Self-efficacy and Attitude towards Mathematics:
Its Implication to Mathematics Learning

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Abstract

The study explored the implication of mathematics self-efficacy and attitude towards mathematics to mathematics learning. Specifically, it determined the relationship and effects of students' attitude towards mathematics (ATM) and mathematics self-efficacy (MSE) to students' mathematics performance. The study utilized the mixed method of research. The participants of the study were the 304 second year teacher education students to determine the causes, effects, and ways of overcoming negative ATM and low MSE. Results revealed that students' ATM and MSE were both significantly correlated and affect mathematics performance. The main cause of negative ATM was the teacher's behavior and pedagogy. The causes of low MSE were personal ability, fear of committing mistakes, and negative feedback from teachers. Students' negative ATM and low MSE resulted in students performing less in class. To overcome these challenges, teachers should treat seriously the need for improving the cognitive model among the students, because it influences their lives today and in the future. The result of the study revealed that teachers should not only teach students mathematical content but also help students manage their thoughts, emotions, and behavior positively towards mathematics because it has implication to mathematics learning. It can be done through teachers' careful curriculum planning, writing, and implementation with an appropriate supported curriculum that aims to develop positive ATM and high MSE among students. The students also need their parents' support through monitoring and checking their progress.

Keywords: Cognitive model, mathematics, learning, attitude, self-efficacy

Introduction

Mathematics is essential in all walks of life. It is fundamental in learning and vital to all levels of education. It is a very challenging subject to learn and appreciate, but its importance cannot be negated. In the curriculum of the Philippines' higher education institutions, mathematics is a required general education subject. In an article Benzilin (2016) quoted that "life is a math equation. In order to gain the most of it, you have to know how to convert negative to positive." Being knowledgeable in mathematics is an advantage because according to her, mathematics is the cradle

of all creations, without which the world cannot move an inch. She added that human beings even living things are bound to learn and follow the laws of mathematics. Everybody needs mathematics in their day-to-day life. Be it a cook, a farmer, a carpenter, a mechanic, a shopkeeper, a doctor, an engineer, a scientist, a musician or a magician. Without mathematics, anyone will not be able to do science, architecture, geology, meteorology, or even a small enterprise. All of it requires the most basic prerequisite of life that is our ability to calculate, estimate, subtract or multiply. Hence, everyone needs mathematical training.

Moreover, Cadorna, Taban, and Gavino (2016) stated that the importance of mathematical skills could be seen in one's personal life and daily activities such as managing finances, marketing, handling business matters, payments, filing of income tax returns, and many more. In the article of Crockett (2016), he stressed that literacy is not enough. According to his survey, the consensus is that students need transparency-level skills for the 21st century. The 21st-century skills include mathematical literacy, critical thinking, creativity, and problem-solving. Reflecting on the message of President Aquino III to the 10th International Mathematics and Science Olympiad in 2013, he stated that "math and science are integral components of our path to progress, each subject allowing humankind to explore the limits of reality, and empowering us to shape the world with reason and imagination."

Congruent to it, Lee-Chua (2013) stated that the Philippines lags behind the rest of the world in Mathematics and Science expertise, as shown by Filipino student's dismal scores in global tests like the 2008 Trends in International Math and Science Study. Chavez (2012) added that pupils have not mastered the competencies in concept formation, comprehension, computation, and problem-solving skills. In response, the Department of Education issued an order no. 31 s. of 2012, including the competencies on critical thinking, reasoning, and problem-solving skills of the students on the priorities of the Enhanced Basic Education Program through K to 12 Basic Education.

The studies of Klomegah (2007) and Nicolidau and Philippou (2008) revealed that students' positive attitude toward mathematics together with motivation and effort would increase performance. Numerous studies indicated that many children began schooling with a positive attitude toward mathematics (ATM); unfortunately these attitudes tend to become less positive as children grow up, and frequently become more pessimistic. Factors that may affect and have destroyed effect on ATM are the pressure exerted on the students to cope with highly demanding tasks, often a pace beyond their capabilities and ambition, together with unimaginable instruction and negative teacher attitudes. In addition, the high school years have been identified as a crucial period in the course of developing students' ATM. According to Nicolidau and Philippou (2008), teachers in high school have the opportunity and responsibility to promote and enhance students' positive attitude towards mathematics. Attitude towards mathematics (ATM) is associated with the psychosocial factor, the locus of control, defined as the personal belief about the extent to which one's behaviors affect or influence specific outcomes. Researches in mathematics education reform are driven by the belief that all students can learn. It is supported by the theory of Piaget under his information processing theory. This

theory contends that "children acquire skills through their everyday efforts to understand and master intellectual challenges."

