



Virtual Manipulative: Its Effects as an Instructional Tool in Teaching Mathematics

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Abstract— The purpose of this study is to determine the effectiveness before and after use of the Virtual Manipulative (VM) as an instructional tool in teaching Mathematics conducted to the two (2) public high schools from Caloocan Division, namely: Kalayaan National High School and Manuel L. Quezon High School, during the SY 2019-2020. The lesson was Area and Perimeter: Square and Rectangle. The pre-test and the post-test were measured by the Teacher-Made Assessment (TMA). The researcher used the 'Math Manipulative' application on mobile during the intervention. The respondents who participated in this research were 97 respondents from Kalayaan National High School and 102 respondents from Manuel L. Quezon of Caloocan Division.

It was found out that the pre-test of Teacher-Made Assessment of the students before the use of Virtual Manipulative is on a beginning stage in competencies. The 'Math Manipulative' application on mobile administered as an intervention consists of different characters and grids that can manipulate to find the answer. The post-test of Teacher-Made Assessment of the students after the use of Virtual Manipulative is on approaching proficiency stage in competencies. Significant difference exists in the pre-test and post-test after the administration of the Virtual Manipulative.

The researcher recommends the use of this Virtual Manipulative as an instructional tool in teaching Mathematics to improve the students' critical thinking skills in learning with more interactive and for the enhancement of their conceptual understanding that were found to have a significant difference exists in the pre-test and post-test after the administration of the Virtual Manipulative.

Keywords— Quasi-Experimental Method, Struggling Students, Teacher-Made Assessment, Virtual Manipulative.

I. INTRODUCTION

Mathematics is the science that deals with the logic of shapes, its quantity, and arrangement. Mathematics is all around us, in everything we do. It is the building block for everything in our daily lives, including architecture, art, money, engineering, sports, and even in technology and mobile devices. According to the Trinity Fammar School (2019), when one learns a Mathematics, he/she strengthens his/her analytical skills, better understanding of the world, exercises his/her brain, it builds the problem-solving skills, stimulates creativity, and facilitates improvements to technology. Of all the benefits of being good at Mathematics, the most current benefit is with the use of the technology.

Based on the research of Ponce (2018), one of the newest forms of educational instructions is technology. Technology improves time by time because of the influence of high-tech equipment that helps the internet to access our home and classrooms nationwide.



One of the beneficiaries of the improving technology are the students because it helps them to be more interested and develop their understanding and especially in Mathematics. Also, the teacher should have a regular access and knowledge about our growing technology because they are the one who guide the students in terms of sense-making, reasoning, problem solving, and communication. Therefore, the teacher should use technology strategically to provide great access and high quality to teach Mathematics in a nice, simple, and interesting way (*National Council of Teachers of Mathematics [NCTM], 2019*).

In 2017, according to Abdullah in his study about virtual manipulatives, he found out that the virtual manipulatives will give an advantage to the students/learners with more interest in virtual learning. The students will enjoy learning through manipulatives. Physical manipulative will facilitate learning among students with more interest in concrete objects.

Virtual Manipulatives are more interactive, technology-enabled visual representation of a dynamic mathematical object, including all the programmable features that allow it to be manipulated. The students will give an opportunity to construct Mathematical knowledge and, they will improve their critical thinking (*Moyer-Packenham and Bolyard, 2016*).

Students who are having a difficulty in learning was advocated to utilize and make use of the virtual models (*e.g., Shin and D.P. Bryant, 2015*) due to their prospective in helping students to much keep up with the explanation and connection of fragment through apposite diagrams. Through technology, students can approach virtual manipulatives on adaptable gadgets such as iPads in inclusion to internet-based computer implementation.

The capacity to allow the planned features to modify educational request, scaffold Mathematical content, and to rise the amount of training chance, all of which can be absorbed into sharpened directions for students with Learning Disability (*B.R. Bryant et al., 2016*).

In Crompton and Burke's (*2015*) study of mobile learning Mathematics manifest that there is an increasing attentiveness in mobile technology advantage with 75% of 48 studies described useful learning results. Similarly, in Fabian et al. (*2016*) analysing of mobile learning inspection in Mathematics, 77% of 31 studies describe that mobile technologies surpass students' achievements. While overall, mobile learning studies in Mathematics have shown a positive effect (*Sung et al., 2016*), the nature of the intervention and the study design affects the success or failure of mobile learning interventions.

