that verbal persuasion was the weakest source of this belief. The use of a second language in the mathematics classroom negatively affected confidence and performance. Also, gender and previous mathematics grades moderated the effects of the other variables such as the increased number of siblings and lower parental education which was negatively related only to women's self-efficacy. Finally, fears and negative beliefs about mathematics were related to confidence levels because they were found for the students with lower self-efficacy.

5.2 CONCLUSIONS

This study revealed the relationship between mathematics self-efficacy, performance, and the socio-cultural forces that affected the lives of these Filipino students. It gave a systemic view – Bronfenbrenner's concept of the ecology of human development where the larger social context of the Philippines was considered and not just the person or immediate setting (Bronfenbrenner, 1977). The next diagram best represents the findings of this study:

FIGURE 14. SYSTEMIC VIEW OF MATHEMATICS SELF-EFFICACY IN THE PHILIPPINES



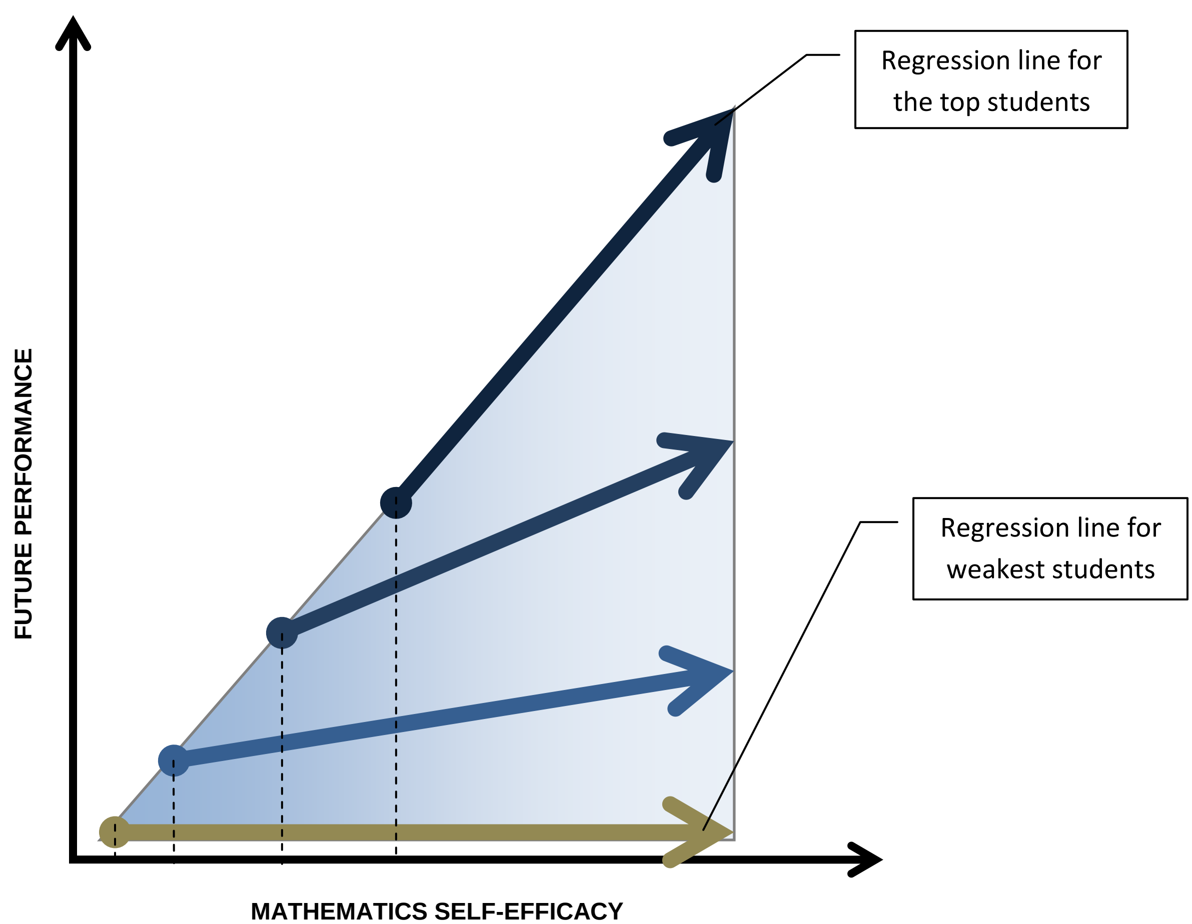
Mathematics self-efficacy was related to performance but its relationship was weak and moderated by other variables such as gender and previous mathematics grades. It revealed that self-efficacy was a statistically significant but minimal predictor of achievement for the top performing men but not for women. This study was different because previous research has shown the difference between the levels of self-efficacy between men and women but not the difference in its relationship to mathematics performance between genders. It can be hypothesized that because of the differentiation in the responsibilities assigned to women and the domestic expectations from them – for instance chores at home or caring for the family – it affected mathematics performance and self-efficacy. In relation, it was seen that the increased number of siblings lowered mathematics performance for women with the highest mathematics grades. The higher the number of siblings, the lower the grades they had. This was because the women were tasked to take care of their younger siblings and parents perhaps gave more responsibilities to their “brighter” children. In effect, this decreased the time dedicated to studies.

The data showed that only the top-performing men had self-efficacy levels that were related to performance thus reflecting Bandura’s theory that confidence positively influences achievement only if the skills or resources are available (Bandura, 1997; Schunk, 2006). Self-efficacy on its own, without the skills, would not result in better grades. Its effects are mediated by previously acquired mathematical ability; otherwise, this over-confidence is just an over-estimation of capability.

Supporting this idea, there was some evidence that differences in the correlation between performance and self-efficacy was mediated by intelligence scores (Oettingen, 1995). In previous studies, it was found that the self-efficacy levels of students with learning disabilities were overly estimated and thus had less predictive value (Klassen, 2006). In contrast, Pajares’ study comparing regular and gifted students showed that the effects of self-efficacy among the latter group were much higher (Pajares, 1996a). He actually interpreted this as estimating self-efficacy beliefs more accurately.

This is a possible reason why a moderate relationship was not found in this study. The low socioeconomic status of the community, the low resources of the school, and the lower educational attainments of the parents may have resulted in the decreased mathematical capabilities of the students. Therefore, self-efficacy levels did not influence the performance of the students because of this lack in capacity. The weaker the student, the less salient self-efficacy became. It is interesting to note that a country-level analysis reflected this individual-level phenomenon. For Finland, Canada and the United States, the higher the PISA ranking in mathematics, the higher the coefficient of self-efficacy for the multiple regression models used (Liang, 2010). The next diagram summarizes the findings from these studies in one single model showing this dynamic between self-efficacy and future performance:

FIGURE 15. RELATIONSHIP OF SELF-EFFICACY, FUTURE PERFORMANCE, AND MATHEMATICAL CAPABILITY



The best predictor of future performance was still past performance for both men and women. Other studies that included this predictor variable produced the same results (Elliott, 1990; Hailikari, Nevgi, & Komulainen, 2007). This was very clear from all the regression models, even when gender and previous performance were controlled.

Finally, classroom and test anxieties, and negative beliefs about mathematics were found for students with lower self-efficacy. Anxieties were felt because of the social pressure to do well in front of their peers. These types of emotions were magnified particularly in this classroom where students were asked to answer and explain problems in front of the whole class. This was also the reason why low self-efficacy students preferred group work where they answered as a team, over individual work.

In conclusion, this study added to the current body of knowledge on self-efficacy by analyzing it together with the socio-cultural factors that influenced the daily lives of the students. It has shown that self-efficacy and performance does not have a simple relationship, and that studies such as these have to take into consideration the context of the students' lives. Self-efficacy can be generalized among different cultural groups, but an effort must be taken to ensure that the context is well understood so that the results could be interpreted correctly. In this case, self-efficacy had some value, but social factors such as poverty, family life, and gender differences were more salient.

5.3 RECOMMENDATIONS

In an attempt to remove confounding variables by studying a school with a homogenous population abroad, the methodology in effect introduced a new set of factors, such as poverty and the use of a second language, that were needed to be taken into consideration. Although the student cohort was still homogenous, it was necessary to perform a mixed-methods study, which included both survey and observations, to correctly interpret the results. In future studies, the same methodological philosophy should be followed to build upon the results of this study.

In addition, it is recommended that multiple schools are selected in the same town mirroring the different socioeconomic levels and resources available to the students so that necessary comparison can be made. In using a larger sample, the quasi-factorial experiment design would be more powerful and it would also reveal the potential interaction of SES to self-efficacy and performance in the regression analysis. With more students, more interviews can be conducted so that the themes that emerge would become clearer.

It should be noted that Bandura criticized studies that have used previous performance (or behavior) to predict future performance (Bandura, 1997), which he labeled as statistical over-control. Researchers have attempted to use these measures to approximate capability. He was right when he said that previous performance was also governed by self-efficacy, therefore, the statistical analyses would not reveal its true effects. However in this case, 3rd year grades were appropriate measures because they were not just previous behavior, they were also sufficient measures of capability. Because the curricula is cyclical, 4th year performance builds upon skills acquired the previous year. They were not the same behavior performed at different times.

Nevertheless, it is still possible to improve on this study by actually measuring student mathematical capability necessary to succeed in the 4th year of high school. For future studies, a capability test – including basic arithmetic and elementary algebraic skills – can be administered to assess capability instead of using 3rd year grades. In addition, a more appropriate English skills assessment can be conducted instead of using English grades. This would further refine the findings of the study.

Adding to the current methodology, it would be ideal to interview the parents and peer groups which were initially planned but not executed because of time constraints. Also, it was found that not all the students had their closest friends from the same school which made the logistics of the interviewing sessions more time consuming. Conversations with the friends and parents would reveal much more details about their activities, their behavior regarding school work, their study time, and the beliefs that are passed on from them to the students. In relation to this, another area of which can be investigated is how much connected mathematics is to their daily lives. In the future, researchers could come up with an inventory of mathematical activities survey that could be administered and used for further research activities. This would include activities such as measuring ingredients for cooking, preparing taxes, or calculating for carpentry work. The mathematical activities inventory survey results would reflect how much a society, or social group, uses and values mathematics and can be used for cross-cultural, or even within-country population comparison studies.

To finish, research in education is not complete without stating its implications to teaching practice. The results of this study are significant because it sheds light to education policy and mathematics learning. In terms of policy, it was clear that the use of a second language was affecting performance and mathematics self-efficacy. It has become an additional barrier students had to hurdle to achieve competency. It has become an equity issue as well because students who are typically not proficient in the English language come from poor and rural families. In contrast, the more affluent city-dwellers have enough resources to send their children to the best schools to learn the language and to provide them with activities that serve as continuous exposure to English. Because of this policy, the government has unintentionally mandated a ruling that ill-serves the poor and perpetuates poverty by preventing them access to better education. In choosing to train its citizens in the English language for its economic benefits, it has sacrificed learning in the sciences and mathematics.