This attitude is reflected through their thoughts about mathematics. Yahya and Fasasi (2012) as cited by Cadorna (2016) reported that many students are not interested in the subject and these students do not possess a positive attitude towards the subject. They also stressed that these students are found to have a fear in the subject. This fear in math is a common problem that many people around the world have. Stephen's study (as cited in Yahya & Fasasi, 2012; also cited in Cadorna et al., 2016) emphasized that when a student is afraid of something, he will do everything to avoid it. Further, Fast et al. (2010) pointed out another factor that affects mathematics learning. The authors stated that the self-efficacy of the students towards mathematics is a strong predictor of math performance than either math anxiety or previous math experience. In general, self-efficacy in mathematics indicates the belief of a person in his/her own competence to solve math problems and achieve high math performance. To address this, Mcleod (2008) proposed in his study the use of CBT (Cognitive Behavioral Therapy). CBT is based on the ideas that how one thinks (cognition), how one feels (emotion) and how one acts (behavior) all interact together. He stressed out that specifically, thoughts determine one's feelings and behavior.

This study is deemed important not only to the teachers but also to the parents to know the effects of students' thoughts and belief on their behaviors. Student's behavior is reflected by his/her mathematics learning or performance. Findings on the effects of students' attitude towards

mathematics (ATM) and Mathematics' self-efficacy (MSE) to their mathematics' performance would pave the way for the teachers and parents to help the students overcome these challenges. The findings will also give teachers the opportunity to evaluate their teaching methodology and approaches whether these would develop a positive attitude of students towards mathematics or not. Moreover, these methods and approaches would be an avenue to help students develop self-efficacy in mathematics and avoid math anxiety. Since positive thoughts and beliefs are commonly developed during the early years in schooling, these should be treated well in the tertiary levels. As a response, this study investigated students' mathematics self-efficacy and attitude towards mathematics.

Theoretical-Conceptual Framework

The study is anchored on the cognitive theory of psychopathology of Beck (2011). He developed a comprehensive theoretical model called the cognitive model. This model describes how people's thoughts and perceptions influence their lives. It explains individuals' emotional, physiological, and behavioral responses as mediated by their perceptions of experience, which are influenced by their beliefs and characteristic ways of interacting with the world, as well as by their experience. In this study, cognitive model comprises the students' (1) attitude towards mathematics; and (2) self-efficacy in mathematics and its influence in mathematics performance. Students' attitude towards mathematics and mathematics self-efficacy describes how students' thoughts and perceptions influence their mathematics learning.

Nicolidau and Philippou (2008) stressed that thoughts or the attitude of the

students towards mathematics starts in the early years of schooling. They emphasized that the teachers in high school have the opportunity and responsibility to promote and even enhance positive attitude towards mathematics. They further explained that fostering positive attitude towards mathematics to students can influence their mathematics performance.

Bandura, in his expectancy theory (which is also known as valence, instrumentality, and expectancy), contends that an individual's effort will lead to performance, which in turn, will lead to a specific outcome (Bandura, 1986 as cited in Crothers et al., 2008). Students' thoughts reflected in their attitudes toward mathematics will lead to a specific outcome because of their actions. Having a positive attitude means that whatever happens there is something good that can be expected from it if efforts were exerted.

Smith et al. (2006) added that another factor that affects students' mathematics performance is math self-efficacy. Mathematics self-efficacy is based on an individual's belief about one's ability to perform specific behaviors. He said that "people with high self-efficacy are more likely to respond with renewed effort (expectancy) when feedback shows that they are not reaching their goals by developing more successful strategies." Supported by Hoffman and Schraw (2009), they said that "students with higher math self-efficacy persist longer on difficult math problems and are more accurate in math computations than those lower in mathematics self-efficacy." Liu and Koirala (2009) further explained that the higher a person rates on mathematics self-efficacy scales, the better this person performs in solving mathematical problems.

Self-efficacy theory of Bandura supports the study. It is based on an individual's belief about his/her ability to perform specific behaviors. Relevant to the statement of Smith et al. (2006), they affirmed that "people with high self-efficacy are more likely to respond with renewed effort when feedback shows that they are not reaching their goals by developing more successful strategies." Bandura added that in self-efficacy theory, people (students) perform the task in which they believe they can succeed; likewise, people are less likely to attempt tasks in which they perceive themselves less competent. He stressed that self-efficacy is the most influential predictor of human functioning. In this study, students' belief in their performance affects their behavior on how they will function in performing mathematics task.