Technology offers a variety of tools that enhance the learning of mathematics concepts by expanding representational possibilities and amplifying and reorganizing students' approaches to problem solving (*Pea, 1985*). For example, Virtual Manipulatives and gaming applications available on a variety of platforms (*e.g., calculators, personal computers, tablets*) have the potential to significantly influence the depth to which students understand important mathematics concepts (*Manches. O'Malley, & Benford, 2010*). Due to a variety of factors,

implementation of technologies in education settings tends to lag the pace at which the technologies are developed (Elstad, 2016). The need to advance technology applications in education by focusing on how the technologies are used in the classroom, and not just on identifying what technologies are available presents a critical issue in mathematics education (Mishra & Koehler, 2006).

II. EXPERIMENTAL METHODS

This study is a Quantitative Research Paradigm. Quantitative research quantifies variables and solves problems using numeric assessment. The process the researcher uses to know that truth is quantitative in nature, this is epistemology. The methodology adopted by quantitative research is mostly experimental with focus on hypothesis testing.

This study will use the Quasi-Experimental Method. Since quasi-experimental designs are used when randomization is impractical and/or unethical, they are typically easier to set up than true experimental designs, which require random assignment of subjects. Additionally, utilizing quasi-experimental designs minimizes threats to ecological validity as natural environments do not suffer the same problems of artificiality as compared to a well-controlled laboratory setting. Since quasi-experiments are natural experiments, findings in one may be applied to other subjects and settings, allowing for some generalizations to be made about population. Also, this experimentation method is efficient in longitudinal research that involves longer time periods which can be followed up in different environments.

Other advantages of quasi experiments include the idea of having any manipulations the experimenter so chooses. In natural experiments, the researchers have to let manipulations occur on their own and have no control over them whatsoever. Also, using self-selected groups in quasi experiments also takes away to chance of ethical, conditional, etc. concerns while conducting the study.

This study will use cluster sampling and will be held at two (2) public high schools in Division of Caloocan, namely: Manuel L. Quezon High School and Kalayaan National High School during the SY 2019-2020 and will select three (3) sections in each school who's having a thirty (30) or above class size among the Grade 7 with a thousand (1000) population on the said public high schools and the said grade level. The researcher will use only the struggling learners' intervention which the sum of their score in the TMA is seventeen (17) out of forty (40) or below based on their pre- and post-test to test the significant differences. to test the significant differences.

In data gathering, the researcher will undergo several steps to accomplish the study. These steps are as follows:

- 1. Creating of the teacher-made assessment.** The researcher will create the teacher-made assessment to collect the students' thoughts and perception using Likert Scale about the effects of the Virtual Manipulatives as an instructional tool in teaching Mathematics. The teacher-made assessment to be formulated are open-ended questions for the details not to be stifled.
- 2. Reliability Testing.** The researcher will conduct a pilot-testing to ensure the reliability of the Teacher-Made Assessment and will use the Cronbach's Alpha to measure the results' internal consistency, that is, how closely related a set of items are as a group.

3. **Validity Testing.** The researcher will conduct the validity testing to the experts of the field of different schools since this is the most important criteria for the quality of a test.
4. **Asking Permission to Conduct Study.** The researcher will ask permission to the Division Office of Caloocan City, to the principal in each school and to the teacher who is currently holding Geometry class to conduct the study.
5. **Retrieval of the Test-Questions.** The answered teacher-made assessment will be retrieved after the testing and the data collected will be classified, analysed, and interpreted.

The respondents of this study will be the two (2) Grade 7 sections of participating teacher on each two (2) participating public high schools of Division of Caloocan, namely: Kalayaan National High School and Manuel L. Quezon High School. The researcher will use only the struggling learners' intervention which the sum of their score in the TMA is seventeen (17) out of forty (40) or below based on their pre- and post-test to test the significant differences. The researcher of the study wanted to know the effects of the Virtual Manipulative as an instructional tool in teaching Mathematics. The participating teacher's participating classes, regardless of race, sex, age, and ethnicity, will be chosen as the respondents of the study.