Returning to the first question raised at the beginning of this dissertation – what is the relationship of students saying “I can’t do math,” to performance? It was found that there was a relationship, but the more important predictor was actual mathematics capacity. Therefore, teachers must not be too worried about “raising” confidence, but rather, changing teaching methods to assure that students deeply understand concepts. In practice, this might mean providing students opportunities to master ideas and to consistently experience mathematical successes either through carefully selected problems, group work and even with much maligned rote activities like repetitive homework which was found to be related to increased self-efficacy levels (B. J. Zimmerman & Kitsantas, 2005). In the end, when the focus turns to improved teaching practices, self-efficacy naturally follows.

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APPENDIX A

LETTER TO STUDENTS' PARENTS

209 CRM Avenue
BF Homes Almanza, Las Piñas

Hunyo 27, 2011

Sa mga minamahal kong mga magulang,

Isang magandang araw sa inyong lahat. Ako ay si Mark Causapin, isang doctoral student ng Columbia University, at naririto sa Taysan National High School upang magsagawa ng isang pag-aaral tungkol sa edukasyon sa matematika ng mga mag-aaral dito. Ibig kong suriin ang mga bagay na nakaka-apekto sa pag-aaral ng mga estudyante na magandang malaman natin upang makatulong sa kanilang paglago at pagiging magaling sa paaralan.

Bahagi ng pag-aaral na ito ay mga survey, na aking pasasagutan sa mga mag-aaral, at mga interview. Sa ating survey, itatanong sa kanila ang kanilang mga opinyon ukol sa matematika. Kasama nito, itatanong din ang ilang mga personal na bagay tulad ng kung ilang magkakapatid, kung sila ay nagtatrabaho, kung ano ito at pati na rin ng mga kasama sa bahay, mga bagay ukol sa barkada, at iba pa. Sa interview naman, ang ilang mag-aaral ay tatanungin ukol sa kanilang mga karanasan sa pag-aaral. Dito, maaaring gumamit ng audio-recorder.

Humihingi ako ng pahintulot upang payagan ang inyong mga anak na sumali sa pag-aaral na ito. Hindi ito makaka-apekto sa kanilang mga grado at hindi malalaman ang kanilang mga indibidwal na sagot ng kahit sino maliban sa akin.

Ang nakalakip na mga sulat ay ang Ingles na kopya ng sulat na ito. Kung kayo po ay pumapayag, maaring pakisabihan ako upang ma-survey at ma-interview ang inyong anak.

Para sa ibang mga tanong, maari ninyo akong sulatan sa mgcausapin@yahoo.com o i-text sa 0916-508-2679. Salamat sa inyong tulong.

Mark Causapin

Paki-sulat ng inyong pangalan kung gusto ninyong sumali ang inyong anak sa survey at interview.

Pangalan: ____
Petsa: _____________________________________

APPENDIX B

SURVEY INSTRUMENT

Pangalan: ____________________________________

Section: ____________

Birthday: ____________

1. Ilan kayong magkakapatid? (kung walang kapatid, isulat "walang kapatid") __________
2. Pang-ilan ka sa magkakapatid? __________
3. Ikaw ba ay nagtatrabaho sa kasalukuyan? __________ Part time o Full time? _________
4. Ikaw ba ay transferee? __________
5. Saan ka nag
    a. Elementary __________
    b. High School (kung transferee) __________
6. Sino ang kasama mo sa bahay? At ano ang trabaho nila? Ano ang kanilang natapos?

Relationship	**Trabaho**	**Full / Part time**	**Natapos**
Example: Inay	*May sari-sari store*	*Full time*	*High School*

7. Pakilista ang mga pangalan ng iyong mga pinaka-close na mga kaibigan.

8. Pakisabi kung gaano mo katindi pinaniniwalaan ang mga bagay na ito. Pakisabi kung gaano mo katindi pinaniniwalaang kaya mong matutunang sagutin ang mga ito (0-100).

    a. ___________ Kaya kong tumakbo ng 30 minuto.

    b. ___________ Ang mga fractions ay kaya kong sagutan.

    c. ___________ Naka-parada ang mga bike at kotse sa mall. Alam mo na 16 lahat ang mga nakaparada, at kung pagsasamasamahin ang mga gulong ng bisikleta at kotse, 38 lahat sila. Ilang bike ang nasa mall?

    d. ___________ Kaya kong sagutin ito: **x+5=7**.

    e. ___________ Determine whether each ordered pair is a solution of the system.

    $$\begin{cases} \boldsymbol{x+y=2} \\ \boldsymbol{x-y=4} \end{cases}$$

    f. ___________ A cage contains birds and rabbits. There are sixteen heads and thirty-eight feet. How many birds are there in the cage?

    g. ___________ Kaya kong matutong sagutin ang mga quadratic equations kagaya ng $\mathbf{x^2+10x+25=0}$.

h. ___________ Matatapos kong basahin ang isang nobela.

i. ___________ Kaya kong mag math ng mabilis sa utak ko.

j. ___________ Sa statistics, kapag ang mean ay 4 ng limang numero, ang mode ay 1, at ang median ay 5, ano yung limang numero na tinutukoy?

k. ___________ Kaya kong mag-algebra.

l. ___________ Kaya ko o kaya kong matutong magpalit ng gulong ng sasakyan.

m. ___________ Exponential functions are functions where $f(x) = a^x + B$ where a is any constant and B is any expression. For example, $\mathbf{f(x) = e^{-x} - 1}$ is an exponential function.

n. ___________ Kaya kong matutunan ang mga bagay na pinagaaralan sa math.

o. ___________ Kaya ko o kaya kong matutunang mag solve ng equations.

p. ___________ Ang quadratic equation ay kahit anong function na ganito ang itsura. $ax^2 + by + c = 0$. Pwedeng palitan ang a, b, at c ng kahit anong number. Halimbawa, $\mathbf{5x^2+2y + 8 = 0}$.

q. ___________ Anong mga number ang pwedeng ipalit sa x at sa y para magtama ang mga equation na ito. $\mathbf{x + y = 10}$ at $\mathbf{x - 7y = 5}$?

r. ___________ For a set of five whole numbers, the mean is 4, the mode is 1, and the median is 5. What are the five numbers?

APPENDIX C

PREDICTORS OF FUTURE MATHEMATICS PERFORMANCE – MULTIPLE REGRESSION RESULTS (INTERACTION BETWEEN GENDER AND PERFORMANCE)

Summary Table (Significant Predictors Based on Regression Analyses)

	TOP (Third Year Mathematics Grade ≥ 80)	**LOW** (Third Year Mathematics Grade < 80)	**ALL** (Regardless of Grade)
MEN	**Self-Efficacy** β = 0.0577, *p-value = 0.0108* **Third Year Math** β = 1.3602, *p-value < 0.0001*	**Third Year Math** β = 1.0653, *p-value = 0.0058*	**Self-Efficacy** β = 0.0382, *p-value = 0.0593* **Third Year Math** β = 1.2635, *p-value < 0.0001*
WOMEN	**Siblings** β = -0.7580, *p-value = 0.0175* **Third Year Math** β = 0.6862, *p-value = 0.0785*	**Third Year Math** β = 1.3793, *p-value = 0.0021*	**Third Year Math** β = 1.0940, *p-value < 0.0001*
ALL (Regardless of Gender)	**Siblings** β = -0.5042, *p-value = 0.0106* **Third Year Math** β = 0.9306, *p-value = 0.0002*	**Third Year Math** β = 1.2444, *p-value < 0.0001*	

Top-Performing Men (Third Year Mathematics Grade ≥ 80)

HUBER M-EST ROBUST REGRESSION OUTPUT

```
Call: rlm(formula = FIRSTQ4THYEARMATH ~ HONOR + SIBLINGS + PARENTAL +
    T_SELF_EFFICACY_TOTAL + THIRDYEARMATH, data = GoodMale)
Residuals:
      Min        1Q    Median        3Q       Max
-3.202766 -0.422572  0.009414  0.447403  2.400519

Coefficients:
                      Value    Std. Error t value
(Intercept)           -31.5346  11.4218    -2.7609
HONOR                   1.4565   1.1620     1.2535
SIBLINGS               -0.1679   0.1095    -1.5343
PARENTAL               -0.0890   0.2020    -0.4407
T_SELF_EFFICACY_TOTAL   0.0577   0.0188     3.0627
THIRDYEARMATH           1.3602   0.1447     9.3978

Residual standard error: 0.6631 on 11 degrees of freedom
  (1 observation deleted due to missingness)
```

LEAST SQUARES REGRESSION OUTPUT

ANOVA [b, c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	216.055	5	43.211	15.936	.000[a]
	Residual	29.828	11	2.712		
	Total	245.882	16			

a. Predictors: (Constant), THIRDYEARMATH, SIBLINGS, HONOR, PARENTAL, T_SELF_EFFICACY_TOTAL

b. Dependent Variable: FIRSTQ4THYEARMATH

c. Selecting only cases for which CLASSXM = A

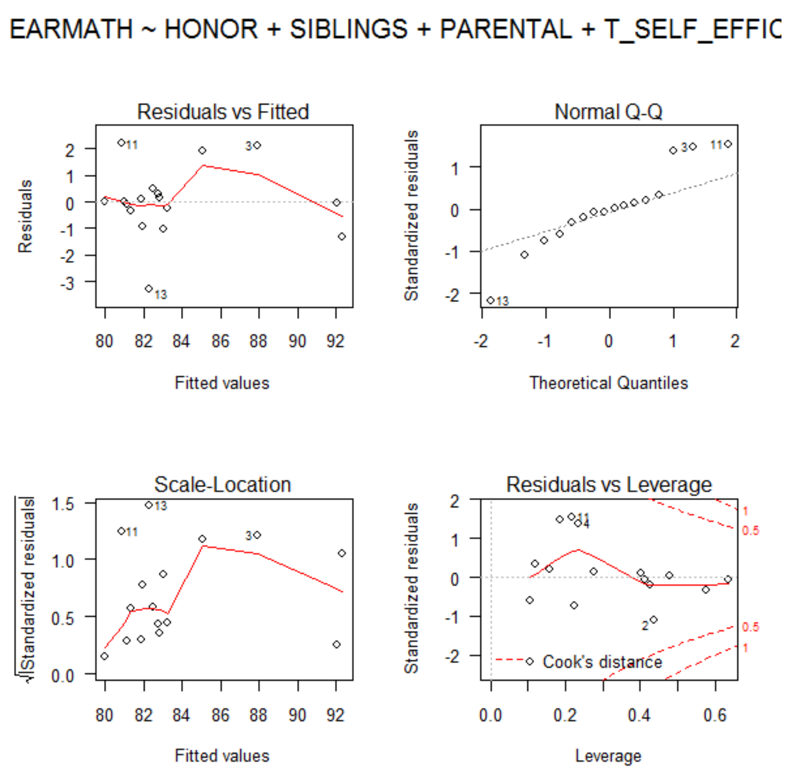
Coefficients a, b

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95% Confidence Interval for B Lower Bound	95% Confidence Interval for B Upper Bound
1	(Constant)	-38.612	18.015		-2.143	.055	-78.263	1.039
	HONOR	1.534	1.746	.095	.879	.398	-2.308	5.376
	SIBLINGS	-.183	.165	-.120	-1.111	.290	-.545	.179
	PARENTAL	-.162	.302	-.062	-.537	.602	-.827	.502
	T_SELF_EFFICACY_TOTAL	.058	.028	.240	2.032	.067	-.005	.120
	THIRDYEARMATH	1.451	.229	.774	6.344	.000	.948	1.955

a. Dependent Variable: FIRSTQ4THYEARMATH

b. Selecting only cases for which CLASSXM = A

RESIDUALS CHECK



Low-Performing Men (Third Year Mathematics Grade < 80)