Di Martino et al. (2010) found that there was an interaction with the three-dimensional model for attitude. They stressed that negative emotional dispositions towards mathematics might be associated with different patterns of attitude, depending on the students' perceived competence and vision of mathematics as well as on the relationship amongst the three dimensions. Further, they emphasized that the ATM of the student along emotional disposition must not only be considered as negative; hence when at least one of the dimensions is negative, students' negative attitude towards mathematics can be profiled depending on the dimension that appears negative. It means that the students' negative attitude starts with any of the three dimensions. To increase thoughts and beliefs about the subject, two of the earliest forms of cognitive behavioral therapy were (1) rational emotive behavior therapy developed by Ellis in the 1950's,

and (2) cognitive behavior therapy (CBT) developed by Beck in 1960's. The following therapy can be used by the teachers to help students with bad effects of negative attitude and beliefs toward mathematics.

This study is related to the studies aforementioned. However, it differs in some aspects. The studies of Nicolidau and Philippou (2008), Klomegah (2007), and Smith et al. (2006) all agreed that math performance is affected by the behavior of the learner towards mathematics. Hoffman and Schraw (2006), Fast et al. (2010), and Liu and Koiala (2009) are all in consensus as well that math self-efficacy is a strong predictor of mathematics performance. Phillips (2015) and Cadorna et al. (2016) both agreed that teachers could do a lot in helping the students overcome their fear of the subject. The methodology of this study is different from the previous studies in that it determined the influence of thoughts (ATM) and beliefs (MSE) on students' mathematics performance.

Objectives of the Study

The study aimed to determine the influence of students' attitude towards mathematics (ATM) and mathematics' self-efficacy (MSE) to students' mathematics performance. Specifically, it sought to determine the characteristics of the students along ATM and MSE; students' level of mathematics performance; the relationship and influence of students' ATM and MSE to mathematics performance; the causes of negative ATM and very low MSE; and ways in overcoming negative ATM and low MSE.

Research Methodology

The study utilized both quantitative and qualitative methods of research.

The quantitative method was employed to determine and describe the students' attitude towards mathematics and mathematics self-efficacy through the use of a questionnaire. This same method was utilized to determine the relationship and influence of students' attitude towards mathematics and mathematics self-efficacy to mathematics performance. The qualitative research method was employed through the informal semi-structured interview and focus group discussion. The informal semi-structure interview was employed to 35 randomly selected students to get their experiences in mathematics. The interview with the students was done for two weeks. From the interview, the effects of their past behavior to their performance were also recorded. Another 10 students were asked to participate in the focus group discussion.

The respondents of the study were the 304 second-year college students who were randomly selected through ratio and proportionate sampling from the population of 1,262. The 304 respondents answered the ATM and MSE questionnaires during the first phase of the study. These were the students enrolled in teacher education course. For the second phase, 35 respondents were selected and interviewed and answered the semi-structured questions, and another 10 respondents were also identified and participated in the focus group discussion.

Finally, these 45 selected respondents who participated in the semi-structured interview and focus group discussion were requested to share their opinions, ideas, and suggestions on how to foster a positive ATM and high MSE to the students. For the validity and authenticity, they were personally interviewed after the FGD by the researchers for purposes of

corroboration, enhancement, verification, and to capture other answers that were not found in the notes. The study used the ATM and MSE questionnaires which were adapted, modified, and patterned from the questionnaires of Programme for International Student Assessment devised by previous studies (Bandura as cited by PISA, 2013; Martha, 2009; Ferla et al., 2009). Before the final utilization of the questionnaires, the researchers consulted the experts to ensure the effectiveness and validity of the questions. Also, the questionnaires were tried to 42 students to test the reliability of the questions. To establish its reliability, Cronbach alpha was computed and found excellent at 0.94 for ATM and good at 0.87 for MSE.

Data Collection Procedure

Research protocol was observed in data gathering. Specifically, the data collection followed two-phase process. First, the 304 2nd-year college students answered the ATM and MSE questionnaires. The second phase was the semi-structured interview where 35 students participated and 10 students in focus group discussion. The second phase was vital in the data collection procedure to ascertain the most common causes, effects, and ways of overcoming negative ATM and low MSE.

