

# EFFECTS OF VEDIC MATHEMATICS TECHNIQUE (VMT) ON STUDENTS' PROBLEM-SOLVING SKILLS AND MOTIVATION TOWARD MATHEMATICS

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**ABSTRACT:** *Vedic Mathematics Technique (VMT) is used to solve mathematical problems in a fast and easy way. It deals with shortcut techniques that carry out numerical calculations in a faster way. This study sought to: determine the level of students' problem-solving skills of the students before and after exposure to VMT; identify the level of students' motivation towards Mathematics before and after exposure to VMT; discover the students' problem-solving skills before and after exposure to VMT in their posttest and retention test; find out the students' motivation towards Mathematics before and after the exposure to VMT. A mixed-method sequential explanatory research design was utilized in the study. It was conducted at Central Mindanao University Laboratory School, Maramag, Bukidnon. Students in Grade 7 were the research participants of the study. The students had very low problem-solving skills in their pretest yet they had high problem-solving skills in their post-test and retention test. Furthermore, students' motivation towards Mathematics before the intervention was rated as highly motivated. After the intervention, the level of students' motivation towards Mathematics remained highly motivated but with a higher mean. In addition, there was a significant difference in the pretest-posttest and pretest-retention tests of the students in terms of their problem-solving skills. However, no significant difference was obtained between the posttest and retention test. Moreover, there was a significant difference between the pretest and posttest on students' motivation toward Mathematics when exposed to VMT. VMT showed a promising effect in increasing students' problem-solving skills and improving motivation toward Mathematics.*

**Keywords:** *problem-solving skills, mathematics motivation, Vedic Mathematics Technique*

## 1. INTRODUCTION

Problem-solving is an integral part of all mathematics learning, and so it should not be an isolated part of the mathematics program. By learning problem-solving in mathematics, students should acquire ways of thinking, habits of persistence and curiosity, and confidence in unfamiliar situations that will serve them well outside the mathematics classroom [1]. Mathematics is all about devising solutions to problems [2]. Problem-solving is an important cognitive activity applied in a real-life context. One of the important elements of problem-solving skills that individuals should have is to choose the appropriate strategy in the solution of the problems, which is important in terms of achieving success in solving problems [3].

The latest result of the Trends in Mathematics and Science Study (TIMSS) conducted in 2003 revealed low achievement scores in Science and Mathematics of selected Grade 4 and Grade 8 (Second Year High School) students from sample schools. For Grade 4 students, the Philippines ranked 23rd out of 25 nations in both Science and Mathematics while for Grade 8 students, it's 42nd out of 45 countries in Science and Mathematics. This study demonstrates the importance of students being informed about various Mathematics study techniques that they can utilize to improve their academic performance in Mathematics. The TIMSS result is consistent with the fourth-year National Achievement Test, which shows that CMULHS' Mean Percentage Score (MPS) in Mathematics is 41.14, which is lower than the Division of Bukidnon's MPS of 46.24 [4].

According to the Trends in International Mathematics and Science Study (2000) [5], Filipino students were found to have difficulties in solving problems that are different from the problems usually given in textbooks. This suggests that the problem-solving skills of the students are not yet developed. It also shows that students deal only with solving routine problems and give emphasis on step-by-step procedures rather than meaningful learning. A study has

shown that 40% of their respondents were below the satisfactory level in translating worded problems due to the following difficulties: carelessness, lack of comprehension, interchanging values, and unfamiliar words [6]. In addition, it was reiterated that the greatest reason why students are performing poorly in Mathematics is that they are still having a hard time finding the relevance of Mathematics in their lives [6]. Students are aware of how they are able to use the basic concepts of Mathematics in their daily lives but when it comes to more complicated mathematics topics and whenever students are experiencing difficulties, they begin to question its essence. According to a study, learning achievement is influenced by many factors; they are intrinsic and extrinsic factors [7]. One of the intrinsic factors is motivation. Piaget believed that motivation is the best to gain students' achievement. Students' motivation comes when they do work to gain experience from it. Motivation serves as a stimulant for effort and achievement. The existence of a good motivation in learning will show good results. Thus, learning outcomes can be caused by intrinsic motivation.

In order to help students to enhance their problem-solving skills and their motivation toward mathematics, the researcher suggested integrating the Vedic Mathematics Technique (VMT) into some appropriate mathematics topics. Nowadays, some students still struggle in the subject of Mathematics. According to the report of PISA (2018), Filipino students achieved an average of 353 points in Mathematical Literacy; this is significantly lower than the OECD average (489 points) and is classified as below Level 1 proficiency. As discussed in the PISA 2018 International report (OECD, 2019). The majority of Filipino students (80.70%) were classified as having Proficiency Levels below Level 2, with 54.4% below Level 1 proficiency. For the Philippines, only 1 out of 5 students (19.7%) attained Proficiency Levels 2 to 4. These students can employ basic algorithms, formulae, procedures, or conventions to solve problems involving whole numbers. Only 0.01% of students

performed within Proficiency Levels 5 to 6. They can develop and work with models for complex situations, identifying constraints and specifying assumptions. They can also apply this insight and understanding, along with a mastery of symbolic and formal mathematical operations and relationships, to develop new approaches and strategies for attacking novel situations.

Vedic Mathematics is the name given to the Indian ancient system of Mathematics, or a set of some precise rules with which any arithmetic, algebraic, geometry, or trigonometry problems can be easily solved [8]. The system is based on 16 Vedic sutras, which are set of word formulae describing steps or logic involved while solving a whole range of mathematical problems, which are considered very difficult or cumbersome in the traditional method. Vedic mathematics was initially rediscovered from Indian scriptures between the years 1911 to 1918 and fully developed in 1957 by Jagadguru Sri Bharathi Krishna Thirthaji Maharaja, a scholar of Sanskrit, Mathematics, and philosophy. Using these techniques, it is possible to calculate 10-15 times faster than usual methods. Difficult problems or huge sums can be solved almost immediately by the Vedic method.

Numerous investigations have been implemented to find out factors associated with students' achievement such as teachers' skills and competencies [9, 10, 11, 12], teachers' awareness, perceptions, and challenges [13, 14, 15, 16, 17], contemporary pedagogies [18, 19, 20, 21, 22, 23] and others [24, 25, 26, 27, 28, 29, 30], however, little has been done on exploring the use of VMT in teaching mathematics.

This study was conducted for the purpose of knowing the effects of the Vedic Mathematics Technique (VMT) on students problem-solving skills and their motivation toward Mathematics. Furthermore, this study intended to know the significant difference in the students problem-solving skills and motivation toward Mathematics of the students before and after exposure to VMT.