HUBER M-EST ROBUST REGRESSION OUTPUT

```
Call: rlm(formula = FIRSTQ4THYEARMATH ~ HONOR + SIBLINGS + PARENTAL +
    T_SELF_EFFICACY_TOTAL + THIRDYEARMATH, data = BadMale)
Residuals:
    Min      1Q  Median      3Q     Max
-6.5661 -1.8955  0.1186  1.9389  5.2244

Coefficients:
                      Value   Std. Error t value
(Intercept)           -9.3470 28.1469    -0.3321
HONOR                  1.8397  1.7034     1.0800
SIBLINGS               0.2606  0.2126     1.2261
PARENTAL               0.0773  0.3025     0.2557
T_SELF_EFFICACY_TOTAL  0.0392  0.0250     1.5707
THIRDYEARMATH          1.0653  0.3698     2.8809

Residual standard error: 2.883 on 50 degrees of freedom
  (15 observations deleted due to missingness)
```

LEAST SQUARES REGRESSION OUTPUT

ANOVA [b, c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	136.282	5	27.256	3.235	.013[a]
	Residual	421.271	50	8.425		
	Total	557.554	55			

a. Predictors: (Constant), THIRDYEARMATH, SIBLINGS, HONOR, T_SELF_EFFICACY_TOTAL, PARENTAL

b. Dependent Variable: FIRSTQ4THYEARMATH

c. Selecting only cases for which CLASSBXM = A

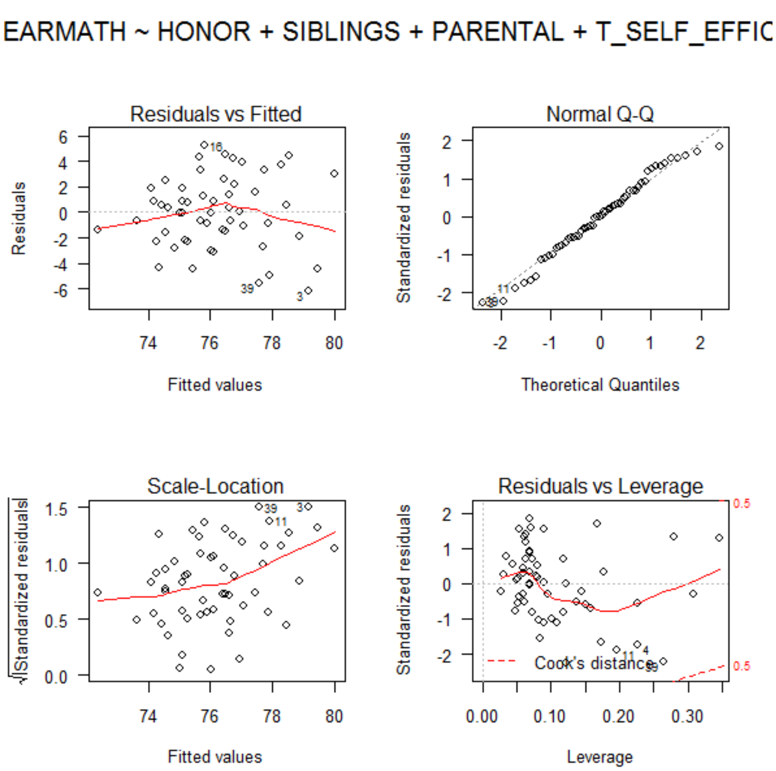
Coefficients [a, b]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95% Confidence Interval for B Lower Bound	95% Confidence Interval for B Upper Bound
1	(Constant)	.478	25.488		.019	.985	-50.716	51.673
	HONOR	1.406	1.542	.115	.911	.367	-1.693	4.504
	SIBLINGS	.178	.192	.114	.923	.360	-.209	.564
	PARENTAL	.109	.274	.053	.396	.694	-.442	.659
	T_SELF_EFFICACY_TOTAL	.039	.023	.220	1.737	.088	-.006	.085
	THIRDYEARMATH	.939	.335	.372	2.805	.007	.267	1.612

a. Dependent Variable: FIRSTQ4THYEARMATH

b. Selecting only cases for which CLASSBXM = A

RESIDUALS CHECK



Top-Performing Women (Third Year Mathematics Grade ≥ 80)

HUBER M-EST ROBUST REGRESSION OUTPUT

```
Call: rlm(formula = FIRSTQ4THYEARMATH ~ HONOR + SIBLINGS + PARENTAL +
    T_SELF_EFFICACY_TOTAL + THIRDYEARMATH, data = GoodFemale)
Residuals:
      Min        1Q    Median        3Q       Max
-11.64077  -1.87186  -0.05241   1.95447   4.62543

Coefficients:
                      Value   Std. Error t value
(Intercept)           29.9056 29.3281     1.0197
HONOR                  1.6828  1.3830     1.2168
SIBLINGS              -0.7580  0.3024    -2.5067
PARENTAL              -0.1430  0.3946    -0.3624
T_SELF_EFFICACY_TOTAL  0.0122  0.0415     0.2938
THIRDYEARMATH          0.6862  0.3775     1.8179

Residual standard error: 2.939 on 32 degrees of freedom
  (4 observations deleted due to missingness)
```

LEAST SQUARES REGRESSION OUTPUT

ANOVA [b, c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	152.477	5	30.495	2.610	.043[a]
	Residual	373.839	32	11.682		
	Total	526.316	37			

a. Predictors: (Constant), THIRDYEARMATH, PARENTAL, SIBLINGS, HONOR, T_SELF_EFFICACY_TOTAL

b. Dependent Variable: FIRSTQ4THYEARMATH

c. Selecting only cases for which CLASSXF = A

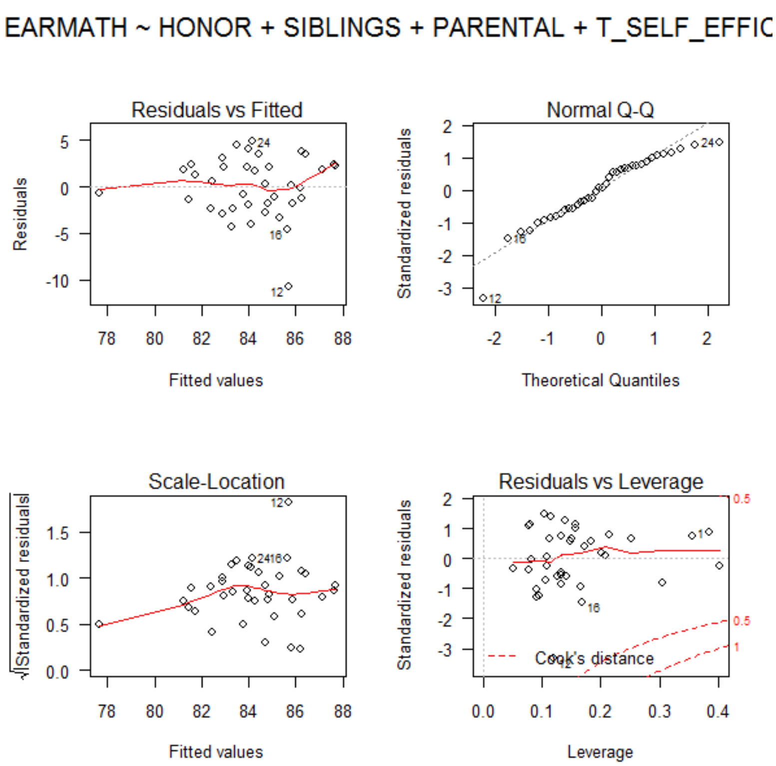
Coefficients [a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	39.006	28.018		1.392	.173	-18.066	96.077
	HONOR	1.537	1.359	.196	1.131	.266	-1.231	4.306
	SIBLINGS	-.622	.298	-.335	-2.088	.045	-1.229	-.015
	PARENTAL	-.195	.388	-.082	-.502	.619	-.986	.596
	T_SELF_EFFICACY_TOTAL	.034	.041	.146	.828	.414	-.049	.116
	THIRDYEARMATH	.547	.360	.275	1.519	.139	-.187	1.282

a. Dependent Variable: FIRSTQ4THYEARMATH

b. Selecting only cases for which CLASSXF = A

RESIDUALS CHECK



Low-Performing Women (Third Year Mathematics Grade < 80)

HUBER M-EST ROBUST REGRESSION OUTPUT

```
Call: rlm(formula = FIRSTQ4THYEARMATH ~ HONOR + SIBLINGS + PARENTAL +
    T_SELF_EFFICACY_TOTAL + THIRDYEARMATH, data = BadFemale)
Residuals:
    Min      1Q  Median      3Q     Max
-7.3754 -2.2116 -0.1121  2.2210  7.2944

Coefficients:
                      Value    Std. Error t value
(Intercept)           -29.8956  32.0858   -0.9317
HONOR                   0.0741   3.5404    0.0209
SIBLINGS                0.0910   0.2012    0.4524
PARENTAL                0.0760   0.3023    0.2513
T_SELF_EFFICACY_TOTAL   0.0057   0.0287    0.1989
THIRDYEARMATH           1.3793   0.4269    3.2307

Residual standard error: 3.315 on 56 degrees of freedom
  (10 observations deleted due to missingness)
```