The researchers also asked the students how they were able to overcome the problem and what their parents should do to help them. The students' response during the interview were analyzed and interpreted. Hence, new ideas were given and it added to the discussion of the study. Personal interview with the teachers was also conducted for purposes of triangulation and in regard to the ways in overcoming negative ATM and very low MSE. Mathematics performance of the students was reflected in the mean of their mathematics grades from their freshman year. It was collected through the cooperation of the registrar.

The ethical standard was observed in the study through confidentiality of the results of the scores. Before the data gathering, the researchers sought informed consent from the proper authorities and the respondents. Data gathered were kept confidential through coding anonymously the respondents.

Statistical Treatment of Data

The following statistical tools were utilized to analyze the data gathered in the study: frequency count and percentage, weighted mean, and rank. Pearson product-moment correlation coefficient was employed to determine the relation of ATM and MSE to mathematics performance.

The coefficient of determination was employed to determine the degree or weight of effects of ATM and MSE to mathematics performance. Multiple regression analysis was used to determine the combined effect of ATM and MSE to mathematics performance.

Results and Discussion

Characteristics of the Students on ATM and MSE

On ATM. Table 1 indicates that the students' ATM average weighted mean is 2.65 with verbal interpretation of Positive ATM. It means that students have positive attitude towards mathematics. It can be gleaned from the table that the students have positive ATM because they perceived mathematics as a very

Table 1. Characteristics of the Students on Attitude towards Mathematics (n=304)

Attitude towards Mathematics Indicators	Weighted Mean	Int.	Rank
Mathematics is very worthwhile and necessary subject.	3.22	P	1
I will strive to improve my performance in Math.	3.04	P	2
I am interested in the things I learn in Mathematics	2.89	P	3
I find time to study Mathematics.	2.71	P	4
I am looking forward to my Mathematics lesson.	2.64	P	5
I love Mathematics!	2.58	N	6.5
I have usually enjoyed studying Mathematics in school.	2.58	N	6.5
I do Mathematics because I enjoy it.	2.50	N	8
I would prefer to do an assignment in Math than to do an essay	2.49	N	9
When I hear the word Math, I feel excited for the subject	2.48	N	10.5
I like to solve new problems in Mathematics.	2.48	N	10.5
I enjoy problem solving in Mathematics.	2.45	N	12
Mathematics is one of my favorite subjects.	2.41	N	13
I enjoy reading about Mathematics.	2.37	N	14
I am happier in Mathematics class than in any other subject.	2.34	N	15
Average weighted mean	2.65	P	

Legend: (HN) Highly Negative ATM = 1.00-1.59   (N) Negative ATM =1.60-2.59
(P) Positive ATM = 2.60-3.59   (HP) Highly Positive ATM = 3.60-4.00
Int. – Interpretation

important subject because it will improve their performance and they are interested in learning the subject so, they find time to study mathematics and look forward to mathematics lesson. It means that the characteristics of the students in ATM were positive because they know that it is important in their field and most of all it is a required subject. Further, having perceived the subject as important, students strive to improve their mathematics performance. It is apparent that when students are interested in the topics, they will allocate time to study and look forward to the lessons. It further implies that students will strive to perform better in mathematics if they perceive mathematics as a worthwhile and necessary subject.

It also means that teachers and parents should let students understand that mathematics is a very important subject for them to learn and study. However, it

cannot be disregarded that the students have negative ATM. Table 1 also reflects that students are happier in other subjects compared to mathematics; have negative attitude in reading about mathematics; do not consider math as one of their favorite subjects; do not enjoy solving problems in mathematics; do not like to solve new problems in math; do not express excitement about the subject; would prefer essay writing rather than solving problems in math; do not like to study mathematics in school; and responded negatively to the statement of loving mathematics. It implies that even if they have the knowledge about the importance of mathematics to their future careers they still have negative ATM on the subject. It means that there are factors that affect their interests, desire to study, and love for the subject.

The result of the study confirmed the statement of Nicolidau and Philippou

(2008) that many children begin schooling with positive attitudes toward mathematics, but unfortunately, these attitudes tend to become less positive as they grow up, and frequently become more negative. They stressed that the factors that may affect and have a negative effect on ATM are pressure exerted on the students to cope with highly demanding tasks, often a pace beyond their capabilities and ambition, together with unimaginable instruction and negative attitude of the teachers. They agreed that mathematics teachers have the opportunity and responsibility of fostering and developing the students' positive attitudes toward mathematics.