## 2. MATERIALS AND METHODS

The study evaluated the students' problem-solving skills and motivation toward mathematics through VMT at Central Mindanao University Laboratory School for SY 2021-2022. The study made use of a mixed-method sequential explanatory research design. For the collection of quantitative data, a one-shot pretest-posttest design was employed to determine the effects of VMT on students' problem-solving skills and motivation toward mathematics. Using random sampling (tossing a coin), a group was chosen at random to be the participants of the study. A pretest-posttest design was used to determine the significant difference in students' problem-solving skills and motivation toward mathematics when exposed to VMT.

Before the conduct, the researcher administers a 60-item teacher-made pretest exam to determine the level of students problem-solving skills as well as a pre-survey of the Mathematics Motivation Scale to see the level of their motivation towards the subject. After the pretest, the students were exposed to Vedic Mathematics Technique and given a posttest after the intervention. Seven (7) days after the

posttest the retention test was conducted. Then an analysis of the quantitative data was administered.

After completing all of the tests, participants were interviewed to obtain qualitative feedback and to determine some of the factors affecting their problem-solving skills and motivation toward mathematics. They were chosen based on the results of their tests and MMS. The interview was conducted through a web interview via Google Meet. Qualitative results were used to further explain this study's quantitative findings, as put forward in the statement of the problem and objectives.

There were two (2) instruments utilized to gather the quantitative data, namely, the validated teacher-made test and mathematics motivation scale. The first instrument utilized was a validated teacher-made test that was used to measure the level of students' problem-solving skills with 60 items covering the topics in the second quarter of grade 7 mathematics: 35 items multiple choice; and 5 items problem-solving. Items were scored '1' for every correct response, zero if otherwise for the multiple-choice and 5 for every correct solution for the problem solving, and zero if otherwise a total of 60 points. The second instrument used in the study was the Mathematics Motivation Scales. It is a 29-item Likert scale with items answered on a five-point scale, from strongly agree to strongly disagree. The said scale underwent a reliability test. Cronbach's alpha value of 0.855 was obtained. A reverse scoring procedure was done for a negative statement. In addition, the instrument used to gather the qualitative data was the 2-item interview questions.

The participants of the study were divided into two groups: two (2) sections of Grade 7 students of Central Mindanao University Laboratory School who were officially enrolled for the school year 2021-2022 during the second grading period, and six (6) students who were interviewed based on their mean difference score in the test and MMS; one (1) highest MD, one (1) zero MD or close to zero, and one (1) lowest MD or negative MD.

Before the conduct, the researcher administers a pretest to determine the level of students problem-solving skills as well as a pre-survey of the Mathematics Motivation Scale to see the level of their motivation towards the subject. It was done using the Google forms where students select their answers in the choices given. Also, in the problem-solving part, students were instructed to write their solutions and answers in a piece of paper and take a picture of it and send it to the email address of the researchers. During the conduct of the study, the researcher used the prepared VMT integrated learning material while having a virtual class with the students. After exposing the class to VMT, the researcher conducted a post-test to see the level of their problem-solving skills and a post-survey of the Mathematics Motivation Scale to determine the level of their motivation towards the subject. A week after the conduct, the researcher administered the final test and survey which is the retention test. Both the post-test and retention tests were done the same as the pre-test. After completing all of the tests, students were interviewed to obtain qualitative feedback and to determine some of the factors affecting their problem-solving skills and motivation toward mathematics.

The data collected were tabulated and analyzed using appropriate statistical tools using the software. Descriptive statistics were used to obtain the frequency values, percentages, standard deviations, and means, of the students' problem-solving skills scores (pretest, post-test, and retention test) as well as their level of motivation. Paired Samples t-test was used to determine the significant difference in the students' problem-solving skills and motivation toward Mathematics. Content analysis was used to analyze the qualitative data whether they make sense and are consistent with the data collected.

The following rating scale was used to better understand the data:

Score	Range	Descriptive rating	Interpretation
40 – 50	90%-100%	Outstanding	Very high problem-solving skills
36 – 39	86%-89%	Very Satisfactory	High problem-solving skills
30 – 35	80%-85%	Satisfactory	Moderate problem-solving skills
25 – 29	75%-79%	Fairly Satisfactory	Low problem-solving skills
0 – 24	74% and below	Did not meet expectations	Very low problem-solving skills

Rating	Scale	Descriptive Rating	Qualitative Interpretation
5	4.20 – 5.0	Strongly agree	Very Highly Motivated
4	3.40 – 4.19	Agree	Highly Motivated
3	2.60 – 3.39	Undecided	Moderately Motivated
2	1.80 – 2.59	Disagree	Low Motivated
1	1.00 – 1.79	Strongly disagree	Very Low Motivated

**3. RESULTS AND DISCUSSIONS**

This section presents the analysis and interpretation of data gathered from the respondents, which are relevant for testing the hypotheses of the study. Tables and other figures are also shown in this chapter to give a convenient analysis of the data. The order of presentation follows the sequence of the objectives identified in the study.

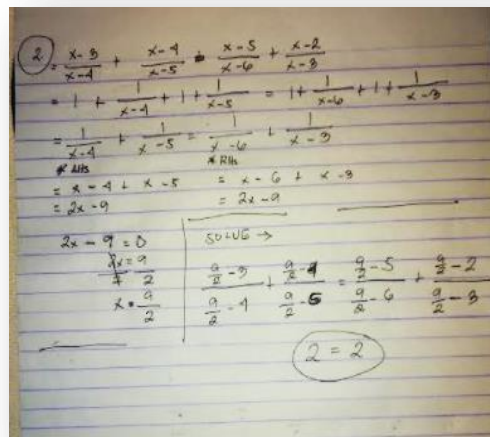
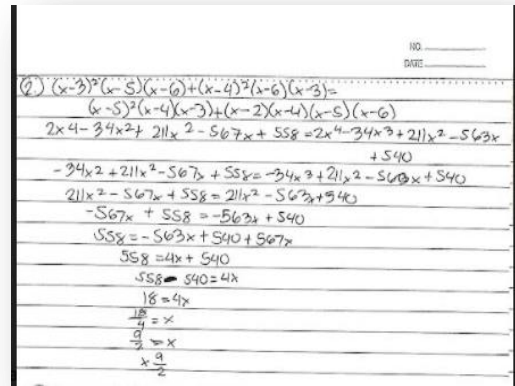
**3.1 Students' problem-solving skills**

Table 1 presents the level of problem-solving skills of students in their pretest, indicating the frequency and percentage of the scores and qualitative interpretation.