LEAST SQUARES REGRESSION OUTPUT

ANOVA [b, c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	146.174	5	29.235	2.700	.030[a]
	Residual	606.294	56	10.827		
	Total	752.468	61			

a. Predictors: (Constant), THIRDYEARMATH, SIBLINGS, HONOR, PARENTAL, T_SELF_EFFICACY_TOTAL

b. Dependent Variable: FIRSTQ4THYEARMATH

c. Selecting only cases for which CLASSBXF = A

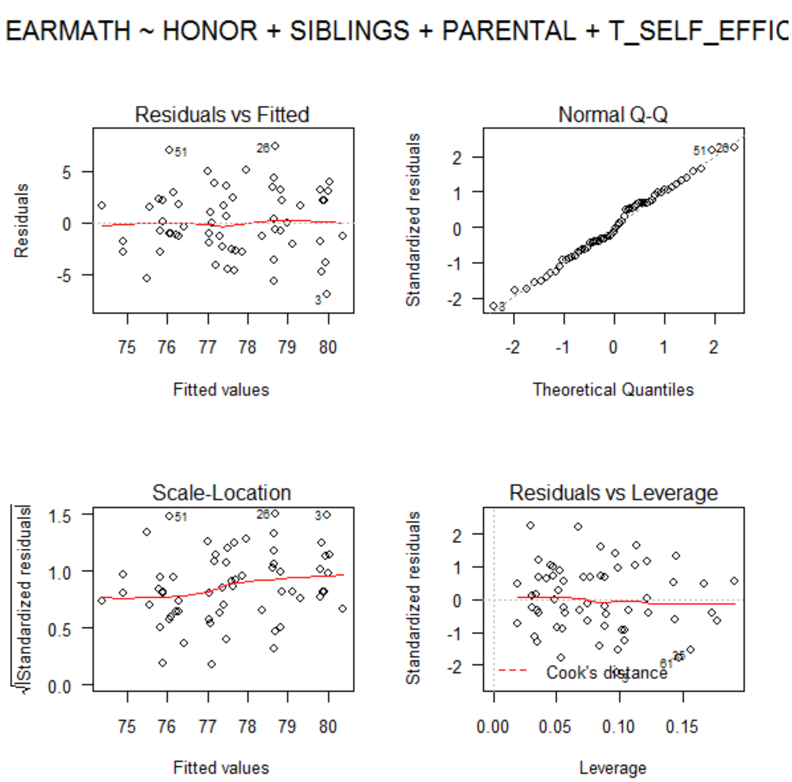
Coefficients [a, b]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95% Confidence Interval for B Lower Bound	95% Confidence Interval for B Upper Bound
1	(Constant)	-22.009	30.840		-.714	.478	-83.789	39.772
	HONOR	.424	3.403	.015	.125	.901	-6.393	7.242
	SIBLINGS	.072	.193	.047	.374	.710	-.315	.460
	PARENTAL	-.030	.291	-.013	-.102	.919	-.612	.552
	T_SELF_EFFICACY_TOTAL	.010	.028	.048	.362	.719	-.045	.065
	THIRDYEARMATH	1.278	.410	.416	3.114	.003	.456	2.100

a. Dependent Variable: FIRSTQ4THYEARMATH

b. Selecting only cases for which CLASSBXF = A

RESIDUALS CHECK



Top-Performing Men and Women (Third Year Mathematics Grade ≥ 80)

HUBER M-EST ROBUST REGRESSION OUTPUT

```
Call: rlm(formula = FIRSTQ4THYEARMATH ~ HONOR + SIBLINGS + PARENTAL +
    T_SELF_EFFICACY_TOTAL + THIRDYEARMATH, data = Top)
Residuals:
      Min        1Q    Median        3Q       Max
-10.95588  -1.81201  -0.04453   2.02506   5.39875

Coefficients:
                      Value   Std. Error t value
(Intercept)            7.3282 18.4364     0.3975
HONOR                  1.1106  1.0102     1.0994
SIBLINGS              -0.5042  0.1897    -2.6570
PARENTAL              -0.3077  0.2781    -1.1065
T_SELF_EFFICACY_TOTAL  0.0412  0.0276     1.4945
THIRDYEARMATH          0.9306  0.2351     3.9583

Residual standard error: 2.865 on 49 degrees of freedom
  (5 observations deleted due to missingness)
```

LEAST SQUARES REGRESSION OUTPUT

ANOVA [b, c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	319.605	5	63.921	6.864	.000[a]
	Residual	456.323	49	9.313		
	Total	775.927	54			

a. Predictors: (Constant), THIRDYEARMATH, SIBLINGS, PARENTAL, HONOR, T_SELF_EFFICACY_TOTAL

b. Dependent Variable: FIRSTQ4THYEARMATH

c. Selecting only cases for which TOP = A

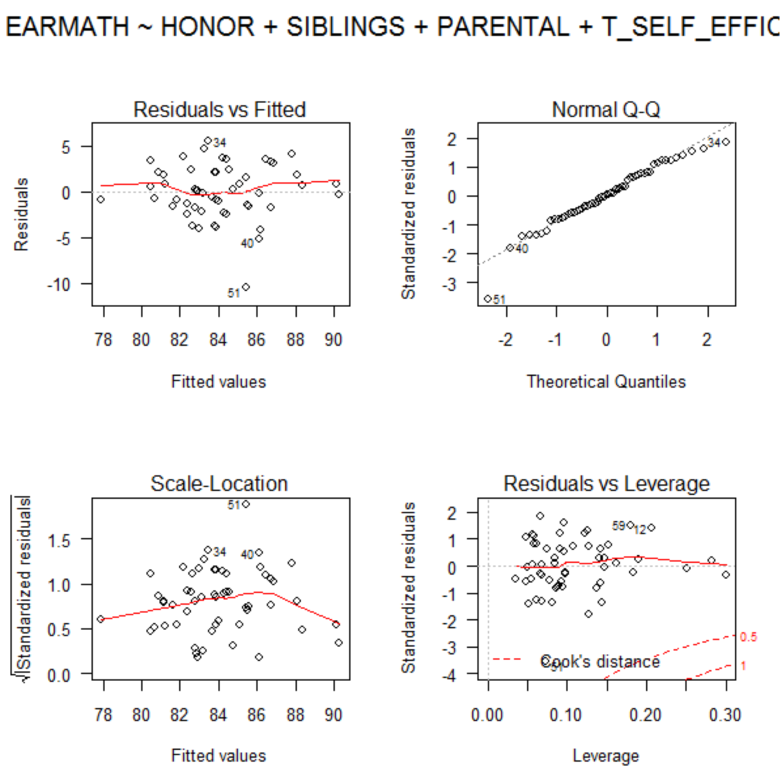
Coefficients [a, b]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95% Confidence Interval for B Lower Bound	95% Confidence Interval for B Upper Bound
1	(Constant)	13.812	18.644		.741	.462	-23.654	51.278
	HONOR	1.076	1.022	.125	1.054	.297	-.977	3.129
	SIBLINGS	-.444	.192	-.260	-2.314	.025	-.830	-.058
	PARENTAL	-.308	.281	-.126	-1.094	.279	-.873	.257
	T_SELF_EFFICACY_TOTAL	.051	.028	.217	1.825	.074	-.005	.107
	THIRDYEARMATH	.837	.238	.435	3.521	.001	.359	1.315

a. Dependent Variable: FIRSTQ4THYEARMATH

b. Selecting only cases for which TOP = A

RESIDUALS CHECK



Low-Performing Men and Women (Third Year Mathematics Grade < 80)

HUBER M-EST ROBUST REGRESSION OUTPUT

```
Call: rlm(formula = FIRSTQ4THYEARMATH ~ HONOR + SIBLINGS + PARENTAL +
    T_SELF_EFFICACY_TOTAL + THIRDYEARMATH, data = Low)
Residuals:
    Min      1Q  Median      3Q     Max
-7.2409 -1.9966 -0.1934  2.1731  7.5544

Coefficients:
                      Value    Std. Error t value
(Intercept)           -21.1916  18.5705    -1.1411
HONOR                   1.2060   1.4810     0.8144
SIBLINGS                0.1436   0.1410     1.0183
PARENTAL                0.0993   0.1990     0.4992
T_SELF_EFFICACY_TOTAL   0.0230   0.0181     1.2696
THIRDYEARMATH           1.2444   0.2455     5.0696

Residual standard error: 3.173 on 112 degrees of freedom
  (25 observations deleted due to missingness)
```

LEAST SQUARES REGRESSION OUTPUT

ANOVA [b, c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	327.507	5	65.501	7.014	.000[a]
	Residual	1045.950	112	9.339		
	Total	1373.458	117			

a. Predictors: (Constant), THIRDYEARMATH, HONOR, SIBLINGS, PARENTAL, T_SELF_EFFICACY_TOTAL

b. Dependent Variable: FIRSTQ4THYEARMATH

c. Selecting only cases for which BOTTOM = A

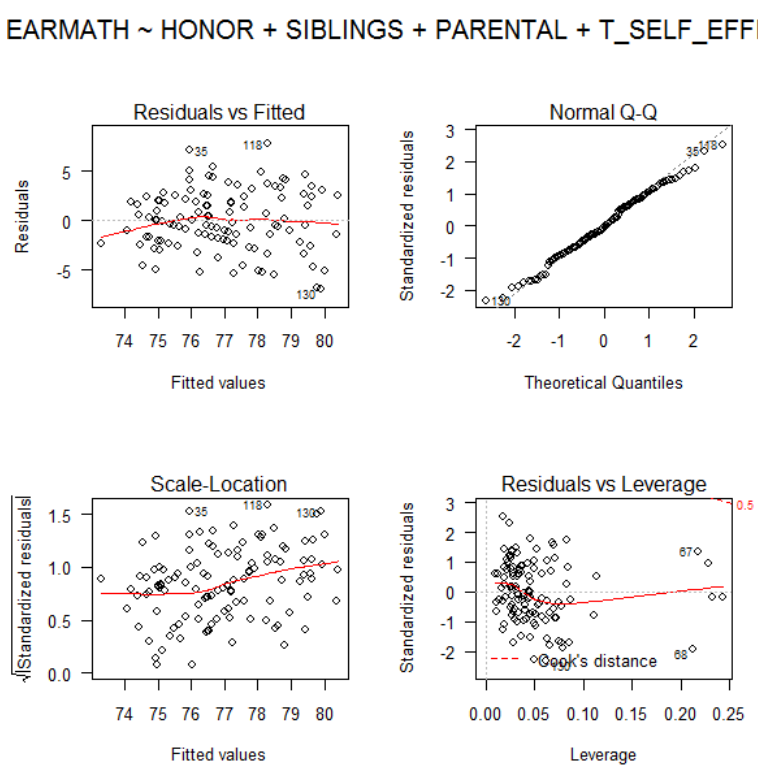
Coefficients [a, b]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95% Confidence Interval for B Lower Bound	95% Confidence Interval for B Upper Bound
1	(Constant)	-13.066	17.553		-.744	.458	-47.846	21.714
	HONOR	1.002	1.400	.059	.716	.476	-1.772	3.776
	SIBLINGS	.123	.133	.078	.923	.358	-.141	.387
	PARENTAL	.060	.188	.027	.318	.751	-.313	.432
	T_SELF_EFFICACY_TOTAL	.025	.017	.126	1.460	.147	-.009	.059
	THIRDYEARMATH	1.139	.232	.425	4.908	.000	.679	1.599

a. Dependent Variable: FIRSTQ4THYEARMATH

b. Selecting only cases for which BOTTOM = A

RESIDUALS CHECK



All Men

HUBER M-EST ROBUST REGRESSION OUTPUT

```
Call: rlm(formula = FIRSTQ4THYEARMATH ~ HONOR + SIBLINGS + PARENTAL +
    T_SELF_EFFICACY_TOTAL + THIRDYEARMATH, data = Male)
Residuals:
    Min      1Q  Median      3Q     Max
-7.3043 -1.5788 -0.1116  1.5704  5.0805

Coefficients:
                      Value    Std. Error t value
(Intercept)           -23.4405  14.6369    -1.6015
HONOR                   1.3651   1.0300     1.3253
SIBLINGS                0.0927   0.1555     0.5957
PARENTAL                0.0190   0.2265     0.0840
T_SELF_EFFICACY_TOTAL   0.0382   0.0199     1.9186
THIRDYEARMATH           1.2635   0.1937     6.5226

Residual standard error: 2.341 on 67 degrees of freedom
  (36 observations deleted due to missingness)
```