On MSE. Table 2 indicates that the students' MSE average weighted mean is 2.77 with a verbal interpretation of High MSE. The respondents answered the questions indicating their belief or confidence in doing the tasks. It can be gleaned from the table that the students have high MSE in solving simple algebraic linear equations, discounts, surface area, volume, and distances. It implies that the respondents displayed high MSE in doing tasks that are being done and taught from elementary up to first year mathematics. It means that students are much more confident in doing things when they are already familiar with it. It also means that the students are confident to solve mathematics tasks if they are related to their daily living and have practical applications; like discounts, interpreting graphs in the newspaper, knowing the number of tiles to be bought to cover the desired area, and determining distances.

Further, Table 2 reflects that as the tasks increase in complexity, students' MSE decreases. For example, students' MSE computing in linear equation was high, but when it came to computing the

Table 2. Characteristics of the Students on Mathematics Self-efficacy (n=304)

Mathematics Self-efficacy Indicators	Weighted Mean	Int.	Rank
Compute for the value of x in the equation $2x - 2 = 20$.	2.94	H	1
Solving an equation like $3(x + 5) = (x + 9)2$	2.89	H	2
Calculate for the price of pants after a 50% off.	2.87	H	3
Understanding graphs presented in newspaper.	2.76	H	4
Calculate the volume of a cube given a side	2.74	H	5
Workout how long it would take to get from one place to another	2.73	H	6
Calculate how much cheaper a refrigerator after a 25% discount.	2.70	H	7.5
Determine the formula to be used in a given problem.	2.70	H	7.5
Calculate how many tiles you need to cover a floor	2.65	H	9
Compute for the distance of one place to another.	2.64	H	10
Compute for the price of commodity given the equation.	2.56	L	11
Calculate the side length of a triangle using trigo. functions	2.55	L	12
Calculate the covered difference of height by knowing the slope of the street.	2.49	L	13
Estimating whether a 3 meter long board can be transported in a jeepney.	2.44	L	14
Calculate the petrol consumption rate of a car.	2.39	L	15
Average weighted mean	2.77	H	

Legend: (VL) Very Low MSE = 1.00-1.59   (L) Low MSE =1.60-2.59
*   (H) High MSE = 2.60-3.59   (VH) Very High MSE = 3.60-4.00*

price of the commodity given the equation, the students' MSE is low. It means that they have less MSE in performing similar task with too much complex application of the mathematical concepts. It further means that the students tend to have low MSE when mathematical tasks were complex and imply that students had problems in their MSE even when they perceived that mathematics is a very important subject. Relevant to the statement of Di Martino and Zan (2010, p. 44) as cited by Pepin (2015), they said that students' perceived competence affects their attitude in doing the task presented. Perceived competence was reflected in their MSE. This finding is supported by Smith et al. (2006) who implied that students with high MSE are more likely to respond with renewed effort when feedback shows that they are not reaching their goals by developing more successful strategies.

Students' Level of Math Performance

Table 3 reflects the mathematics performance of the students. The mean was 2.14 with a standard deviation of 0.39. The performance level of the students was 86% with a descriptive rating of very satisfactory.

It can be inferred that the students performed very satisfactorily and responses were homogenous. It means that their performance rating was near each other since the standard deviation is less than three. It implies that they share the same characteristics or may be thoughts and beliefs about the subject. It can be noted that the students were performing in between proficiency and satisfactory. However, this study aims to find ways to elevate mathematics performance to proficiency or even high proficiency. Gauss

referred to mathematics as the "Queen of the Sciences" (as cited in CHED Memo. 17 s. 2007). Learning it, therefore, will pave ways for students to develop competences that can be facilitative of learning other subject matters like chemistry or physics. It is then the researchers' ultimate goal to find ways to improve mathematics performance.

Table 3. Students' Mathematics Performance

	N	Mean	SD	Performance Level	Descriptive Rating
Mathematics Performance	304	2.14	0.39	86%	Very Satisfactory

Legend: n – sample size   SD – Standard deviation   Very Satisfactory = 82 - 88

The Correlation and Influence of Students' ATM and MSE to Mathematics Performance

As shown in Table 4, the correlation of ATM and MSE to students' mathematics have a computed value of r = .332 and .333, respectively, both with a verbal interpretation of low correlation. Both have a coefficient of determination value of $r^2 = 11\%$. The p-value indicates that the correlations were both significant. It can be inferred that students' ATM and MSE are significantly correlated with students' mathematics performance. Even if the correlation is low, the coefficient of determination reflects that ATM and MSE are 11% accountable to the changes in the students' mathematics performance. It implies that 11/100 performance of students that involves mathematical tasks can be determined by their ATM or MSE. Pepin et al. (2015) explained that negative emotional disposition results to a dislike in mathematics, a low perceived competence (low MSE). It means that emotional disposition can be considered as ATM, saying I like/dislike has a relationship with the students' perceived competence as reflected in their MSE.