**Table 1. Level of Students' problem-solving skills in the pretest**

Range	VEDIC MATHEMATICS TECHNIQUE		Qualitative Description
	F = 63	%	
90% - 100%	6	9.6%	Very High Problem-Solving Skills
86% - 89%	3	4.8%	High Problem-Solving Skills
80% - 85%	1	1.6%	Moderate Problem-Solving Skills
75% - 79%	3	4.8%	Low Problem-Solving Skills
74% and below	50	79.2%	Very Low Problem-Solving Skills
Mean = 30.87 (Very Low Problem-Solving Skills)			

As presented in table 1, 50 or 79.2% of the students obtained scores that are being interpreted as very low problem-solving skills. There were three (3) or 4.8% of the students who obtained scores that are interpreted as low problem-solving skills and one (1) or 1.6% for moderate problem-solving skills. In addition, there were three (3) or 4.8% who had high problem-solving skills, and six (6) or 9.6% of the students had very high problem-solving skills. The mean score in their pretest was 30.87 equivalent to an MPS of 51.46 interpreted as very low problem-solving skills. This indicates that students had less prior knowledge of the topics. Although there were already 50% of the students had prior knowledge of the topics, still, half of the class was considered to have very low problem-solving skills. Figure 3 shows sample students' outputs in the pretest.



**Figure 3. Students' problem-solving written outputs (pretest)**

As reflected in Figure 3, students did not know yet how to solve the given expressions. Interviewee 3 claimed that the topics included in the pretest were new to him/her and become unfamiliar. He/she had no idea what it is all about. Interviewee 6 who did advance reading of the topic given by the teacher was able to search on linear equations and tried his/her best to understand the topics but was not very successful in his/her attempt Below is their interview transcript:

*"Before pa nag start atong klase, daghan nakog na learn pero kay naa namay new topic so wala koy idea unsa ni about ang topic." (Before we start our class, I already learned a lot but this new topic is unfamiliar and I don't have any idea what is it.)*

*-Interviewee 3*

*"Regarding sa new topic, naa koy gamay nga idea kay gipangutana man mi ni sir if naa ba miy idea about linear equations. So nag search ko unsa kaha na. Though nag advance reading ko pero di nako ma gets ang mga topic jud." (Regarding the new topic, I have a little idea because we are asked if we have any idea and I did some research in advance. Though I read in advance I can't understand it at all.)*

*-Interviewee 6*

The outcomes of the pretest can be attributed to the students' prior understanding of linear equations to which they were exposed. Also, given the fact that the teacher did not discuss yet the said topic, very low scores were expected. These findings are supported by the study which found that the scores of the students in the pretest did not meet the average level of proficiency [31]. In addition, the findings are expected since they do not have a foundation for the topic [32].

Table 2 presents the level of students' problem-solving skills in their posttest indicating the frequency, percentage of scores, and qualitative interpretation.

**Table 2. Students' Level of Problem Solving Skills in the posttest.**

Range	VEDIC MATHEMATICS TECHNIQUE		Qualitative Description
	F = 63	%	
90% - 100%	23	36.6%	Very High Problem-Solving Skills
86% - 89%	21	33.4%	High Problem-Solving Skills
80% - 85%	19	30.2%	Moderate Problem-Solving Skills
75% - 79%	0	0%	Low Problem-Solving Skills
74% and below	0	0%	Very Low Problem-Solving Skills
Mean = 52.81 (High Problem-Solving Skills)			

As shown in Table 2, 23 or 36.6% of the students gained a score that can be interpreted as very high problem-solving skills. Twenty-one (21) or 33.4% of the students belonged with the high problem-solving skills, and nineteen (19) or 30.2% of the students obtained a score indicating moderate problem-solving skills. The mean score of their post-test was 52.81, which was equivalent to an MPS of 88.02 showing high problem-solving skills. The data implicate that students were able to understand the topics and were successful in answering the test items after exposure to VMT. This suggests that VMT had potentially enhanced their problem-solving skills, as reflected in the high posttest mean percentage score. The result shows a change in their scores before and after the implementation of VMT (See Table 1 versus Table 2). This suggests that students were able to solve such problems because of the intervention used. They were able to know the concepts and techniques on how to solve problems in a faster and easy way. Consequently, students obtained better results than their pretest scores. This finding can easily be observable in Figure 4.

As shown, students were able to solve the linear equations easily with shortcuts as presented by the teacher using VMT. This solution was an application of Rule 5 in VMT, which states that "the sum of the denominators on the left-hand side and the sum of the denominators on the right-hand side are the same, then the sum should be equated to zero to get the solution." These outputs imply further that students could apply the knowledge they learned from their teachers using VMT.

Moreover, students were able to appreciate VMT as elaborated during their interviews. Interviewee 1 disclosed that it is easy to solve when using the VMT. Solving can be done mentally using VMT, and it is very helpful in solving problems. VMT as a helpful technique is confirmed by Interviewee 2, he/she even added that it is very easy to apply and solving can be done in a shorter period. Below are the transcripts of their interviews:

$$2.) \frac{x-3}{x-4} + \frac{x-4}{x-5} = \frac{x-5}{x-6} + \frac{x-2}{x-3}$$

$$(x-4) + (x-5) = (2x-9)$$

$$(x-6) + (x-3) = (2x-9)$$

$$2x-9=0$$

$$2x-9+9=0+9$$

$$\frac{2x}{2} = \frac{9}{2}$$

$$x = \frac{9}{2}$$

$$3.) \frac{x-8}{x-9} + \frac{x-9}{x-10} = \frac{x-10}{x-11} + \frac{x-11}{x-12}$$

$$(x-8) + (x-9) = 2x-17$$

$$(x-10) + (x-11) = 2x-21$$

$$2x-17=0$$

$$2x-17+17=0+17$$

$$2x=17$$

$$x = \frac{17}{2}$$

Figure 4. Sample students' output during posttest

"Mas dali maka-solve maam if I use Vedic Math, like pwede ra siya i-imagine pag solve. Instead nga mugamit kog scratch paper maam, dili na lang kay pwede naman ma solve mentally. Very helpful siya maam when I solve problems." (It is easier to solve problems whenever I use Vedic Mathematics Technique like I can solve it mentally without using scratch papers. It's very helpful for me whenever I solve problems.)

-Interviewee 1

"Para sa ako maam, helpful kaayo and VMT ug very easy pa jud siya gamiton. Maka solve na lang kog problem in a short period of time. Makatabang jud siya sa education namo." (Vedic Mathematics Technique is very helpful and it is easy to use. I can solve the problems in a short period of time. It is very useful for our education.)