LEAST SQUARES REGRESSION OUTPUT

ANOVA [b, c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1056.269	5	211.254	29.607	.000[a]
	Residual	478.060	67	7.135		
	Total	1534.329	72			

a. Predictors: (Constant), THIRDYEARMATH, SIBLINGS, PARENTAL, T_SELF_EFFICACY_TOTAL, HONOR

b. Dependent Variable: FIRSTQ4THYEARMATH

c. Selecting only cases for which GENDER = 1

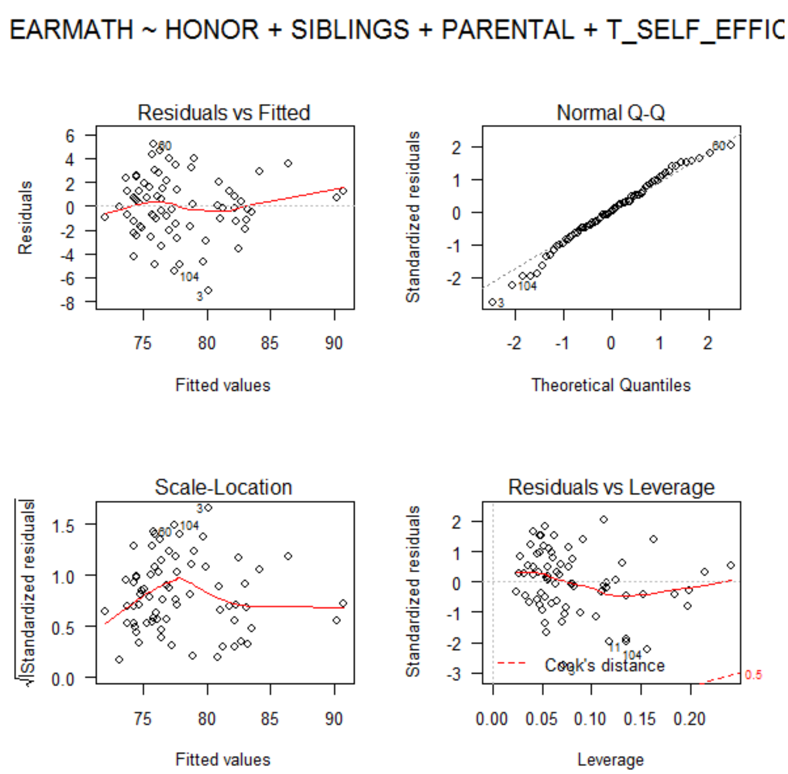
Coefficients [a, b]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95% Confidence Interval for B Lower Bound	95% Confidence Interval for B Upper Bound
1	(Constant)	-20.957	13.778		-1.521	.133	-48.458	6.544
	HONOR	1.491	.970	.145	1.537	.129	-.445	3.426
	SIBLINGS	.071	.146	.033	.482	.631	-.222	.363
	PARENTAL	.074	.213	.024	.346	.730	-.352	.499
	T_SELF_EFFICACY _TOTAL	.041	.019	.157	2.195	.032	.004	.078
	THIRDYEARMATH	1.226	.182	.665	6.726	.000	.862	1.590

a. Dependent Variable: FIRSTQ4THYEARMATH

b. Selecting only cases for which GENDER = 1

RESIDUALS CHECK



All Women

HUBER M-EST ROBUST REGRESSION OUTPUT

```
Call: rlm(formula = FIRSTQ4THYEARMATH ~ HONOR + SIBLINGS + PARENTAL +
    T_SELF_EFFICACY_TOTAL + THIRDYEARMATH, data = Female)
Residuals:
     Min       1Q   Median       3Q      Max
-10.9408  -1.9715  -0.2297   2.3831   7.3126

Coefficients:
                      Value   Std. Error t value
(Intercept)           -6.5495 16.0606    -0.4078
HONOR                  1.4442  1.2190     1.1848
SIBLINGS              -0.2508  0.1680    -1.4934
PARENTAL              -0.0535  0.2387    -0.2240
T_SELF_EFFICACY_TOTAL  0.0176  0.0228     0.7701
THIRDYEARMATH          1.0940  0.2108     5.1907

Residual standard error: 3.263 on 94 degrees of freedom
  (32 observations deleted due to missingness)
```

LEAST SQUARES REGRESSION OUTPUT

ANOVA [b, c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1218.485	5	243.697	21.194	.000[a]
	Residual	1080.825	94	11.498		
	Total	2299.310	99			

a. Predictors: (Constant), THIRDYEARMATH, PARENTAL, SIBLINGS, T_SELF_EFFICACY_TOTAL, HONOR

b. Dependent Variable: FIRSTQ4THYEARMATH

c. Selecting only cases for which GENDER = 0

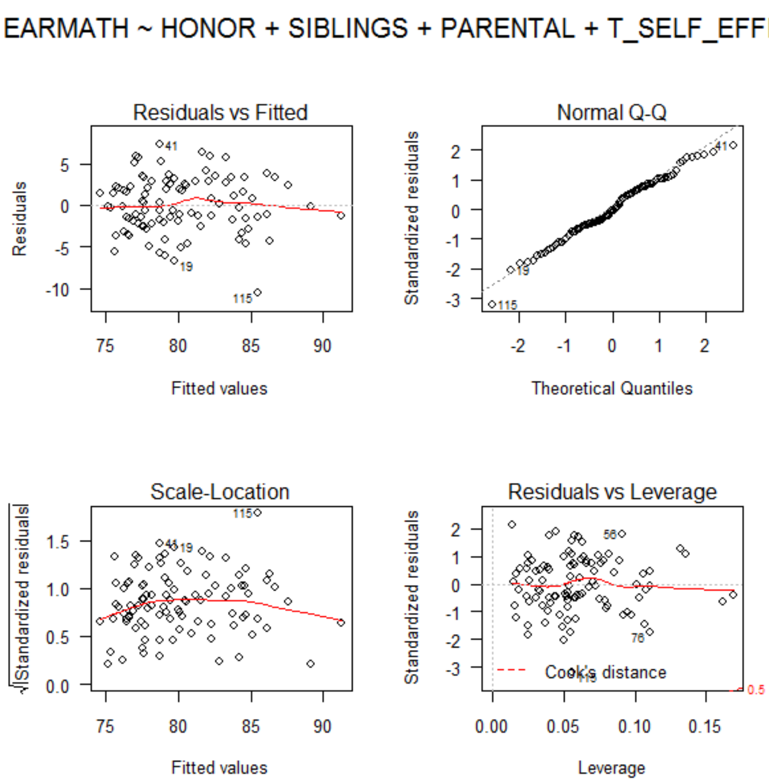
Coefficients [a, b]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95% Confidence Interval for B Lower Bound	95% Confidence Interval for B Upper Bound
1	(Constant)	-4.796	15.264		-.314	.754	-35.103	25.511
	HONOR	1.296	1.159	.119	1.118	.266	-1.005	3.596
	SIBLINGS	-.216	.160	-.098	-1.353	.179	-.533	.101
	PARENTAL	-.118	.227	-.038	-.520	.604	-.568	.332
	T_SELF_EFFICACY_TOTAL	.025	.022	.090	1.169	.245	-.018	.068
	THIRDYEARMATH	1.065	.200	.590	5.314	.000	.667	1.462

a. Dependent Variable: FIRSTQ4THYEARMATH

b. Selecting only cases for which GENDER = 0

RESIDUALS CHECK



APPENDIX D

PREDICTORS OF SELF-EFFICACY – MULTIPLE REGRESSION RESULTS (INTERACTION BETWEEN GENDER AND PERFORMANCE)

Summary table (significant predictors based on regression analyses)

	TOP **(Third Year Mathematics Grade ≥ 80)**	**LOW** **(Third Year Mathematics Grade < 80)**	**ALL** **(Regardless of Grade)**
MEN	-	-	Coefficients not significant based on ANOVA *p-value = 0 .137*
WOMEN	**Siblings** β **=** -3.1227, *p-value = 0.0115* **Parental** β **=** 2.7696, *p-value = 0.0691* **Third Year Math** β **=** 2.6191, *p-value = 0.0703*	**Third Year Math** β = 5.4844, *p-value = 0.0035*	**Third Year Math** β **=** 2.3352, *p-value = 0.0092*
ALL **(Regardless of Gender)**	Coefficients not significant based on ANOVA *p-value = 0.092*	**Third Year Math** β = 3.5504, *p-value = 0.0074*	

Top-Performing Men (Third Year Mathematics Grade ≥ 80)

HUBER M-EST ROBUST REGRESSION OUTPUT

```
Call: rlm(formula = T_SELF_EFFICACY_TOTAL ~ HONOR + SIBLINGS + PARENTAL +
    THIRDYEARMATH, data = GoodMale)
Residuals:
    Min       1Q  Median       3Q      Max
-30.788   -9.107   1.479   6.154   22.872

Coefficients:
              Value     Std. Error t value
(Intercept)   -100.2175 195.1095   -0.5136
HONOR           -7.0241  20.0771   -0.3499
SIBLINGS         0.3779   1.8908    0.1998
PARENTAL        -1.2775   3.4863   -0.3664
THIRDYEARMATH    2.3197   2.3803    0.9746

Residual standard error: 13.5 on 12 degrees of freedom
  (1 observation deleted due to missingness)
```

LEAST SQUARES REGRESSION OUTPUT

ANOVA [b, c]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	883.857	4	220.964	.792	.552[a]
	Residual	3347.903	12	278.992		
	Total	4231.760	16			

a. Predictors: (Constant), THIRDYEARMATH, SIBLINGS, HONOR, PARENTAL

b. Dependent Variable: T_SELF_EFFICACY_TOTAL

c. Selecting only cases for which CLASSXM = A

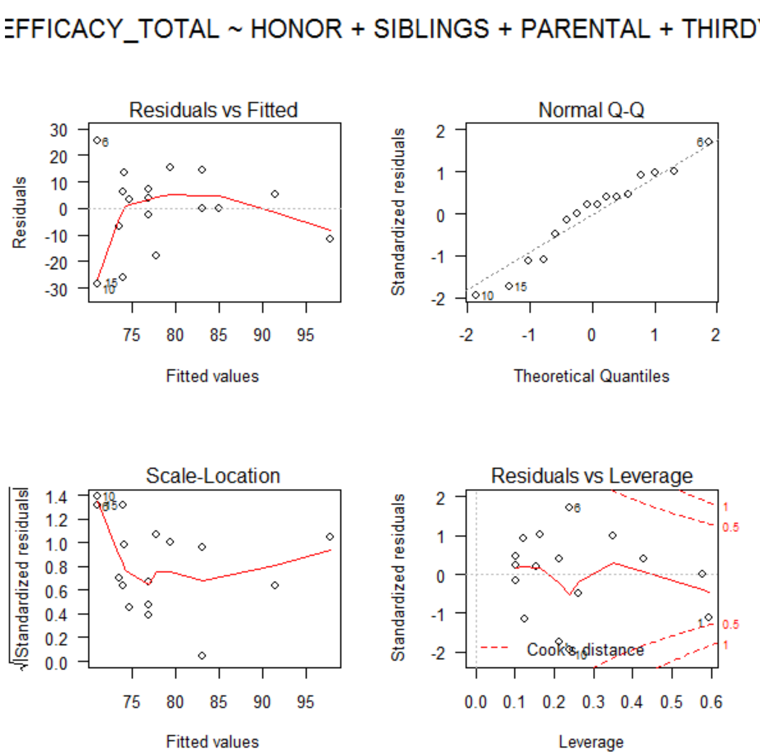
Coefficients [a, b]

