

Students' Level of Conceptual Understanding in Solving Quadratic Equation Using Microsoft Math Program

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ABSTRACT

This study aimed to assess the students' level of conceptual understanding in solving quadratic equations to determine the effectiveness of the Microsoft Math Program. A quasi-experimental research design was adopted involving thirty-eight (38) Grade 9 students enrolled in A.Y.: 2018-2019 at MSU-Marantao Community High School. The respondents were given a pre-test before introducing the Microsoft Math Program and a post-test after three weeks of using the program. Data revealed that the majority or 65.79% of the respondents failed the pre-test but were able to pass the post-test with a passing rate of 94.74%. The respondents in general had a low level of conceptual understanding in the pre-test and an average level in the post-test. Pre-test and post-test scores were also revealed to have a significant difference as evidenced in the p-value of 0.000. Additionally, the respondents revealed that using the Microsoft Math Program had advantages as it is user-friendly and it offers a step-by-step presentation of solutions, thereby implying the program's potential benefit in enhancing the performance of students in solving quadratic equations. Math teachers are advised to find ways to increase their students' interest in the subject with the use of appropriate and effective instructional materials such as the Microsoft Math Program.

Keywords: conceptual understanding, level of conceptual understanding, Microsoft math program, quadratic equation

I. INTRODUCTION

Students are active learners with individual interests, needs, abilities, and career goals. Students are thus unique individuals who can construct their understanding by developing meaning based on a variety of learning experiences. This becomes possible when learners shift learning experiences from rote memorization to learning with understanding and encounter experiences that proceed from simple to complex. Such an approach to teaching is necessary in all subject areas, most especially mathematics, which has been known to be a difficult subject.

There are students who are good at solving problems but cannot understand the concepts employed in such problems. A poor understanding of the concepts leads to misconceptions in learning mathematics (Asotigue, 2009). It is the task of educators to use strategies to improve students' understanding of mathematics effectively and efficiently. According to Mua (2011), using the appropriate method in teaching helps students learn mathematics properly and be able to maximize its benefits in their development and apply them in everyday life.

The use of technology as resource material in teaching is seen as an effective action to help students learn mathematics better. These resources are integrated to facilitate and enhance the teaching-learning episodes undertaken by both the teachers and the students. Given the rapid developments in science and technology today, the use of technology may have the potential not only to maintain attention but also to motivate learners to pay attention (Bester & Brand, 2013). Teaching mathematics today is also evolving with the production of higher-level technology, which many math teachers have no idea about. These technologies could be a great help for teachers in enhancing their teaching competence and achieving better quality learning. Mathematics teaching necessitates a fast-paced manner of service, thus a need for knowledge on high new set of technology (Carim, 2011). Teachers can apply modernized teaching approaches by introducing technology in teaching mathematics as intellectual toolkits for instructional effectiveness.

In this study, the Microsoft Math Program is given focus to determine its effectiveness as a teaching and learning resource in mathematics. The study of Yildiz and Aktas (2015) posits that computer-aided instruction increases students' mathematical achievements and promotes a positive attitude towards the subject. Similarly, the National Council of Teachers of Mathematics (NCTM, 2000) favors the use of technology in the classroom. These claims necessitates a con-

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tinuous investigation on the effectiveness of teaching tools to advance the quality of teaching mathematics. Hence, the purposes of this study are, first, to examine students' conceptual understanding of solving quadratic equations after exposing them to a program and, second, to contribute to the knowledge based on teaching through technology.

In the context of this study, the researchers already have adequate knowledge on how the Microsoft Math Program works, but its effects on the level of conceptual understanding of high school students remain a pending case. This motivated the researchers to determine such effects by testing it among Grade 9 students, particularly in MSU-Marantao Community High School. The researchers purposely selected the target population as they are currently undertaking lessons on quadratic equations, as well as their accessibility to the researchers.