-Interviewee 2

The high problem-solving skills of students as revealed in their post-test scores which were caused by VMT as stated by the participants was one of the significant findings of the study. The problem-solving approaches or methods that a teacher use appears to be crucial to solving the problem successfully [33]. Moreover, learning mathematics becomes more relevant when students are exposed to a variety of methodologies [6]. As a result, it is critical for teachers to diversify their problem-solving tactics and methodologies. Table 3 presents the level of students' problem-solving skills in their retention test indicating the frequency, percentage of scores, and qualitative interpretation.



**Table 3. Level of students' problem-solving skills in the retention test.**

Range	VEDIC MATHEMATICS TECHNIQUE		Qualitative Description
	F = 63	%	
90% - 100%	26	41.2%	Very High Problem-Solving Skills
86% - 89%	12	19.1%	High Problem-Solving Skills
80% - 85%	25	39.7%	Moderate Problem-Solving Skills
75% - 79%	0	0%	Low Problem-Solving Skills
74% and below	0	0%	Very Low Problem-Solving Skills
Mean = 53.03 (High Problem-Solving Skills)			

As revealed in Table 3, 26 or 41.2% of the students obtained scores that can be interpreted as very high problem-solving skills. Twelve (12) or 19.1% of the students belonged to the high problem-solving skills and 25 or 39.7% of the students with scores that can be interpreted as moderate problem-solving skills. The mean score of their post-test was 53.03 equivalent to an MPS of 88.39 interpreted as high problem-solving skills. These findings mean that students who were exposed to VMT retained their high problem-solving skills two weeks after the posttest was given to them. It is noteworthy to mention that the mean score in the retention test was higher than the post-test indicating VMT's potential to enhance students' retention.

As indicated, students were able to retain what they had learned after exposure to VMT. Figure 5 illustrates that even after one week of the conduct of the post-test, students were able to remember the rules in VMT. The student's used Rule 5 which states that if the sum of denominators on the left-hand side and the sum of denominators on the right-hand side are the same then the sum/total should be equated to zero to get the solution

$$\begin{aligned}
 & 3) \frac{1}{x-8} + \frac{1}{x-9} = \frac{1}{x-7} + \frac{1}{x-10} \\
 & \text{LHS } (x-8) + (x-9) = 2x - 17 \\
 & \text{RHS } (x-7) + (x-10) = 2x - 17 \\
 & 2x + 17 = 0 \\
 & 2x + 17 - 17 = 0 - 17 \\
 & \frac{2x}{2} = \frac{-17}{2} \\
 & x = \frac{-17}{2}
 \end{aligned}$$

$$\begin{aligned}
 & 1) \frac{2}{2x+1} + \frac{3}{3x+2} = \frac{1}{x+1} + \frac{6}{6x+1} \\
 & \text{LHS} \quad \quad \quad \text{RHS} \\
 & 2(3x+2) = 6x+4 \quad 1(6x+1) = 6x+1 \\
 & 3(2x+1) = 6x+3 \quad 6(x+1) = 6x+6 \\
 & \quad \quad \quad 12x+7 \quad \quad \quad 12x+7 \\
 & 12x+7 = 0 \\
 & \frac{12x}{12} = \frac{-7}{12} \\
 & x = \frac{-7}{12}
 \end{aligned}$$

**Figure 5. Sample outputs of students in the retention test**

Moreover, Interviewee 5 was able to recognize that knowing VMT is a big help. Though he/she knew that it cannot be used in all topics, however, it can be applied to specific lessons, which helped save time. Interviewee 6 agreed with what was explained by Interviewee 5. In fact, Interviewee 6 liked VMT because the long process was shortened and became easier. It was indeed a useful technique, Interviewee 6 continued. Below are their interview transcripts:

*“Para sa ako maam, knowing vedic math is a big help for me. Dili man namo siya magamit sa tanan topics maam pero atleast naa siyay gamit sa other lessons. Same sa uban maam, ang pagsave jud sa time ang benefits namo Maka save na gani ug time, ma solve pa namo ang uban item kay naa naman mi time.” (Knowing Vedic Mathematics Technique is a big help for me. Though we can't use it for all math lessons, there are some lessons where we can use it. It benefits us by saving enough time to finish all the items given to us.)*

-Interviewee 5

*“Ganahan ko sa idea sa vedic math kay instead nga muagi mi sa taas nga process, dili na kay naa may mas dali. Useful jud siya nga technique for me.” (I like the idea of the Vedic Mathematics Technique because we can solve the problem without doing the tedious process. Indeed, it is useful for me.)*

-Interviewee 6

In support of this claim, the findings of two (2) studies revealed that the performance of the students improved in their retention tests [34, 35]. On the other hand, it contradicts the results of another study that during the retention test, students performed comparably in their posttest [36].

**3.2 Students' Motivation towards Mathematics**

The importance of student motivation is reflected in the realm of mathematics education which treats motivation as a desirable outcome and a means to enhance understanding [37].

The study started by identifying the students' level of motivation toward mathematics. This was done through the Mathematics Motivation Scale adapted from the study of [38]. The scale consists of twenty-nine (29) statements. It is a 29-item Likert scale with items answered on a five-point scale- from strongly agree to strongly disagree. The positive items received the score based on points 5 – Strongly Agree, 4 – Agree, 3 – Normal, 2 – Disagree, and 1 – Strongly Disagree while the negative items were reversely scored such that 1 – Strongly Agree, 2 – Agree, 3 – Normal, 4 – Disagree, and 5 – Strongly Disagree. Each item's interpretation was done by obtaining each mean score.

Students' Motivation towards Mathematics before the Intervention

As shown in the table, out of twenty-nine (29) mathematics motivation statements, the students rated seven (7) statements as “strongly agree” interpreted as “very highly motivated”, ten (10) statements as “Agree” interpreted as “highly

motivated”, eight (8) statements as “normal” interpreted as “moderately motivated” and four (4) statement as “disagree” interpreted as “low motivated”.

The above findings imply that students' biggest wish is to understand the content of the learning material used in the math class. They wanted to get the best grades in math class. The skills they learn from math class can be applied in other classes. They feel that the learning materials used in math class are useful. If they study hard enough, they can understand the content of the learning materials used in math class. If they pay full attention in math class, they can get better grades. If they have enough time to practice math, they will have better performance.

Also, a highly motivated student says that in math class, they would like to have some challenging materials that will make them learn more. They would like to have curiosity-initials materials in math class even if they are quite difficult. Learning math can improve their thinking and logic. They hope they can get higher grades in math than any other classmates. They want to get higher scores in math class because they want to demonstrate their capability to their classmates. The skills they learn from the math class can be applied in other classes. They like every topic and content in math class. What they learn in math class can be applied in their daily life. If they have the correct learning pattern to learn math, they will learn better in the class. they believe that they will have excellent math grades in math class.