Model		Unstandardized Coefficients		Standardized Coefficients			95% Confidence Interval for B	
		B	Std. Error	Beta	T	Sig.	Lower Bound	Upper Bound
1	(Constant)	-140.945	178.148		-.791	.444	-529.096	247.206
	HONOR	-8.214	17.546	-.122	-.468	.648	-46.444	30.016
	SIBLINGS	.802	1.654	.126	.485	.636	-2.801	4.406
	PARENTAL	-1.429	3.035	-.132	-.471	.646	-8.041	5.183
	THIRDYEARMATH	2.801	2.175	.360	1.288	.222	-1.939	7.540

a. Dependent Variable: T_SELF_EFFICACY_TOTAL

b. Selecting only cases for which CLASSXM = A

RESIDUALS CHECK



Low-Performing Men (Third Year Mathematics Grade < 80)

HUBER M-EST ROBUST REGRESSION OUTPUT

```
Call: rlm(formula = T_SELF_EFFICACY_TOTAL ~ HONOR + SIBLINGS + PARENTAL +
    THIRDYEARMATH, data = BadMale)
Residuals:
    Min      1Q  Median      3Q     Max
-53.920 -12.637   2.269  12.222  33.881

Coefficients:
              Value     Std. Error t value
(Intercept)   -172.7307 157.3376    -1.0978
HONOR            4.7137   9.9914     0.4718
SIBLINGS        -0.2829   1.2336    -0.2294
PARENTAL         0.6000   1.6887     0.3553
THIRDYEARMATH    3.1988   2.0474     1.5624

Residual standard error: 18.66 on 56 degrees of freedom
  (10 observations deleted due to missingness)
```

LEAST SQUARES REGRESSION OUTPUT

ANOVA [b, c]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1169.841	4	292.460	.850	.499[a]
	Residual	19261.121	56	343.949		
	Total	20430.962	60			

a. Predictors: (Constant), THIRDYEARMATH, SIBLINGS, HONOR, PARENTAL

b. Dependent Variable: T_SELF_EFFICACY_TOTAL

c. Selecting only cases for which CLASSBXM = A

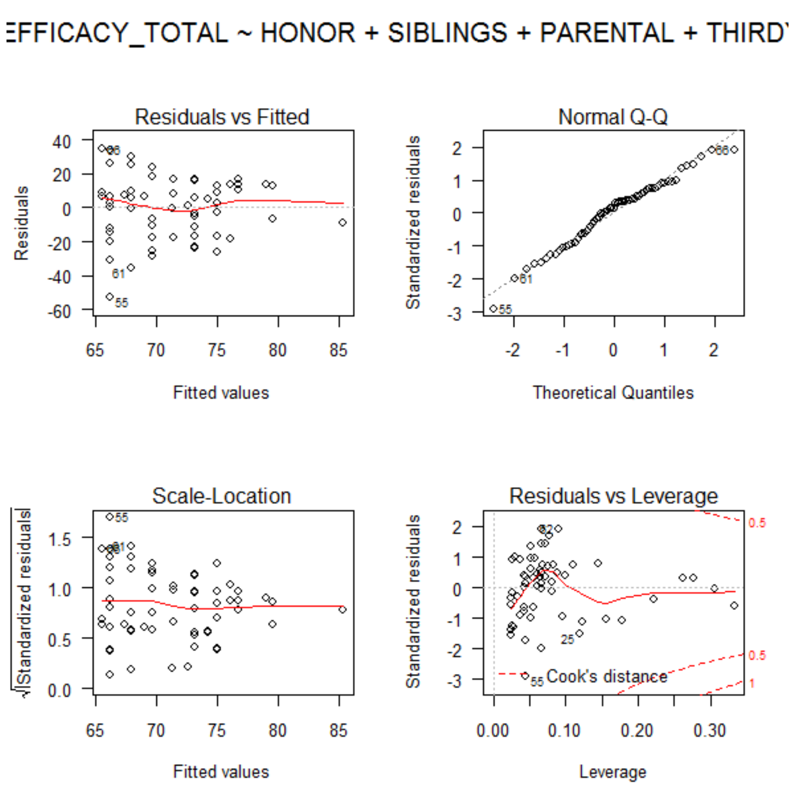
Coefficients [a, b]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95% Confidence Interval for B Lower Bound	95% Confidence Interval for B Upper Bound
1	(Constant)	-198.792	153.963		-1.291	.202	-507.218	109.634
	HONOR	5.156	9.777	.070	.527	.600	-14.430	24.742
	SIBLINGS	-.001	1.207	.000	-.001	.999	-2.420	2.417
	PARENTAL	.600	1.653	.050	.363	.718	-2.711	3.910
	THIRDYEARMATH	3.516	2.003	.235	1.755	.085	-.497	7.530

a. Dependent Variable: T_SELF_EFFICACY_TOTAL

b. Selecting only cases for which CLASSBXM = A

RESIDUALS CHECK



Top-Performing Women (Third Year Mathematics Grade ≥ 80)

HUBER M-EST ROBUST REGRESSION OUTPUT

```
Call: rlm(formula = T_SELF_EFFICACY_TOTAL ~ HONOR + SIBLINGS + PARENTAL +
    THIRDYEARMATH, data = GoodFemale)
Residuals:
    Min      1Q  Median      3Q     Max
-43.713  -8.310   0.989   9.839  25.103

Coefficients:
              Value     Std. Error t value
(Intercept)  -128.1417  112.9368    -1.1346
HONOR          -0.0778    5.2872    -0.0147
SIBLINGS       -3.1227    1.1710    -2.6666
PARENTAL        2.7696    1.4768     1.8754
THIRDYEARMATH   2.6121    1.3992     1.8668

Residual standard error: 13.85 on 35 degrees of freedom
  (2 observations deleted due to missingness)
```

LEAST SQUARES REGRESSION OUTPUT

ANOVA [b, c]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2822.547	4	705.637	3.332	.021[a]
	Residual	7411.444	35	211.756		
	Total	10233.991	39			

a. Predictors: (Constant), THIRDYEARMATH, PARENTAL, SIBLINGS, HONOR

b. Dependent Variable: T_SELF_EFFICACY_TOTAL

c. Selecting only cases for which CLASSXF = A

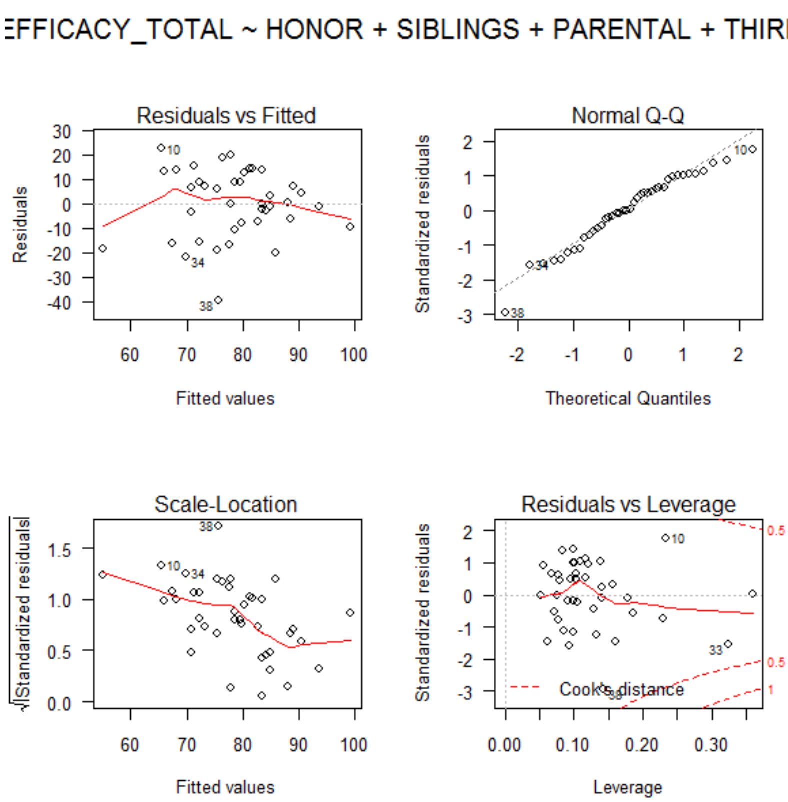
Coefficients [a, b]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95% Confidence Interval for B Lower Bound	95% Confidence Interval for B Upper Bound
1	(Constant)	-162.682	112.267		-1.449	.156	-390.597	65.233
	HONOR	-1.972	5.378	-.060	-.367	.716	-12.891	8.946
	SIBLINGS	-2.482	1.193	-.308	-2.081	.045	-4.903	-.060
	PARENTAL	3.146	1.503	.308	2.093	.044	.094	6.197
	THIRDYEARMATH	2.994	1.392	.348	2.152	.038	.169	5.819

a. Dependent Variable: T_SELF_EFFICACY_TOTAL

b. Selecting only cases for which CLASSXF = A

RESIDUALS CHECK



Low-Performing Women (Third Year Mathematics Grade < 80)

HUBER M-EST ROBUST REGRESSION OUTPUT

```
Call: rlm(formula = T_SELF_EFFICACY_TOTAL ~ HONOR + SIBLINGS + PARENTAL +
    THIRDYEARMATH, data = BadFemale)
Residuals:
     Min       1Q   Median       3Q      Max
-45.3858  -8.6690   0.1065   9.5274  30.9442

Coefficients:
              Value     Std. Error t value
(Intercept)   -349.1090  139.1785    -2.5084
HONOR           -3.6525   17.0055    -0.2148
SIBLINGS         0.5462    0.9573     0.5706
PARENTAL        -1.4161    1.4381    -0.9847
THIRDYEARMATH    5.4844    1.8079     3.0335

Residual standard error: 13.84 on 61 degrees of freedom
  (6 observations deleted due to missingness)
```