Table 4. Correlation of ATM and MSE to Mathematics Performance

	Pearson Product Moment Correlation Coefficient (r)			Sig. (2-tailed)	
			Interpretation	p-value	Interpretation
ATM vs. Mathematics Performance	0.332	11%	Low correlation	0.00	Significant
MSE vs. Mathematics Performance	0.333	11%	Low correlation	0.00	Significant
ATM and MSE vs. Mathematics Performance	0.369	13.5%	Low correlation	0.00	Significant

Legend: If p-value < 0.05 (Significant)

Further, Table 4 also shows that the combined effect of ATM and MSE to mathematics performance is 13.5%. It can be inferred that the effect of the combination of ATM and MSE is 2.5% higher than its effect separately. It implies that it is imperative to look for ways to avoid negative ATM and low MSE because it has a significant negative effect in mathematics performance.

Supported by Fast et al. (2010), they asserted that mathematics self-efficacy is a strong predictor of mathematics performance than either math anxiety or previous math experience. This is related to the statement of Lett and Nillas (2012) who stated that self-efficacy and performance have a reciprocal relationship; self-efficacy affects performance and performance affects self-efficacy. It means that when students continually perform less in math, there is a probability that these students will have low mathematics self-efficacy.

To support this, the following were the transcripts of some of the responses of the students during the focus group discussion and interview about the effects of ATM and MSE to mathematics. Note: FGD# refers to the student from the focus group discussion while ISS# refers to student from semi-structured interview.

Student FGD1: *I am not confident if the topic is about math and other subjects related to number would be affected. And I am also easily discouraged because of my lack of self-confidence.*

Student FGD4: *Because of my attitude in the subject, I am not able to concentrate on the lesson, and I'm not willing to study.*

Student FGD5: *When my attitude to mathematics becomes negative, I find it hard to understand mathematics, find it boring, and eventually get low grades.*

Student FGD9: *I had developed high mathematics self-efficacy when I was in elementary and high school, so the effects were I got high grades, gained self-confidence/ trust and overcame my weakness.*

Student ISS33: *I have positive ATM and have high MSE because: (1) Our teacher always respond to some clarification from us; (2) our teacher always provides exciting and interesting learning process; (3) our teacher presents her lesson comprehensively and challenges her students through games.*

Based on the response of the students, negative ATM affects not only their grades in math but also their psychological belief/ thoughts about math. Because negative ATM results to the students' unwillingness

to study and concentrate, other subjects that include numbers can also be affected. Student ISS33 added that effective teaching pedagogy gave him positive ATM and high MSE.

Causes of Negative ATM and Very Low MSE

Thirty-five (35) selected respondents were interviewed about the causes of having negative ATM and low MSE. The following were the transcripts of some of the responses of the students who had negative ATM and low MSE when asked about the causes of their negative ATM and low MSE.

Student ISS1: *I think the cause of my negative ATM is that I always think that it is hard and I never really put an effort to love mathematics.*

Student ISS2: *It started when I was in grade 1. Our teacher is an essentialist and very terror in math. She always pushes us to excel in Math since she is a mathematician. Every time we received a low score, she punished us and let us stand for the whole period. Since then mathematics has become a terrifying subject for me.*

Students ISS4: *It all started during my secondary years. I remember that I had difficulty in mathematics. It was because our mathematics teacher during that time didn't conduct classes. Our teacher would just give us an activity to answer.*

Students ISS5: *It started in secondary school because mathematics was getting hard for me and the teacher made it harder by discouraging us every time we couldn't get the right answer.*

Student ISS6: *I find it difficult to understand during secondary years because the teacher would just face/talk to the one who understood the topic during the period.*

Student ISS20: *It was because our teacher didn't teach us well and didn't promote good teaching and learning process.*

Student ISS21: *I have negative ATM and low MSE because when I was in elementary, my teacher in mathematics got easily angry when we could not catch up with the correct answer. Then, when I was in high school, my mathematics teacher was so lazy and she always left us with seatwork without even discussing it.*

Student ISS27: *I have negative ATM because I think my teacher's instruction and how she discusses topics are not delivered well. So, up to now I am not confident to do math problems.*