In addition, moderately motivated students tell that their best wish is to attend an ideal university via learning math. They want to get other people's recognition so they want higher scores in math class. They believe that they can understand the most difficult part of the math materials on their own. They believe that they can master every topic in math class. As for math, they are competent to teach other their classmates. In taking math exams, they will have a negative thought that they are inferior to their other classmates. In taking math exams, they are totally blank and cannot remember what they have learned before. Before taking a math exam, they are too wary to take a good sleep.

And lastly, low motivated students apprise that Math is not difficult for them. In taking math exams, they would think about the consequence of failure in the exam. In taking the exam, they feel nervous and worried and their heart beat faster.

Based on the results, it can be affirmed that even before the intervention, students' motivation toward mathematics varies from moderately to very highly motivated. Students were motivated in solving problems because their past lessons were excellently taught to them. Hence, students find the technique interesting.

As shown in the table, out of twenty-nine (29) mathematics motivation statements, the students rated seven (7) statements as “strongly agree” interpreted as “very highly motivated”, ten (10) statements as “Agree” interpreted as “highly motivated”, eight (8) statements as “normal” interpreted as “moderately motivated” and four (4) statement as “disagree” interpreted as “low motivated”.

The above findings imply that students' biggest wish is to understand the content of the learning material used in the math class. They wanted to get the best grades in math class.

The skills they learn from math class can be applied in other classes. They feel that the learning materials used in math class are useful. If they study hard enough, they can

**Table 4. Students' motivation toward Mathematics before intervention**

Indicators	Mean	Qualitative Description
My biggest wish is to understand the content of the learning material used in the math class.	4.63	Very Highly Motivated
My most wanting is to get the best grades in math class.	4.59	Very Highly Motivated
If I pay full attention in math class, I can get better grades.	4.48	Very Highly Motivated
If I study hard enough, I can understand the content of the learning materials used in math class.	4.45	Very Highly Motivated
If I have enough time to practice in math, I will have better performance.	4.35	Very Highly Motivated
The skills I learned from the math class can be applied in other classes.	4.25	Very Highly Motivated
I feel the learning materials used in math class are useful	4.24	Very Highly Motivated
If I have the correct learning pattern to learn math, I will learn better in class.	4.18	Highly Motivated
Learning math can improve my thinking and logic.	4.17	Highly Motivated
The skills I learned from the math class can be applied in other classes..	4.04	Highly Motivated
What I learn in the math class can be applied in my daily life	3.82	Highly Motivated
I hope I can get a higher grade in math than any other classmates.	3.67	Highly Motivated
I believe that I will have excellent math grades in math class.	3.60	Highly Motivated
I would like to have curiosity-initials materials in math class even if they are quite difficult.	3.57	Highly Motivated
In math class, I would like to have some challenging materials that will make me learn more.	3.42	Highly Motivated
I like every topic and content in math class.	3.40	Highly Motivated
My best wish is to attend an ideal university by learning math.	3.39	Moderately Motivated
I want to get higher scores in math class because I want to demonstrate my capability to my classmates.	3.36	Moderately Motivated
I want to get other people's recognition so I want higher scores in math class.	3.24	Moderately Motivated
I believe that I can master every topic in math class.	3.23	Moderately Motivated
In taking math exams, I will have a negative thought that I am inferior to other classmates.*	3.19	Moderately Motivated
As for math, I am competent to teach other my classmates.	3.18	Moderately Motivated
In taking math exams, I am totally blank and cannot remember what I have learned before.*	2.99	Moderately Motivated
I believe that I can understand the most difficult part of the math materials on my own.	2.95	Moderately Motivated
Before taking a math exam, I am too wary to take a good sleep.*	2.86	Moderately Motivated
Math is not difficult for me.	2.54	Low Motivated
In taking a math exam, I would think about the consequence of failure in the exam.*	2.49	Low Motivated
In taking the math exam, my heart beat faster.*	2.31	Low Motivated
In taking the exam, I feel nervous and worried.*	2.22	Low Motivated
<b>Overall Mean</b>	<b>3.54</b>	<b>Highly Motivated</b>

\* negative indicators (scoring is reversed)

Legend:

Scale	Range	Descriptive Rating	Qualitative Interpretation
5	4.20-5.00	Strongly Agree	Very Highly Motivated
4	3.40-4.19	Agree	Highly Motivated
3	2.60-3.39	Undecided	Moderately Motivated
2	1.80-2.59	Disagree	Low Motivated
1	1.00-1.79	Strongly disagree	Very Low Motivated

understand the content of the learning materials used in math class. If they pay full attention in math class, they can get better grades. If they have enough time to practice math, they will have better performance.

Also, a highly motivated student says that in math class, they would like to have some challenging materials that will make them learn more. They would like to have curiosity-initials materials in math class even if they are quite difficult. Learning math can improve their thinking and logic. They hope they can get higher grades in math than any other classmates. They want to get higher scores in math class because they want to demonstrate their capability to their classmates. The skills they learn from the math class can be applied in other classes. They like every topic and content in math class. What they learn in math class can be applied in their daily life. If they have the correct learning pattern to learn math, they will learn better in the class. they believe that they will have excellent math grades in math class.

In addition, moderately motivated students tell that their best wish is to attend an ideal university via learning math. They want to get other people's recognition so they want higher scores in math class. They believe that they can understand the most difficult part of the math materials on their own. They believe that they can master every topic in math class. As for math, they are competent to teach other their classmates. In taking math exams, they will have a negative thought that they are inferior to their other classmates. In taking math exams, they are totally blank and cannot remember what they have learned before. Before taking a math exam, they are too wary to take a good sleep.

And lastly, low motivated students apprise that Math is not difficult for them. In taking math exams, they would think about the consequence of failure in the exam. In taking the exam, they feel nervous and worried and their heart beat faster.

Based on the results, it can be affirmed that even before the intervention, students' motivation toward mathematics varies from moderately to very highly motivated. Students were motivated in solving problems because their past lessons were excellently taught to them. Hence, students find the technique interesting. The following are the students' transcripts.