This study hopes to help Mathematics teachers in honing students' abilities in solving mathematical problems using the Microsoft Math Program. As innovative alternative teaching tool, this program holds out promise in making mathematics teaching and learning more productive.

Research Problem

The study primarily aimed to determine whether the students' level of conceptual understanding in solving quadratic equations would improve and significantly increase by using the Microsoft Math Program. Specifically, it sought answers to the following questions:

1. What is the respondents' profile in terms of:
 - 1.1 gender;
 - 1.2 latest grade in Math; and
 - 1.3 number of hours spent in studying Math?
2. What is the pre-test performance of the respondents in solving quadratic equations?
3. What is the post-test performance of the respondents in solving quadratic equations?
4. What is the level of conceptual understanding of the respondents in the pre-test and post-test?
5. Is there a significant difference between the pre-test and post-test performances of the respondents?
6. What are the respondents' views on the use of Microsoft Math Program in solving quadratic equations?

II. METHODS AND MATERIALS

Research Design

This study employed the quasi-experimental design which involves administering pre-tests and post-tests before and after an intervention, respectively. The quasi-experimental design has one main component—randomly assigned groups. This translates to every participant having an equal chance of being in the experimental group, where they are subject to manipulation.

In this study, instead of having an experimental and controlled group, the researchers decided not to divide the selected Grade 9 students and take them as one group. Said respondents were given a test before and after the introduction of the Microsoft Math Program. The test performances of the respondents in the pre-test and post-test were compared to check if there was a significant difference between them. Then their views on the said program were taken to explicate their attitude towards their experiences and to support the quantitative data as well.

Research Instruments and Its Validity

The research instrument used in this study is a researcher-made questionnaire adopted from Macalalin and Waliloden (2010). However, there were modifications made by the researchers to suit the type of students in this study. The first part of the questionnaire contains the respondents' profile in terms of gender, family monthly income, latest grade in Math, and number of hours spent studying the subject. The second part is a test on solving quadratic equations composed of seventeen (17) problems. This test served as both the pre-test and post-test to ensure that the assessment contained the same coverage and number of items.

Before distributing the questionnaire to the target respondents, it was first pilot tested to a comparable group of students from Datu Calaca Memorial National Comprehensive High School, Tuca-Maul, Marantao Lanao del Sur, to ensure its validity and reliability using Cronbach's alpha statistics. The research instrument obtained an acceptable reliability coefficient (Cronbach's alpha = 0.707) which means that it is reliable since the minimum value for such a reliability coefficient is 0.700 as established in the literature.

Data Gathering Procedure

1. Pre-Implementation Phase

Prior to the conduct of the study, a letter of re-

quest was made by the researchers and was noted by the thesis adviser. This was given to the principal of MSU-Marantao Community High School to secure permission for the conduct of the study. Once granted, questionnaires were given to the target participants to gather information about their demographic profiles.

2. Implementation Phase

To achieve the goals of this study, a pre-test was administered before the introduction of the Microsoft Math Program. Testing procedures were observed to avoid bias and irrelevant results in the study. After checking and obtaining the results of the pre-test, the intervention was then implemented. With that, an orientation was conducted to inform the students about the uses of the Microsoft Math Program.

The researchers discussed quadratic equations with the use of the Microsoft Math Program for three (3) weeks. After completing the coverage, the researchers then allowed the students to operate and explore the program where the students were grouped into two and each group was given a computer to explore the program together. The purpose of the grouping was for the students to work and guide one another considering that some of them did not have a computer at home.

3. Post-Implementation Phase

The respondents were then given a post-test after learning about quadratic equations the Microsoft Math Program. After the post-test, the researchers interviewed five (5) randomly selected students among the respondents to gather their views on using the Microsoft Math Program in solving quadratic equations. The analysis and interpretation of the data followed.