Student ISS30: *I have negative ATM and low MSE because of the teacher. Some of our mathematics teachers have more knowledge in the sense that they just teach the students in a boastful manner. They make the students feel that they know everything without hearing the difficulties of the students with the subject.*

Student ISS32: *I started to hate mathematics because of how my teacher delivers the lesson. He delivers it without fun in it. I found it boring and eventually lost my interest. However, when I am in fourth high school, I started to love mathematics because our math teacher motivated us and engaged us in different activities. But again, in college, I hated math again because of our teacher. Teacher is the factor!*

Based from the responses of the respondents, the students had positive ATM and high MSE in the early years

of their schooling. But most of them developed negative ATM in the secondary level because of their teachers' behavior and pedagogy. Some of the bad behaviors of the teachers as stated by the students were being terror, absent, self-centered, lazy, and boastful. Nicolidau and Philippou (2008) confirmed this statement when they said that many children begin schooling with positive attitude towards mathematics but unfortunately, these attitudes tend to become less positive as they grow up, and frequently become more negative. He stressed that these factors have destructive effect on students' ATM. Hence, Mata et al. (2012) added that the teacher plays an important part in developing students' attitude towards mathematics. On the other hand, students' attitude is not only the teachers' responsibility. Study shows that students' vision about mathematics, effort exerted, level of intelligence, and emotional disposition also affect ATM.

The result of the study also confirmed the three-dimensional model for attitudes (TMA) as discussed by Di Martino (2016). This model takes explicitly into account the close relationship of the three dimensions – (1) emotional disposition towards mathematics (2) vision of mathematics, and (3) perceived competence. It means that aside from the teacher's behavior and pedagogy, the TMA model affects students' ATM as reflected by the answer of student SSI1 saying "I always think that it is hard and I never really put an effort to love mathematics." Further, self-efficacy in math is included in the TMA model. It belongs to the students' perceived competence. The result of the study also found that the causes of very low MSE among students were personal ability (perceived competence); fear of committing mistakes (emotion); and destructive feedback from teachers (teachers' behavior). Hence, in this study,

students' ATM and MSE have significant relationship (r = 0.65). Note that according to the respondents, negative ATM and low MSE commonly starts at elementary and secondary level. Finally, the cognitive model explains that how the students think (thoughts), how the students feel (emotion) and how the students act (behavior) all interact together and affect mathematics learning.

Ways in Overcoming Negative ATM and Low MSE

The study identified ways to overcome negative ATM and very low MSE. Below are some of the transcripts of the recommendations of the students for teachers, parents, and for themselves when asked about how to avoid/overcome negative ATM and low MSE.

To the teachers:

Student ISS10: *They should be mindful of their students not in just one aspect but also in all aspects of education. And also teachers should not discourage children.*

Student ISS2: *I don't want the future generations to have the same perspective in math like mine. I want them to enjoy the beauty of numbers and to have fun in solving mathematical equations. Thus, I recommend that teachers should have an excellent and creative training ground for math. Instead of scaring the students with the numbers, teachers should promote self-efficacy to the students toward mathematics.*

Student ISS25: *Teachers should provide various ways in teaching mathematics. Children should be trained early for them to be able to love mathematics and they will be practiced to be confident.*

Student ISS22: *Teachers teaching mathematics should provide reinforcement and they should encourage the students with the idea that mathematics is not that complex; instead it is a manageable subject as long as you have the willingness to learn.*

To the parents:

Student ISS5: *Let them study with you and review the lessons at home*

Student ISS6: *They should check the progress of their child.*

Student ISS10: *They should follow up their kid and have tutorials at home.*

Student ISS23: *Always support your children and follow up about what they do in school.*

To the students:

Student ISS7: *If there is difficulty in mathematics lesson, they should ask about it and if possible ask for a tutor.*

Student ISS10: *They should be cooperative and collaborative with their teachers for them to catch up with the lesson and gain more knowledge.*

Based from the respondents, in order for the students to overcome negative ATM and low MSE, teachers should: (1) help the students develop holistic learning; (2) help the students enjoy mathematics by having fun while learning; (3) provide students with various teaching methodology and approaches to train them and become confident through practice; (4) and also provide reinforcements and encouragements that mathematics is not complex but a manageable subject. Parents' roles are: (1) support, (2) monitor, and (3) check their student's progress. The

students' roles are: study, ask questions, cooperate and collaborate with their teachers, and ask for a tutor when needed.