*“Before pa atong klase maam, motivated na ko daan tungod kay ganahan ko sa lessons. After sa klase nato maam, I can say nga motivated japun ko kay na amaze ko sa idea sa vedic math.” (Before our class, I am motivated because I like he lessons. Even after our class, I can say that I am still motivated because I am amaze by the idea of Vedic Mathematics Technique.)*

*-Interviewee 2*

*“To be honest maam I rate nako akong self kay mga 2.9 kay im not really interested in mathematics kay bisag unsaon nakog pagpaminaw kay di jud nako masabtan ang formula and then as time goes by little by little narealize nako maam nga ang mathematics kung makasabot lang ka kay enjoyable man diay unya*

*murag ma visualize na sa imong mind. I rate myself mga 4.6 maam because murag ma understand kay ma visualize na nako.” (I rate my motivation as 2.9 because I’m not really interested in Mathematics but as time goes by I was able to realize that Mathematics can be enjoyed and can be visualized. Thus, I rate my motivation this time as 4.6 because I was able to understand it.)*

*-Interviewee 5*

This claim corroborates the study which found that students had a strong motivation to act in specific ways in order to achieve and that they had the potential to learn even if they had no prior knowledge [39]. Hence, students that are motivated were willing to involve in some task given. Also, it was revealed that the students' willingness and desire to participate contribute to the success of the learning process [40].

Students’ Motivation towards Mathematics after the Intervention

Table 5 reveals the level of motivation of the students after the intervention. It is also shown in the table the weighted mean per motivation statement, qualitative description, and interpretation.

**Table 5. Students’ engagement in Mathematics after intervention**

Indicators	Mean	Qualitative Description
My biggest wish is to understand the content of the learning material used in the math class.	4.66	Very Highly Motivated
My most wanting is to get best grades in math class.	4.57	Very Highly Motivated
If I pay full attention in math class, I can get better grades.	4.48	Very Highly Motivated
If I study hard enough, I can understand the content of the learning materials used in math class.	4.43	Very Highly Motivated
If I have enough time to practice math, I will have a better performance.	4.42	Very Highly Motivated
The skills I learned from the math class can be applied in other classes.	4.33	Very Highly Motivated
I feel the learning materials used in math class are useful	4.31	Very Highly Motivated
The skills I learned from the math class can be applied in other classes.	4.30	Very Highly Motivated
I hope I can get a higher grade in math than any other classmates	4.25	Very Highly Motivated
Learning math can improve my thinking logic.	4.24	Very Highly Motivated
If I have the correct learning pattern to learn math, I will learn better in class.	4.22	Very Highly Motivated
In math class, I would like to have some challenging materials that will make me learn more.	4.21	Very Highly Motivated
Before taking a math exam, I am too wary to take a good sleep.*	4.06	Highly Motivated
In taking a math exam, I would think about the consequence of failure in the exam.*	4.01	Highly Motivated
In taking the math exam, my heart beat faster.*	3.99	Highly Motivated
In taking the exam, I feel nervous and worried.*	3.96	Highly Motivated
What I learned in the math class can be applied in my daily life.	3.91	Highly Motivated
I want to get higher scores in math class because I want to demonstrate my capability to my classmates.	3.90	Highly Motivated
In taking math exams, I will have a negative thought that I am inferior to other classmates.*	3.90	Highly Motivated
My best wish is to attend an ideal university by learning math.	3.82	Highly Motivated
I would like to have curiosity-initials materials in math class even if they are quite difficult.	3.75	Highly Motivated

I want to get other people’s recognition so I want higher scores in math class.	3.75	Highly Motivated
In taking math exams, I am totally blank and cannot remember what I have learned before.*	3.73	Highly Motivated
I believe that I will have excellent math grades in math class.	3.70	Highly Motivated
I like every topic and content in math class.	3.55	Highly Motivated
As for math, I am competent to teach other my classmates.	3.55	Highly Motivated
Math is not difficult to me.	3.55	Highly Motivated
I believe that I can understand the most difficult part in the math materials by my own.	3.52	Highly Motivated
I believe that I can master every topic in math class.	3.46	Highly Motivated
<b>Overall Mean</b>	<b>4.02</b>	<b>Highly Motivated</b>

\* negative indicators (scoring is reversed)

Legend:

Scale	Range	Descriptive Rating	Qualitative Interpretation
5	4.20-5.00	Strongly Agree	Very Highly Motivated
4	3.40-4.19	Agree	Highly Motivated
3	2.60-3.39	Undecided	Moderately Motivated
2	1.80-2.59	Disagree	Low Motivated
1	1.00-1.79	Strongly disagree	Very Low Motivated

As shown in the table, out of twenty-nine (29) mathematics motivation statements, the students rated twelve (12) statements as “strongly agree” interpreted as “very highly motivated”, and seventeen (17) statements as “Agree” interpreted as “highly motivated”.

As a result, it can be concluded that in math class, they would like to have some challenging materials that will make them learn more. Their biggest wish is to understand the content of the learning material used in the math class. Learning math can improve their thinking and logic. They wanted to get the best grades in math class. The skills they learn from the math class can be applied in other classes. They hope they can get a higher grade in math than any other classmates. The skills they learn from math class can be applied in other classes. They feel that the learning materials used in math class are useful. If they have the correct learning pattern to learn math, they will learn better in the class. If they study hard enough, they can understand the content of the learning materials used in math class. If they pay full attention in math class, they can get better grades. If they have enough time to practice math, they will have better performance.

Also, a highly motivated student says that they would like to have curiosity-initials materials in math class even if they are quite difficult. They want to get higher scores in math class because they want to demonstrate their capability to their classmates. Their best wish is to attend an ideal university by learning math. They want to get other people's recognition so they want higher scores in math class. They like every topic and content in math class. What they learn in math class can be applied in my daily life. They believe that they will have excellent math grades in math class. They believe that they can understand the most difficult part of the math materials on their own. They believe that they can master every topic in math class. As for math, they are competent to teach other my classmates. Math is not difficult for them. In taking math exams, they will have a negative thought that they are inferior to other classmates. In taking math exams, they would think about the consequence of failure in the exam. In taking the exam, they feel nervous and worried; their heart beats faster,

and they are totally blank and cannot remember what they have learned before. Meanwhile, before taking a math exam, they are too wary to take a good sleep.

Based on the results, it is observed that after the intervention, students' motivation toward mathematics was affected by the technique used. The overall mean was 4.02 indicating that students were highly motivated. This implies that the student's motivation toward mathematics increases because of the technique that was introduced to them. In addition, they were thrilled every time they are given tasks to do that can be solved using such a technique. The following are the students' transcripts.