The teacher-made assessment is a multiple-choice type of test. The teacher-made assessment materials are two (2) different set of questions based on the topic: Area and Perimeter of: Square and Rectangle (*refer to Appendix B*), which are reliability and validity tested (*refer to Appendix F*). Followed by 20 test items on each topic by which the respondents will be answered. All the said two (2) different set of questions has its Table of Specifications (TOS) (*refer to Appendix C*). With the use technology, the researcher will be utilized the offline "Math Manipulatives" application on mobile. During the conduct testing, the researcher will instruct the respondents about the instructions of the questions. In the process of the activity, the researcher neither will facilitate by providing clarifications when students have a confusion on the instructions but will not assist the respondents in answering the questions nor provide explanations about the topic. Understanding the topic was taught before the use of the Virtual Manipulative. The answer sheet/s will collect and check. The results will record and analyse.

Quasi-Experimental Method will be used to analyse the data from the survey questionnaire.

To determine the evaluation and the problem encountered by the respondents, questionnaires are examined through Quasi-Experimental Method such as paired sample t-test.

The five-point Likert Scale with boundaries was adapted from the study conducted by Aguilar (2018) and will be used as a guide for data interpretation.

Paired Two Sample T-test. Is to determine whether there is statistical evidence that the means difference between paired observations on a particular outcome is significantly different from zero (*Kent State University, 2020*).

III. RESULTS AND DISCUSSION

The findings of the researcher arrived to:



Problem 1. The learners' performance before the use of Virtual Manipulative as an instructional tool in teaching Mathematics in:

1. Square and Rectangle: Area and Perimeter.

1.1 Kalayaan National High School. It was found that the data show of the pre-test of the non-struggling learners at Kalayaan National High School has a 30 or 30.73 percent of the learners who are categorized as good learners with scores ranging from 18-25, followed immediately by 1 or 1.03 percent who are labelled as very good learners based on their scores ranging from 26-33, and there is 0 or 0 percent were categorized as excellent students with score ranging from 34 and above. Also, findings reveal that the pre-test of the struggling learners at Kalayaan National High School has a 57 or 58.76 percent of the learners who are categorized as fair learners with scores ranging from 10-17 and followed immediately by 9 or 9.28 percent who are labelled as poor learners based on their scores ranging from 9 and below. Which has a grand total of 97 learners from the said school.

1.2 Manuel L. Quezon National High School. It was found that the data show of the pre-test of the non-struggling learners at Manuel L. Quezon High School has a 25 or 24.51 percent of the learners who are categorized as good learners with scores ranging from 18-25 and followed immediately by 0 or 0 percent who are labelled as excellent and very good learners based on their scores ranging from 34-40 and 26-33. Also, findings reveal that the pre-test of the struggling learners at Manuel L. Quezon High School has a 59 or 57.84 percent of the learners who are categorized as fair learners with scores ranging from 10-17 and followed immediately by 18 or 17.65 percent who are labelled as poor learners based on their scores ranging from 9 and below. Which has a grand total of 102 learners from the said school.

Problem 2. The struggling learners' performance after the use of Virtual Manipulative as an instructional tool in teaching Mathematics in:

2. Square and Rectangle: Area and Perimeter.

2.1 Kalayaan National High School using traditional teaching. Data show that the post-test of the struggling learners at Kalayaan National High School using traditional teaching has a 25 or 69.70 percent of the learners who are categorized as very good learners with scores ranging from 26-33 and followed immediately by 5 or 15.15 percent who are labelled as good and fair learners based on their scores ranging from 18-25 and 10-17. Which has a total of 33 learners from the said cluster of the said school.

Kalayaan National High School using virtual manipulative. Data show that the post-test of the struggling learners at Kalayaan National High School using virtual manipulative has a 16 or 48.49 percent of the learners who are categorized as good learners with scores ranging from 18-25, followed immediately by 13 or 39.39 percent who are labelled as very good learners based on their scores ranging from 26-33, there is 3 or 9.09 percent were categorized as fair students with score ranging from 10-17, and has 1 or 3.03 percent who are labelled as poor learner based on their scores ranging from 0-9. Which has a total of 66 learners from the said cluster and has a grand total of 97 learners of the said school.