LEAST SQUARES REGRESSION OUTPUT

ANOVA [b, c]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2534.099	4	633.525	2.403	.059[a]
	Residual	16080.533	61	263.615		
	Total	18614.632	65			

a. Predictors: (Constant), THIRDYEARMATH, SIBLINGS, HONOR, PARENTAL

b. Dependent Variable: T_SELF_EFFICACY_TOTAL

c. Selecting only cases for which CLASSBXF = A

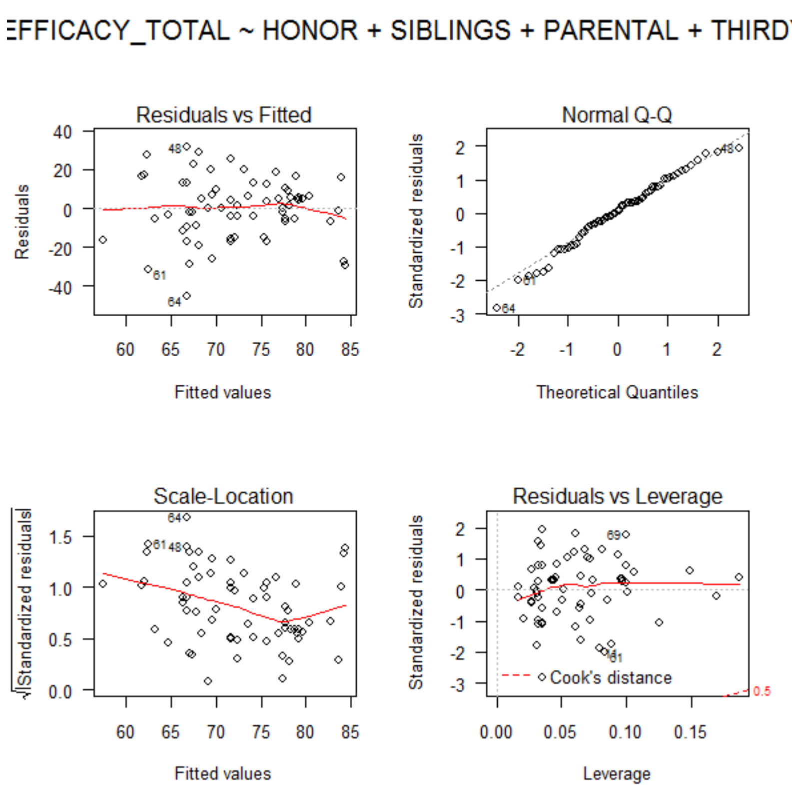
Coefficients [a, b]

Model		Unstandardized Coefficients		Standardized Coefficients			95% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	-335.023	137.367		-2.439	.018	-609.706	-60.341
	HONOR	-3.171	16.784	-.023	-.189	.851	-36.733	30.391
	SIBLINGS	.380	.945	.050	.403	.689	-1.509	2.270
	PARENTAL	-1.311	1.419	-.117	-.924	.359	-4.149	1.527
	THIRDYEARMATH	5.301	1.784	.357	2.971	.004	1.733	8.870

a. Dependent Variable: T_SELF_EFFICACY_TOTAL

b. Selecting only cases for which CLASSBXF = A

RESIDUALS CHECK



Top-Performing Men and Women (Third Year Mathematics Grade ≥ 80)

HUBER M-EST ROBUST REGRESSION OUTPUT

```
Call: rlm(formula = T_SELF_EFFICACY_TOTAL ~ THIRDYEARMATH + SIBLINGS +
    PARENTAL + HONOR, data = Top)
Residuals:
    Min      1Q  Median      3Q     Max
-42.054  -8.878   1.684  10.033  19.095

Coefficients:
              Value    Std. Error t value
(Intercept)   -93.5598  87.7109   -1.0667
THIRDYEARMATH   2.1378   1.0793    1.9808
SIBLINGS       -1.0544   0.9306   -1.1330
PARENTAL        1.6381   1.3257    1.2356
HONOR          -0.2506   4.7036   -0.0533

Residual standard error: 14.88 on 52 degrees of freedom
  (3 observations deleted due to missingness)
```

LEAST SQUARES REGRESSION OUTPUT

ANOVA [b, c]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2027.501	4	506.875	2.119	.092[a]
	Residual	12439.839	52	239.228		
	Total	14467.340	56			

a. Predictors: (Constant), THIRDYEARMATH, SIBLINGS, PARENTAL, HONOR

b. Dependent Variable: T_SELF_EFFICACY_TOTAL

c. Selecting only cases for which CLASS = A

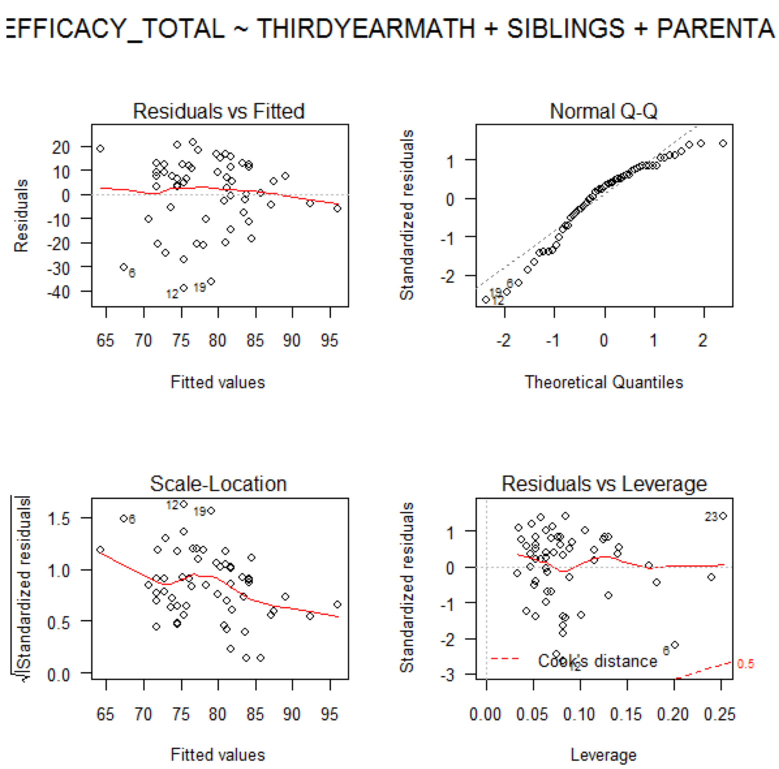
Coefficients [a, b]

Model		Unstandardized Coefficients		Standardized Coefficients			95% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	-143.246	90.419		-1.584	.119	-324.686	38.194
	HONOR	-1.165	4.849	-.033	-.240	.811	-10.895	8.565
	SIBLINGS	-.940	.959	-.129	-.980	.332	-2.865	.985
	PARENTAL	1.822	1.367	.176	1.333	.188	-.920	4.565
	THIRDYEARMATH	2.726	1.113	.332	2.450	.018	.494	4.959

a. Dependent Variable: T_SELF_EFFICACY_TOTAL

b. Selecting only cases for which CLASS = A

RESIDUALS CHECK



Low-Performing Men and Women (Third Year Mathematics Grade < 80)

HUBER M-EST ROBUST REGRESSION OUTPUT

```
Call: rlm(formula = T_SELF_EFFICACY_TOTAL ~ THIRDYEARMATH + SIBLINGS +
    PARENTAL + HONOR, data = Low)
Residuals:
    Min      1Q  Median      3Q     Max
-53.160 -12.458   2.124  10.934  33.329

Coefficients:
              Value     Std. Error t value
(Intercept)   -199.0411  100.2788    -1.9849
THIRDYEARMATH    3.5504    1.3042     2.7223
SIBLINGS         0.0452    0.7955     0.0569
PARENTAL        -0.4652    1.1106    -0.4188
HONOR            2.3098    8.4412     0.2736

Residual standard error: 16.88 on 122 degrees of freedom
  (16 observations deleted due to missingness)
```

LEAST SQUARES REGRESSION OUTPUT

ANOVA [b, c]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	3086.218	4	771.554	2.614	.039[a]
	Residual	36012.319	122	295.183		
	Total	39098.537	126			

a. Predictors: (Constant), THIRDYEARMATH, HONOR, SIBLINGS, PARENTAL

b. Dependent Variable: T_SELF_EFFICACY_TOTAL

c. Selecting only cases for which BOTTOM = A

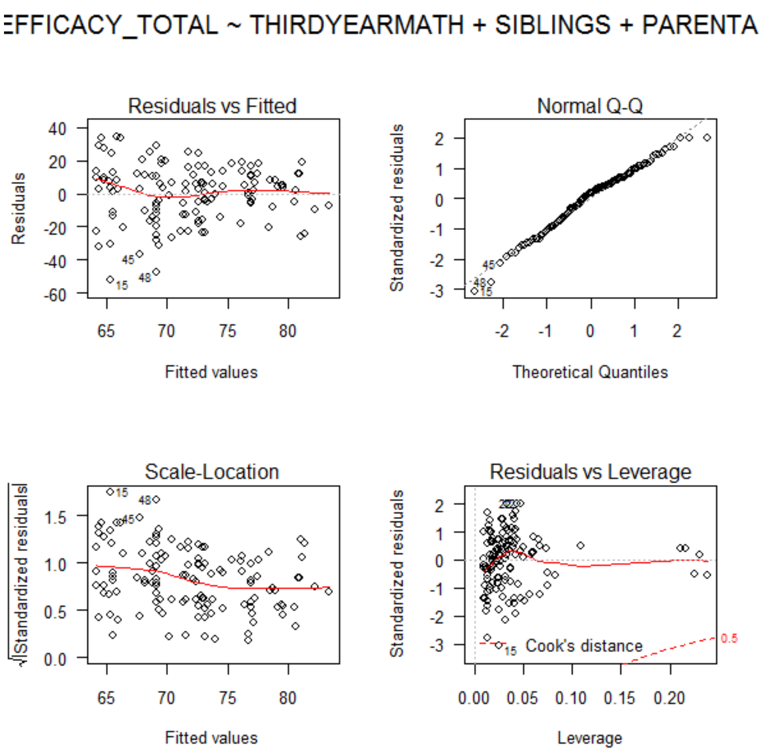
Coefficients [a, b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-218.390	93.249		-2.342	.021	-402.985	-33.795
	HONOR	2.910	7.849	.032	.371	.711	-12.628	18.449
	SIBLINGS	.228	.740	.027	.308	.759	-1.237	1.692
	PARENTAL	-.366	1.033	-.031	-.354	.724	-2.410	1.678
	THIRDYEARMATH	3.780	1.213	.272	3.117	.002	1.379	6.181

a. Dependent Variable: T_SELF_EFFICACY_TOTAL

b. Selecting only cases for which BOTTOM = A

RESIDUALS CHECK



All Men

HUBER M-EST ROBUST REGRESSION OUTPUT

```
Call: rlm(formula = T_SELF_EFFICACY_TOTAL ~ THIRDYEARMATH + SIBLINGS +
    PARENTAL + HONOR, data = Male)
Residuals:
    Min       1Q  Median      3Q     Max
-55.610 -13.336   3.485  11.418  31.130

Coefficients:
              Value     Std. Error t value
(Intercept)   -103.4698   91.6837    -1.1286
THIRDYEARMATH    2.3034    1.1930     1.9308
SIBLINGS        -0.0173    0.9894    -0.0175
PARENTAL        -0.1401    1.4079    -0.0995
HONOR           -1.8590    6.5924    -0.2820

Residual standard error: 18.27 on 73 degrees of freedom
  (31 observations deleted due to missingness)
```