*“Before maam, katong wala paka nag klase akong motivation jud is naa ra sa 3 out of 5 maam kay galibog jud ko then dili jud ko ganahan mag tan-aw ug mga equations nga dugay mahuman kanang tedious process kay mubo kaayo akong patience maam. So 3 out of 5 akong motivation maam back then. But after the class maam, I can say nga nag taas jud akong motivation maam kay gitun-an jud nako tong vedic math maam. So it is very helpful and not time-consuming. So I rate myself as 5. I am very motivated na po.” (Before the class starts, my motivation is 3 out of 5 because I don't like to look at the equations that require a tedious process just to solve them. But after the class, I can say that my motivation was boosted because I really find time to learn it. It's very helpful and not time-consuming. Thus, I rate myself as 5. I am now motivated.)*

-Interviewee 1

*Na motivate ko maam kay na gets nako ang lesson maam.” (I am motivated because I understand the lesson.)*

-Interviewee 3

This result is in accordance with the study stating that students' motivation in mathematics is a significant tool to support the continuity of their learning [41]. Students' motivation toward the subject became a factor in solving a problem. Also. Another study revealed that increased motivation is linked to the importance of the task and how it can be completed [42]. This suggests that their motivation aids in the learning of problem-solving techniques.

The paired t-test between the pretest and post-test scores of Students' Problem-Solving Skills when exposed to Vedic Mathematics Technique

Table 6 presents the paired t-test of the pretest and posttest scores of the intervention. As presented in the table, for 63 students, the mean score was 30.87 with a standard deviation of 14.300. Also, the t-value is -12.166 with a probability value of 0.000 (p<0.05), indicating a highly significant difference. Thus, the null hypothesis, which states that there is no significant difference in the students' problem-solving skills in terms of pretest-posttest when exposed to VMT is rejected. This implies that the students enhanced their problem-solving skills after exposure to VMT. Consequently, VMT shows remarkable improvement in students' problem-solving skills and that students were able to familiarize the content even after class.

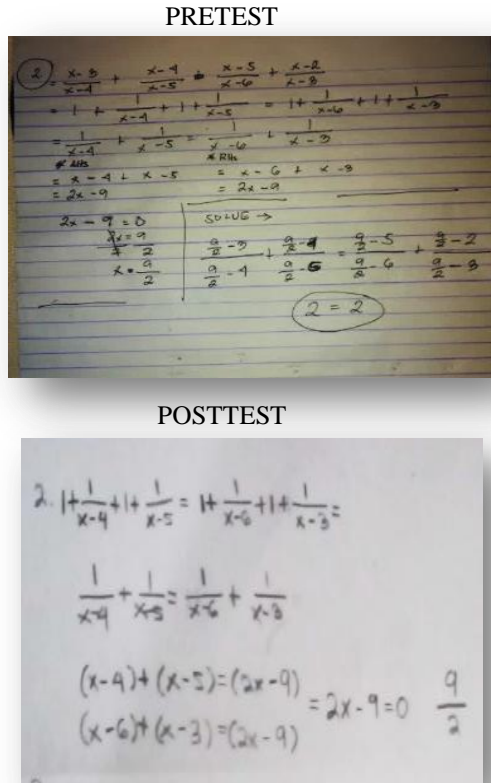


**Table 6. Comparison of students' problem-solving skills between pretest and posttest**

Group	N	Mean	SD	t-value	Sig.	
Problem Solving Skills	Pretest	63	30.87	14.300	-12.166	0.000**
	Posttest	63	52.81	2.375		

\*\*p-value highly significant at 0.05 level

Sample outputs of selected student further elaborate that he/she was able to apply the technique learned from their teachers as seen in Figure 6 below. It can be observed that the pretest solution was long while the posttest solution was shorter.



**Figure 6. Sample outputs of the student (pretest versus posttest)**

Interviewee 4 learned a lot from the technique. Benefits of learning VMT include time-saving, and enjoyment during class while solving mathematical tasks. This is exposed in the transcript below:

*“Naa jud koy natun-an maam. Ang benefits jud sa pagkabalo namog vedic math maam kay ang maka save ug time sa pag solve ug problem. Na enjoy jud nako ang klase maam” (I learned something in our class. The benefits of knowing Vedic Mathematics Technique is that I can save time in solving problems. I really enjoy our class.)*

-Interviewee 4

Students performing better in the posttest can be attributed to VMT. This finding is supported by a study asserting that students were able to perform the problem given to them [43]. Similarly, a study revealed that Vedic mathematics techniques improve the speed of calculations while solving

some basic mathematical problems resulting in the improvement of students' scores [44]. This is also parallel to the study where findings revealed that a significant difference existed in the students' problem-solving skills from pretest to posttest [34].

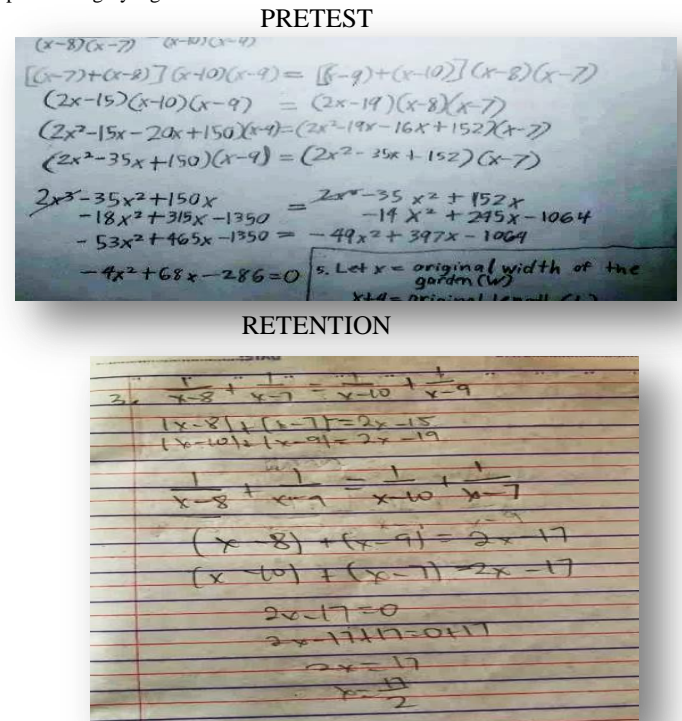
The paired t-test between the pretest and retention test scores of Students' Problem-Solving Skills

Table 7 displays the result of the paired t-test of the pretest and retention test scores of students' problem-solving skills when exposed to Vedic Mathematics Technique.

**Table 7. Comparison of students' problem-solving skills between pretest and retention test**

Group	N	Mean	SD	t-value	Sig.	
Problem Solving Skills	Pretest	63	30.87	14.300	-12.542	0.000**
	Retention	63	53.03	3.032		

\*\*p-value highly significant at 0.05 level



**Figure 7. Sample output of students (pretest versus retention test).**

As shown in the table, the t-value is 18.862 with a probability Table 7 displays the paired t-test of the pretest and retention test scores of the intervention. As shown, the pretests mean score of the students was 30.87 with a standard deviation of 14.300 while the retention means the score was 53.03 with a standard deviation of 3.032. Moreover, the resulting t-value is 2.542 with a probability value of 0.000 (p<0.05), indicating the effectiveness of exposing students to VMT in improving students' retention in mathematics.