III. RESULTS AND DISCUSSION

Respondents' Profile

Table 1—Distribution of the Respondents' Gender

Gender	Frequency	Percent
Male	10	26.3
Female	28	73.7
Total	38	100.0

Table 1 shows the frequency and percentage distribution of the respondents according to their gender. There were 10 or 26.3% of the respondents who were male and 28 or 73.7% who were female. Hence, as can

be deduced, majority of the respondents were female. Thus, the population of Grade 9 students in MSU-Marantao Community High School was dominated by females. Accordingly, females are generally more dutiful and meticulous enough of rules in the classroom, observant, and more well-behaved than males. However, as to their achievements in Mathematics, studies have conflicting claims as to which gender performs better.

Table 2 - Distribution of the Respondents' Family Monthly Income

Monthly Income	Frequency	Percent
below 10,000	23	60.5
10,000 - 15, 000	3	7.9
15,001 - 20,000	6	15.8
20,001 - 30,000	5	13.2
above 30,000	1	2.6
Total	38	100.0

Table 2 shows the frequency and percentage distribution of the respondents according to their family monthly income. Based on the data, 23 or 60.5% of the respondents have a family monthly income of below 10,000; 3 or 7.9% receive 10,000-15,000; 6 or 15.8% are paid 15,001 to 20,000; 5 or 13.2% get 20,001 to 30,000; and 1 or 2.6% earns above 30,000. Thus, there are more respondents whose families earn a monthly income of below 10,000. This implies that their parents may experience difficulty in providing all the needs of their children in school, especially school laboratory fees and more upgraded technology tools that are useful in learning

Table 3—Distribution of the Respondents' Latest Grade in Mathematics

Latest Grade in Math	Frequency	Percent
74 and below	1	2.6
75-79	6	15.8
80-84	8	21.1
85-89	15	39.5
90-94	6	15.8
95-99	2	5.3
Total	38	100.0

Table 3 shows the frequency and percentage distribution of the respondents according to their latest grade in Mathematics. As shown in the table, 1 or 2.6% of the respondents got a grade of 74 and below; 6 or 15.8% got 75 to 79; 8 or 21.1% got 80 to 84; 15 or 39.5% got 85 to 89; 6 or 15.8% got 90 to 94; and 2 or 5.3% got 95 to 99. Most of the respondents got a grade of 85 to 89 in Mathematics. Thus, many of them had passed

the subject. This may indicate that many of them perhaps were interested in Mathematics, and they might also have acquired sufficient knowledge about math concepts. However, teachers should also investigate the factors or reasons why some students got a low score or a failing grade. This could be due to ineffective strategies, anxiety toward the subject, or their attitude or perception of the subject (Suan, 2014). Furthermore, teachers must use or find possible approaches and strategies for these students to gain higher scores and pass in Mathematics (Mamenting and Ali, 2017). As said, teachers have rich repertoires of instructional strategies and approaches.

Table 4-Distribution of the Respondents' Number of Hours Spent in Studying Mathematics

Number of hours spent in studying Math	Frequency	Percent
5-20 minutes	8	21.1
21-30 minutes	4	10.5
31-45 minutes	5	13.2
1 hour	16	42.1
1.5 hours	1	2.6
2 hours and more	4	10.5
Total	38	100.0

Table 4 shows the frequency and percentage distribution of the respondents according to the number of hours spent in studying math. As shown in the table above, 8 or 21.1% of the respondents spent 5 to 20 minutes in studying math; 4 or 10.5 % spent 21 to 30 minutes; 5 or 13.2% spent 31 to 45 minutes; 16 or 42.1% spent 1 hour; 1 or 2.6% spent 1 hour and 30 minutes; and 4 or 10.5% spent 2 hours. This implies that majority of the respondents make time for studying mathematics. Thus, the students need to be more motivated in studying math so they could learn more especially in solving math problems.

In addition, according to Polya (1945, as cited by Soriano, 2014), to solve a problem is to find a way where no way is known off-hand, to find a way out of difficulty, to find a way around an obstacle, and to attain a desired end that is not immediately attainable. However, Polya added that students also need to be motivated to learn aside from spending time studying which will help them develop their ability and interest to think and reason. This positive attitude will make them more interested in any lesson and will help them absorb and retain information more easily.