Teachers have different ways to approach and overcome negative ATM and MSE as indicated above. They can use the cognitive behavioral therapy by Beck (1960) or the rational emotive behavioral therapy by Ellis (1950) to help students become rational in their thoughts about the subject. However, it must be noted that verbal persuasions have a more limited impact on students' self-efficacy since outcomes are described and not directly experienced (Pantziara, 2016). It means that teachers should not only try to solve these challenges by verbal persuasions but also through developing didactical interventions. There are a lot of didactical interventions that a teacher can devise but the very important thing to consider in planning and making these interventions is to put the teacher's, parent's, and student's role in the teaching and learning process. One of the best ways to achieve this collaboration is through instructional materials being prepared by the teachers. It can be in a form of strategized instructional materials, modules, lesson plans, and even textbooks prepared by the teacher specifically for their students. These must be properly designed with qualities that promote positive attitude towards mathematics and develop students' mathematics self-efficacy.

To give an example, one of the researchers of this present study designed a sample text book that contains qualities of promoting positive ATM and high MSE. The textbook is entitled Mathematics 9: An Innovative Approach (ISBN: 978-621-802-332-1). It was carefully designed and developed by the researcher to help students develop positive ATM and high

MSE. A grade 9 student said that "When I started to use the text book, I came to love mathematics; it was just like playing a puzzle game. I just need to focus and enjoy every pace of the game."

Dr. Josephine Francia Rivero-Villanueva, Dean of Graduate Studies, Naga College Foundation, Inc. commented: "The presentation of the lesson is done in a very conversational tone, as if the author is conducting a one-on-one tutorial to whoever will use the book; it is unhurried, devoid of pressure compared to some traditional textbooks which seems to rush the students from one task to another. The use of "Filipino" or "Tagalog" in some discussions will surely shed light and make learning the content easier, as compared to lessons purely articulated in English. Students will find this book interesting as well as informative in a relaxed and "no pressure" style. After all, learning happens in a relaxed and devoid of pressure learning environment." This study does not claim that an instructional material has to be translated to Filipino for students to understand math. The point is the teacher should try to assess and determine the weaknesses of the students, and from there, they will innovate the teaching and learning process by providing appropriate instructional materials. On the part of the students, the text book was designed to assist them in their studies with or without their teacher because topics were comprehensively presented with many examples suited to the learner's ability and interest. Mathematics self-efficacy can also be developed by having good learning experience and achievement through worksheets at the end of the lessons. The parents will also be given the opportunity to help, monitor, and check their students' learning by going over their students'

home works and accomplishments. To help students develop positive emotional disposition in mathematics, teachers must not forget to integrate values and reinforce ATM.

Conclusion

The study concludes that improving students' attitude towards mathematics and mathematics self-efficacy affect mathematics learning. Even if the respondents' mathematics performance level was very satisfactory and they were happy in other subjects, they do not enjoy solving new problems in mathematics, and do not love the subject. Students' Attitude towards Mathematics (ATM) and Mathematics Self-efficacy (MSE) were significantly correlated with mathematics performance. The main cause of students' ATM and MSE was the teachers' behavior and pedagogy. To overcome negative ATM and low MSE, the students suggested that teachers should be mindful of their students not just in one aspect but also in all aspects of education; have an excellent and creative training ground for math and promote self-efficacy of the students towards mathematics; should provide various ways of teaching mathematics; and should provide reinforcement and encourage the students to think that mathematics is a manageable subject.

Recommendation

Based on the findings, the following are highly recommended:

1. Teachers should help students manage their thoughts, emotions, and behavior positively towards mathematics. It can be done through teachers' careful curriculum planning, writing, and

implementation with appropriate instructional material that aim to develop positive ATM and high MSE among students.

2. Teachers should help the students develop holistic learning; to enjoy mathematics by having fun while learning; provide students with various teaching methodology and approaches in training them to become confident through practice; and provide rein-forcements and encouragement that mathematics is not complex but a manageable subject. Most importantly, teachers should not give destructive feedbacks.

3. Create/innovate instructional materi-als to encourage positive mathematics learning. Materials for both teachers and students must be carefully designed to suit the ability and potentials of the students. To achieve this, financial support from government and non-government organizations (NGOs) is needed.

4. Parents should support, monitor, and check their students' progress. Similarly, the students should focus on their study, ask questions to clarify concepts, cooperate, collaborate and ask for a tutor when needed. To achieve this, parent-teacher collaboration is needed.

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