The findings imply that the students could retain the concepts they learned from the teachers using VMT. They were still able to apply the techniques in solving. More so, the increase in the mean with a lower standard deviation in the retention test suggests that students' knowledge slightly improves after the posttest. Their scores were now closer to each other

around the mean. This is a remarkable finding that highlighted VMT’s effectiveness in enhancing students’ problem-solving skills in terms of retention scores. Figure 7 and the interview transcript of Interviewee 3 illustrate the above results.

*“Actually maam, ganahan kaayo ko sa vedic math pero all in all ganahan kaayo ko sa iyahang way of solving.” (I really like Vedic Mathematics Technique nevertheless, I really like its way of solving problems.)*

-Interviewee 3

This result is in accordance with the study where they revealed that applying intervention with the scientific approach enhances students’ learning [37]. Also, it was discovered that there is a significant difference in the students’ problem-solving skills between pretest and retention tests [34].

The paired t-test between the pretest and post-test scores of students’ motivation towards Mathematics when exposed to Vedic Mathematics Technique

Table 8 presents the comparison of the pretest and post-test scores of students’ engagement in mathematics when exposed to contextualized instruction. The mean score before the intervention is 3.96 and the mean score after the intervention is 4.21. The t-value is 4.66 with a probability value of 0.000 ( $p < 0.05$ ) indicating a significant difference between the pretest and post-test scores on students’ engagement in mathematics when exposed to CI. Hence, the null hypothesis stating "there is no significant difference between the pretest and posttest on students’ engagement in mathematics when exposed to CI" is rejected.

**Table 8. Comparison of students’ problem-solving skills between pretest and post-test**

Group		N	Mean	SD	t-value	Sig.
Motivation	Before	67	3.52	0.4188	-7.557	0.000**
	After	67	4.01	0.3969		

\*\*p-value highly significant at 0.05 level

As shown in Table 8, the t-value is -7.557 with the probability value of 0.000 ( $p < 0.05$ ) which indicates a significant difference between pretest and posttest on students’ motivation in Mathematics when exposed to the Vedic Mathematics Technique. Thus, the null hypothesis stating that there is no significant difference between the pretest and posttest on students’ motivation towards Mathematics when exposed to VMT is rejected.

*“At first maam, naa ra sa 4 out of 5 akong motivation maam kay di man ko familiar sa technique maam. Kato nang ga discuss naka maam, naganahan naman ko sa idea sa vedic math maam. Naganahan nakog solve ug problems. This time ma rate nako akong motivation as 5 na maam.” (At first, I can rate my motivation as 4 out of 5 because I’m not familiar with the technique. After the class, my motivation becomes 5 out of 5 because I like the idea of the Vedic Mathematics Technique and I started to like problem-solving.)*

- Interviewee 4

*“Sa sugod maam, medyo dili jud ko motivated kay ga struggle jud ko, samot na sa learning materials maam, pero kung ma discuss na maam kay mutaas jud akong motivation kay kabalo naman ko maam.” (I was a little bit demotivated because I really struggle with the subject, especially when it comes to the learning materials. However, when the learning materials are discussed, then I’ll be motivated because I know the lessons already.)*

-Interviewee 6

The results support the study where they revealed that there is a significant difference in students’ motivation toward Mathematics when exposed to an intervention [45]. It is always believed that the student’s motivation and learning strategies play crucial roles in their learning [41]. Motivation and learning strategies are of interest to educational psychologists and researchers nowadays.

**4. CONCLUSIONS AND RECOMMENDATIONS**

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

The problem-solving skills of the students in the pretest is low. However, as the students were exposed to VMT, their post-test and retention test results becomes high. This infers that the Vedic Mathematics Technique has implicitly enriched the problem-solving skills of the students.

The motivation of the students towards mathematics before the intervention shows as highly motivated. Likewise, students’ motivation toward mathematics after the intervention results in being highly motivated. Consequently, students during the pretest and posttest were highly motivated.

There is a significant difference in the pretest-posttest and pretest-retention tests of the students in terms of their problem-solving skills. However, no significant difference was obtained between the posttest and retention test. Therefore, VMT influences the increase in students’ problem-solving skills from pretest to posttest and pretest to retention test.

There is a significant difference between the pretest and posttest on students’ motivation toward Mathematics when exposed to Vedic Mathematics Technique. Hence, it indicates that the intervention used enhanced their motivation toward mathematics.

**5. CONCLUSIONS AND RECOMMENDATIONS**

Based on the summary, findings, and conclusions of the study, the following recommendations are given:

Nowadays, problem-solving focuses on a defined procedure for completing a certain task. Solving mathematics problems using different techniques is also a trend nowadays. This could be a useful skill to teach to the students. As a result, mathematics teachers will be challenged to be more creative in their teaching and to think about different techniques that can be used to solve such problems, as well as ways to relate mathematical problems to students’ everyday lives.

To the school administrators, it is proposed to conduct training and seminars for teachers about techniques that can help improve the mathematical skills of the students. To the

teachers, the intervention used in this study will help eradicate students' fear of the subjects. Hence, teachers are urged to integrate it into their lessons.

To address the problem-solving skills of the students, the researcher suggests using the VMT as another way to solve problems. In this study, it was utilized in the lessons of Grade 7 students. However, it is suggested to integrate it into some lessons at the higher level, especially lessons that involve arithmetic. In addition, more research about the integration of Vedic Mathematics Technique in the classroom setting is recommended which seeks the effects on other factors such as engagement, attitude, and academic performance.

As per students' motivation, it is recommended for teachers to integrate various Vedic Math techniques during their topic discussion since it can help elicit positive reactions from students. Moreover, in the execution of the Vedic Mathematics technique, it is recommended to do it face-to-face since in this study, the VMT was integrated into the virtual setting.

In terms of future research, it is proposed that the study be conducted over a longer period of time in order to fully grasp the influence of the Vedic Mathematics Technique's integration. Extending the time can also be used to see how well students remember the Vedic Math Technique approaches for solving problems. Also, it is suggested to use a quasi-experimental research design in a face-to-face environment to see the effects of VMT in two different groups of students with regard to their problem-solving skills and motivation toward mathematics.

#### ACKNOWLEDGMENT:

The researchers would like to extend their deepest gratitude to Central Mindanao University headed by Dr. Jesus Antonio G. Derije, the University President, and the Department of Science and Technology – Science Education Institute (DOST-SEI) led by Dr. Jossette T. Biyo, the Director, for the scholarship grant.

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