Similarly, for Steltenpohl (2012, as cited by Mamenting & Ali, 2017), time management includes scheduling an appropriate amount of time for study as well as planning tasks to be accomplished within a

designated period. Length of time may not be the basis for effective studying, but it is the quality of spending that time that matters. Students should use their study time wisely in a way that maximizes learning. Indeed, good study habits are important for students to learn effectively.

Oftentimes, spending an hour studying mathematics is not enough to learn and answer any mathematical problems. Therefore, time management would be very helpful to students for follow-up review after every class as they need more practice in analyzing and solving mathematical problems. It takes time to learn for learning is not instantaneous.

Pre-test Performance of the Respondents

Table 5-Distribution of Respondents' Performance in the Pre-Test

	Raw Score	Transmuted Grade	f	%	Mean Rating	Qualitative Description
	3.00	58.82	1	2.6		
	4.00	61.76	5	13.2		
	5.00	64.70	2	5.3		
	6.00	67.65	5	13.2		
	7.00	70.59	9	23.7		
	8.00	73.53	3	7.9		
	9.00	76.47	4	10.5		
Re- sponde nts	10.00	79.41	2	5.3	8.00/7 3.53	Failed
	11.00	82.35	2	5.3		
	12.00	85.29	1	2.6		
	14.00	91.18	1	2.6		
	16.00	97.06	1	2.6		
	17.00	100.00	2	5.3		
	Total		38	100.0		

Scaling:
 98 and above - Excellent 81 – 86 - Fair/Satisfactory
 93 – 97 - Very Good 75 – 80 - Passing
 87 – 92 - Good 74 and below - Failed

Table 5 shows the respondents' pre-test performance. As shown, 25 or 65.3% of the respondents obtained a failing grade ranging from 74 and below; 6 or 15.8% obtained a passing grade of 75-80; 3 or 7.9% obtained a satisfactory grade ranging from 81-86; 1 or 2.6% obtained a good grade within the range of 87-92; while only 1 or 2.6% obtained a very good grade within

the range of 93-97; and only 2 or 5.3% obtained an excellent grade of 98 and above in the pre-test. On average, with a mean score of 8.00, the respondents' pre-test score had a grade equivalent of 73.53 described as failed. This implies that some of the respondents were having difficulty understanding the concepts and in solving quadratic equations.

This finding signifies that there is a need to improve the respondents' performance in Mathematics by considering other teaching approaches. According to Tenedero (1998, as cited by Mua, 2011 pg. 3), "students are not failing because of the curriculum. They can learn any subject matter when they are taught with methods and approaches responsive to learning styles and strengths and using the appropriate method in teaching is true to any subject. Besides that, teachers must develop and use effective instructional materials, and create a stimulating learning environment.

Post-test Performance of the Respondents

Table 5-Distribution of Respondents' Performance in the Pre-Test

	Raw Score	Transmuted Grade	f	%	Mean Rating	Qualitative Description
	7.00	70.59	2	5.3		
	9.00	76.47	3	7.9		
	10.00	79.41	4	10.5		
	11.00	82.35	5	13.2		
Respondent	12.00	85.29	5	13.2	12.6842 / 87.31	Good
	13.00	88.23	6	15.8		
	14.00	91.18	1	2.6		
	15.00	94.12	4	10.5		
	16.00	97.06	2	5.3		
	17.00	100.0	6	15.8		
	Total			38		

Scaling:

98 and above - Excellent	81 – 86 - Fair/Satisfactory
93 – 97 - Very Good	75 – 80 - Passing
87 – 92 - Good	74 and below - Failed

Table 6 shows the mean and respondents' post-test scores. As shown, only 2 or 5.3% of the respondents obtained a failing grade ranging from 74 and below; 7 or 18.4% obtained a passing grade ranging from 75-80;

10 or 26.4% obtained a satisfactory grade ranging from 81-86; 7 or 18.4% obtained a good grade within the range of 87-92; 6 or 15.8% obtained a very good grade within the range of 93-97; and 6 or 15.8% obtained an excellent grade within the range of 98 and above in the post-test. On average, with a mean score of 12.6842, the respondents' post-test score had a grade equivalent of 87.31 described as good.