LEAST SQUARES REGRESSION OUTPUT

ANOVA [b, c]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	2290.947	4	572.737	1.805	.137[a]
	Residual	23166.328	73	317.347		
	Total	25457.275	77			

a. Predictors: (Constant), THIRDYEARMATH, SIBLINGS, PARENTAL, HONOR

b. Dependent Variable: T_SELF_EFFICACY_TOTAL

c. Selecting only cases for which GENDER = 1

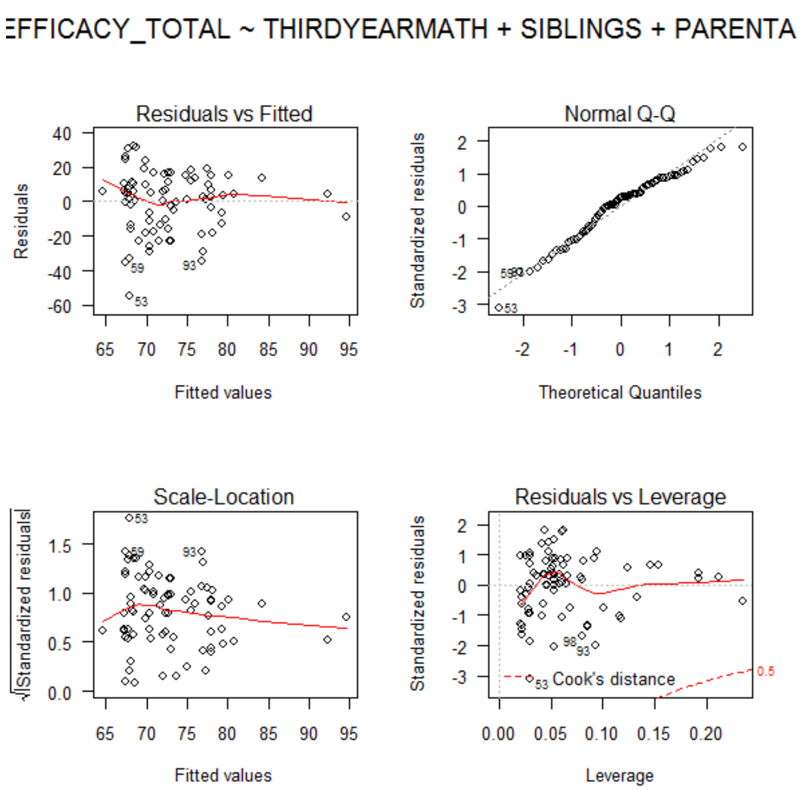
Coefficients [a, b]

Model		Unstandardized Coefficients		Standardized Coefficients			95% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	-118.540	89.371		-1.326	.189	-296.657	59.577
	HONOR	-2.826	6.426	-.068	-.440	.661	-15.633	9.981
	SIBLINGS	.221	.964	.026	.229	.819	-1.701	2.143
	PARENTAL	-.212	1.372	-.018	-.154	.878	-2.947	2.523
	THIRDYEARMATH	2.480	1.163	.335	2.132	.036	.162	4.797

a. Dependent Variable: T_SELF_EFFICACY_TOTAL

b. Selecting only cases for which GENDER = 1

RESIDUALS CHECK



All Women

HUBER M-EST ROBUST REGRESSION OUTPUT

```
Call: rlm(formula = T_SELF_EFFICACY_TOTAL ~ THIRDYEARMATH + SIBLINGS +
    PARENTAL + HONOR, data = Female)
Residuals:
    Min      1Q  Median      3Q     Max
-48.701 -10.965   2.002   8.605  27.629

Coefficients:
              Value     Std. Error t value
(Intercept)   -107.2796  69.0475    -1.5537
THIRDYEARMATH    2.3352   0.8794     2.6553
SIBLINGS        -0.2322   0.7877    -0.2948
PARENTAL         0.5542   1.1081     0.5001
HONOR           -4.8201   5.4689    -0.8814

Residual standard error: 13.72 on 101 degrees of freedom
  (26 observations deleted due to missingness)
```

LEAST SQUARES REGRESSION OUTPUT

ANOVA [b, c]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	3110.339	4	777.585	2.946	.024[a]
	Residual	26656.954	101	263.930		
	Total	29767.293	105			

a. Predictors: (Constant), THIRDYEARMATH, SIBLINGS, PARENTAL, HONOR

b. Dependent Variable: T_SELF_EFFICACY_TOTAL

c. Selecting only cases for which GENDER = 0

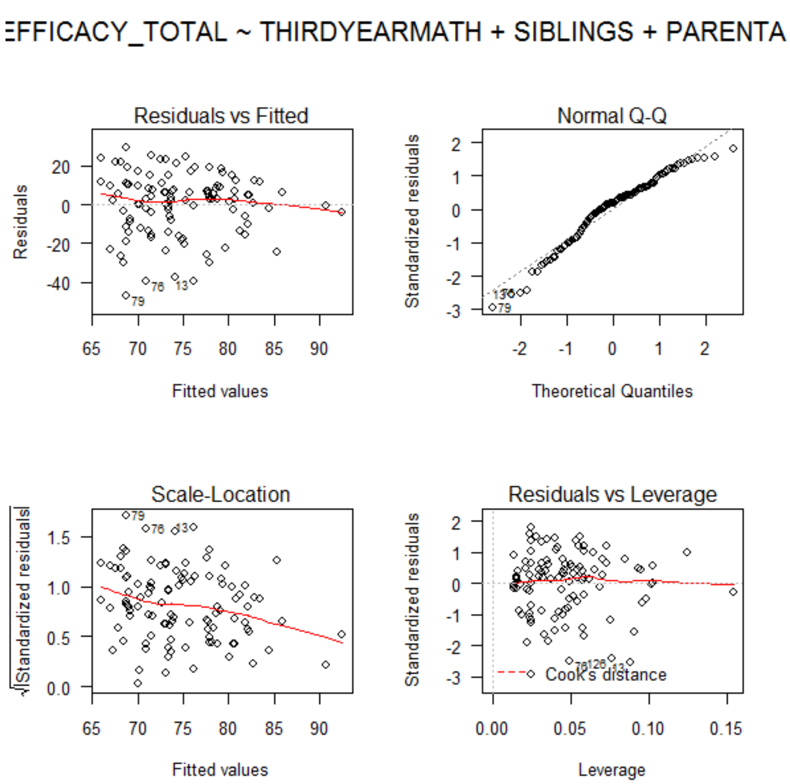
Coefficients [a, b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-117.042	66.508		-1.760	.081	-248.976	14.892
	HONOR	-5.011	5.268	-.129	-.951	.344	-15.461	5.439
	SIBLINGS	-.295	.759	-.038	-.389	.698	-1.800	1.210
	PARENTAL	.630	1.067	.057	.590	.556	-1.487	2.747
	THIRDYEARMATH	2.444	.847	.388	2.885	.005	.764	4.124

a. Dependent Variable: T_SELF_EFFICACY_TOTAL

b. Selecting only cases for which GENDER = 0

RESIDUALS CHECK



APPENDIX E

PARENTAL OCCUPATIONS AND EDUCATION

FATHER’S OCCUPATION AND EDUCATION

Occupation	0	1	2	3	4	5	(blank)	Grand Total
Auto-painter			1					1
Baker			1					1
Baranggay Tanod			1					1
Barbero			1					1
Brineman			1					1
Bus inspector			1					1
Business Manager						1		1
Butcher			1					1
Caretaker			1					1
Cargador		1						1
Carpenter	3	10	15			1	1	30
Casadi Dressing Plan			1					1
Caterer			1					1
Chef		1						1
Chicken Dresser		1	1					2
Company Driver						1		1
Construction Worker		4	3					7
Councilor			2					2
Dresser			1					1
Dresser sa Cariño			1					1
Driver		2	9			5	2	18
Egg Dealer		1						1
Electrician			1			1		2
Employee						1		1
Engineer						1		1
Factory worker			1				1	2
Farmer/ Massage therapy			1					1
Feedmill Worker		1						1
Fishermen	1							1
Fruit Dealer							1	1
Gaffer			1					1
Houseboy		1						1
Jeepney Driver			1			1		2
Junk Shop Owner			1					1
Kagawad			1					1
Kung ano-ano							1	1
Laborer		8	13		1			22

Laborer/ Carpenter			1				1
Machine Operator			1				1
Magtitinda ng itlog		1					1
May sari-sari store			1				1
Mechanic			1				1
Mekaniko					1		1
Messenger		1	1				2
Nag-aalaga at nag-aahente ng manok						1	1
none		1	3		2	1	7
OFW			3	1	1		5
Pahinante			1				1
Pig Poultry Owner		1					1
Porman					1		1
Poultry		1					1
Presidential Security Group					1		1
Private Clerk			1				1
Production Worker		1	1				2
Retired					1		1
Retired Soldier					1		1
Security Guard					2		2
SEDCI Corporation					1		1
Server					1		1
Sewer		1					1
Sound Technician			1				1
STI		1					1
Trabahador		1					1
Traffice Enforcer			1				1
Tricycle Driver		1	3		2	1	7
Vaciador		2	1				3
Vendor		2	2		1		5
Veterinary Technician			1				1
Welder	1	1			1		3
Worker			1	1			2
(blank)							
Grand Total	**5**	**45**	**86**	**3**	**28**	**9**	**176**

MOTHER’S OCCUPATION AND EDUCATION

Occupation	0	1	2	3	4	5	(blank)	Grand Total
Assistant Cook			1					1
Avon Seller			1				1	2
Bakery attendant		1						1
Bakery owner			1					1
Beautician			3					3
BHW		1				1		2
Casadi Dressing Plan		2						2
Checker			1					1
Chicken Dresser		1						1
Day Care Worker						1		1
Direct Seller			1					1
Dresser			2					2
Dresser sa Cariño		1						1
Dressing Plant			1					1
Factory worker			1					1
Fish Vendor						1		1
Fixer		1						1
Frisser			1					1
Further Processing			1					1
Government Employee						1		1
Helper			1					1
Housekeeper		4	5			2	1	12
Housemaid			1					1
Housewife		9	15	1		3	3	31
Janitress		1						1
Karindirya owner		1						1
Kasambahay		1						1
Labandera		1	1					2
Laborer		1				1		2
laundry			1					1
Manicure/Pedicure			2					2
May sari-sari store			3			1		4
Member of STL			1					1
Naghahardin; Nagaayos ng Halaman			1					1
Nagtitinda ng produkto ng avon					1			1
None		4	13			6		23
Nurse						1		1
Office						1		1
OFW			3			1		4
Pharmacist						1		1
Photoprinter						1		1
Receiver of eggs						1		1
Rice Vendor		1						1
Saleslady			1					1
SariSari Store		2	7					9

Secretary					1		1
Server		1					1
Sewer	3	7			1		11
Tutorial Service					1		1
Vendor	3	6			1		10
(blank)							
Grand Total	**38**	**83**	**1**	**1**	**27**	**5**	**155**

< Elementary – 0, Elementary – 1, High School – 2, Vocational – 3, Some College – 4, College – 5