This finding implies that after using the Microsoft Math Program, the respondents' post-test scores are better on average as compared to the results of the pre-test. Perhaps, the use of the Microsoft Math Program helped students improve their performance in solving quadratic equations. Although there are still two participants who failed to improve, the data revealed a great development in the students' performance after the intervention as evidenced by the decrease of 60% in the number of failed students in the pre-test. The succeeding data representation further clarifies this result.

Respondents' Level of Conceptual Understanding

Table 7-Levels of Conceptual Understanding of the Respondent's Pre-test and Post-test Scores

Level of Conceptual Understanding	Pre-test			Post-test		
	f	%	Mean Value	f	%	Mean Value
High	4	10.5		2	5.3	
Average	9	23.7	Low	17	44.7	Average
Low	25	65.8		19	50.0	

Scaling:

14-17 - High Level of Conceptual Understanding
9-13 - Average Level of Conceptual Understanding
0-8 - Low Level of Conceptual Understanding

Table 7 presents the students' level of conceptual understanding in the pre-test and post-test. The results show that the lowest scores obtained by 65.8% of respondents in the pre-test are within the range of 0-8, and the scores between 9-12 (average), and 23.7% respectively; while the highest scores are within the range of 13-17, with 10.5% of the total number of respondents. On the post-test, nineteen (19), or 50% of respondents have a low conceptual understanding of solving quadratic equations, while seventeen (17), or 44.7% of respondents have an average. Overall, the pre-test showed a generally low level of conceptual

understanding of solving quadratic equations while the post-test showed a generally average level.

This implies that the use of the Microsoft Math Program improved the performance of the respondents in solving quadratic equations. At first, students struggled with solving quadratic equations as shown by a great number of them who failed. Probably, the reasons why students find Mathematics difficult are their lack of understanding, and that they cannot connect their previous knowledge to the new concepts because of a weak foundation in this subject. However, when taught using a new strategy and using new technology and software, they proved to know the concepts and the ability to apply them when asked to solve problems.

Hypothesis Testing

Table 8- Significant Difference between the Respondents' Pre-test and Post-test Scores

	Mean Score	Qualitative Rating	Correlation Coefficient	p-value	Interpretation	Action Taken
Pre-test	8.0000	Failed				
Post-test	12.6842	Good	0.603	0.000	Significant	Reject Ho

Table 8 shows the t-test analysis of the respondents' pre-test and post-test scores in solving quadratic equations. The findings showed that the p-value is less than 0.05 level of significance. Thus, a significant difference between the pre-test and post-test scores of the respondents is observed. This implies that the use of the Microsoft Math Program in teaching quadratic equations significantly improved the performance of the students in solving quadratic equations. With that, the introduction of using the Microsoft Math Program, in effect, helps increase the conceptual understanding of the respondents in solving quadratic equations.

Technology is an influential force that affects the students' attitude and practices in learning. It is in this era that the teacher takes the lead in technology utilization. Therefore, a teacher must be techno-savvy to be able to cope with developments and to guide and help students in their learning. Teachers and students need to work collaboratively to create, evaluate, and effectively utilize information, media, and technology that is changing at an unprecedented rate.

Specifically, through Microsoft Math, teachers can both improve their teaching and enhance students' ability to solve mathematical problems.

Respondents' Views on Using Microsoft Math Program in Solving Quadratic Equation

In this study, interviews with selected participants revealed substantial information about using Microsoft Math. They played a vital role in clarifying and supporting the quantitative data gathered in the quasi-experiment. Upon conducting the study, the researchers asked permission from five selected respondents for an interview. It was for collecting detailed information regarding their views on using the Microsoft Math Program. In-person interviews with the respondents, which were voice recorded, were the procedure employed. Additional data collection tools were used when necessary, such as an audio recorder during the interview, a camera for taking pictures of the respondents during the interview, as well as interview notes. After the interview, answers were analyzed thematically to determine and categorize the responses.

Below are the interpretations of the interview results:

1. How can the Microsoft Math Program help you in solving quadratic equations?

Most of the respondents stated that the Microsoft Math Program helped them enhance their skills in solving quadratic equations as they found the program interesting. Aside from that, this program served as a guide or reference for those who did not understand the lessons clearly. Implementing the use of technology during math classes as another approach to teaching might help hone students' problem-solving skills in general. This is consistent with the findings of Carim and Trinquite (2011) in its study "The Use of Microsoft Math Program in Solving Trigonometric Problem as Perceived by the Students", which revealed that students find the use of the Microsoft Math Program in solving trigonometric problems highly agreeable and effective. Hence, using technology like Microsoft Math in learning mathematics could increase students' interest in Mathematics as it is an effective and innovative aid in learning.

2. Is there any difficulty in using this Microsoft Math program?

The majority of the respondents found the Microsoft Math program easy to use in solving mathematical problems, which proves that it is a user-

friendly program for young learners. In this vein, the researchers observed that the respondents were willing to learn, explore, and operate the program. The respondents even cross-checked the correctness of their answers during the discussions using the Microsoft Math Program. This is one of the reasons why the respondents found the program interesting and understandable as the instructions were easy to follow and they could confirm their answers.

3. What do you think are the advantages and disadvantages of using the Microsoft Math Program?

The respondents agreed that using the Microsoft Math Program has advantages being easy to use, its feature of showing step-by-step solutions, and its ability to solve difficult problems. In addition, several disadvantages were also observed, for instance, the students would not bother listening to their teacher anymore because they would rely on the program during discussions and may use it in doing their homework. On a positive note, the students still acknowledged the importance of manual problem-solving despite the presence of Microsoft Math. This implies that they still want to learn how to solve problems on their own to understand how solutions are derived.

4. Did the Microsoft Math Program help you improve your skills in solving mathematical problems?

Most of the respondents realized that the Microsoft Math program is a great help in improving their skills in solving mathematical problems since it provides a complete process of getting the solution and shows different mathematical formulas. This finding corroborates that of Bagumbaran-Macala (2017), who found that a computer-aided interactive teaching approach is beneficial in improving students' level of conceptual understanding and performance in Mathematics. On average, students exposed to a computer-aided interactive teaching approach outperformed those students who were not exposed to it in the conceptual understanding test.

Considering the views of the respondents, the Microsoft Math Program is indeed good for mathematics teachers to use in the classroom. Students deserve to experience effective teaching strategies and materials that can improve their performance. Hence, teachers and administrators alike may consider the integration of the Microsoft Math Program in the teaching-learning process.

IV. CONCLUSIONS AND RECOMMENDATIONS

The Grade 9 high school students in MSU-Marantao Community High School mostly were females and some of them found Mathematics difficult maybe because they only spent one hour studying the subject. Many of the respondents had a family monthly income below 10,000 which may not suffice all their educational needs. The respondents' pre-test scores revealed a low level of conceptual understanding in solving quadratic equations, while an average level was shown in the post-test. Moreover, the hypothesis testing further fortified this increase when the result showed that their performance significantly increased in the post-test. Hence, the use of the Microsoft Math Program in teaching and learning quadratic equations was found to have a significant impact on the performance of students.

Furthermore, the interview data corroborated the positive effect of the Microsoft Math Program as revealed in the experiment. As presented, most of the respondents found the Microsoft Math Program user-friendly and facilitative in their learning of quadratic equations. In relation, using technology may not only have advantages but also disadvantages. However, this does not diminish the value of the program; students and teachers must practice the proper usage of technology during class hours.

Hence, the use of technology as resource material in teaching is seen as an effective strategy to help students learn mathematics better. As an innovative alternative teaching tool, the Microsoft Math Program holds promise in making Mathematics teaching and learning more productive.

Based on the findings, conclusions, and implications of the study, the following recommendations are drawn:

Students should empower themselves to build up their mathematics performance and spend enough time in studying mathematics to improve their level of conceptual understanding in the subject area.

Mathematics teachers, on the other hand, should be sensitive enough to increase their students' interest in mathematics using appropriate and effective instructional materials like the Microsoft Math Program.

That being said, school administrators should adhere to the standards in the selection of highly qualified and innovative teachers. They must implement plans and straighten out programs for the development of in-service teachers and must provide effective facilities and equipment for the students to perform well in their academics. They may consider the

Microsoft Math Program to be integrated in mathematics teaching, in addition to other materials they prefer.

Hence, computer programmers should develop more educational programs that can help students lessen their difficulties in mathematics and enhance their ability to solve problems. Moreover, future researchers are advised to conduct further studies on using the Microsoft Math Program in solving mathematical problems. They may also investigate other computer-based tools, develop a new material, and test its effectiveness.

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VI. REFERENCES

- Asotigue, A. (2009). *Integrative Multi-Modal Strategy in Teaching Mathematics: Effects on Students' Level of Conceptual Understanding*. [Unpublished Master's thesis]. Mindanao State University, Marawi City.
- Bagumbaran-Macala, N. (2017). *Computer-Aided Interactive Teaching Approach: Effects on Students' Conceptual Understanding, Performance and Attitude in Mathematics*. [Unpublished Master's thesis]. Mindanao State University, Marawi City.
- Bester, G., & Brand, L. (2013). The Effect of Technology on Learner Attention and Achievement in the Classroom. *South African Journal of Education*, (33)2.
- Carim, F.P., & Trinquite, K.K.A. (2011). *The Use of Microsoft Math Program in Solving Trigonometric Problem as Perceived by the Students*. [Unpublished undergraduate thesis]. Mindanao State University, Marawi City.
- Maca-alin, F.M. & Walilodin, H.U. (2010). *Perception of Sophomore High School Students on the Effectiveness of Solving Polynomials Using Microsoft Math Program*. [Unpublished undergraduate thesis]. Mindanao State University, Marawi City.
- Mamenting, A., & Ali, N. (2017). *Learning Strategies and Students' Perception about Mathematics Learning*. [Unpublished undergraduate thesis]. Mindanao State University, Marawi City.
- Mua, R.C. (2011). *Cooperative Learning Approach: Its Effectiveness in Mathematics Performance among Grade IV Pupils at Lalapong Elementary School*. [Unpublished Master's thesis]. Mindanao State University, Marawi City.
- Naga, J., & Poonadatu, S. (2017). *Math 2 (College Algebra) Students' Misconceptions in Solving Equations in One Variable*. [Unpublished undergraduate thesis]. Mindanao State University, Marawi City.
- National Council of Teachers of Mathematics (2000). *Principles and Standards for School Mathematics*. Reston, VA: National Council of Teachers of Mathematics.
- Soriano, H.C. (2014). *Differentiated Instruction-Oriented Module: Effects on Students' Thinking Skills, Problem Solving Skills, and Performance in Algebra*. [Unpublished Master's thesis]. Mindanao State University, Marawi City.
- Suan, J.S. (2014). *Factors Affecting Underachievement*

in Mathematics. Maritime Education and Training Center Alumnus, Mambaling, Cebu City, Philippines.

Yildiz, Z., & Aktas, M., (2015). The Effect of Computer Assisted Instruction on Achievement and Attitude of Primary School Students. *International Online Journal of Educational Sciences (IOJES)*, 7(1), 97-109.