2.2 Manuel L. Quezon High School using traditional teaching. Findings reveal that the post-test of the struggling learners at Manuel L. Quezon High School using traditional teaching has a 27 or 69.23 percent of the learners who are categorized as good learners with scores ranging from 18-25, followed immediately by 9 or 23.07 percent who are labelled as very good learners based on their scores ranging from 26-33, and there is 3 or 7.69 percent were categorized as fair learners with scores ranging from 10-17 . Which has a total of 39 learners from the said cluster of the said school.

Manuel L. Quezon High School using virtual manipulative. Data show that the post-test of the struggling learners at Manuel L. Quezon High School using virtual manipulative has a 30 or 78.95 percent of the learners who are categorized as good learners with scores ranging from 18-25, followed immediately by 5 or 13.16 percent who are labelled as very good learners based on their scores ranging from 26-33, and there is 3 or 7.89 percent were categorized as fair students with score ranging from 10-17. Which has a total of 38 learners from the said cluster and has a grand total of 77 learners of the said school.

Problem 3. Significant difference of before and after use of the Virtual Manipulative of the struggling learners.

3. Kalayaan National High School.

- 3.1 Control Group. The hypothesis was rejected and concludes that there is significant difference in the struggling learners' performance before and after use of the virtual manipulative since the computed t-stat value of -16.5867767 is less than the t-crit (two-tail) of 2.034515297 using 0.05 level of significance. Data implies that the use of virtual manipulative improves the learners' performance in the topic Square and Rectangle: Area and Perimeter
- 3.2 Experimental Group. The hypothesis was rejected and concludes that there is significant difference in the struggling learners' performance before and after use of the virtual manipulative since the computed t-stat value of -18.93564455 is less than the t-crit (two-tail) of 2.039513446 using 0.05 level of significance. Data implies that the use of virtual manipulative improves the learners' performance in the topic Square and Rectangle: Area and Perimeter.

4. Manuel L. Quezon High School.

- 4.1 Control Group. The hypothesis was rejected and concludes that there is significant difference in the struggling learners' performance before and after use of the virtual manipulative since the computed t-stat value of -16.35576307 is less than the t-crit (two-tail) of 2.02269092 using 0.05 level of significance. Data implies that the use of virtual manipulative improves the learners' performance in the topic Square and Rectangle: Area and Perimeter
- 4.2 Experimental Group. The hypothesis was rejected and concludes that there is significant difference in the struggling learners' performance before and after use of the virtual manipulative since the computed t-stat value of -19.79974943 is less than the t-crit (two-tail) of 2.026192463 using 0.05 level of significance. Data implies that the use of virtual manipulative improves the learners' performance in the topic Square and Rectangle: Area and Perimeter.



IV. CONCLUSION

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

1. The pre-test level of the learners before using the virtual manipulative is on a beginning stage in competencies in terms of solving the area and perimeter of the square and rectangle.
2. The post-test level of the learners after using the virtual manipulative is on an approaching proficiency in competencies in terms of solving the area and perimeter of the square and rectangle.
3. Significant difference exists in the students' performance before and after use of the virtual manipulative as an instructional tool in teaching Mathematics in both Kalayaan National High School and Manuel L. Quezon High School.

APPENDIX

Appendix A

Pre-test and Post-test

Name: _____ Date: _____

Square: Area and Perimeter

Multiple Choice: Encircle the letter of the correct answer.

1. It is a plane figure with four equal straight sides and four right angles.
a. Square b. Rectangle c. Circle d. Triangle
2. This can be defined as the space occupied by a flat shape or the surface of an object.
a. Perimeter b. Angle c. Area d. Line
3. It refers to the total length of the sides or edges of a polygon with angles.
a. Perimeter b. Angle c. Area d. Line
4. It is the formula to find the Area of a Square.
a. $A=s+s$ b. $A=s^2$ c. $A=2s$ d. $A=2s^2$
5. How to find the Perimeter of a Square?
a. $P=s+4$ b. $P=4+s$ c. $P=s^4$ d. $P=4s$
6. If the side of the Square is 7m, then find its Area.
a. $A=49m^2$ b. $A=48m^2$ c. $A=45m^2$ d. $A=42m^2$
7. If the side of the Square is 11cm, then find its Area.
a. $A=110cm^2$ b. $A=132cm^2$ c. $A=120cm^2$ d. $A=121cm^2$
8. If the side of the Square is 14m, then find its Area.
a. $A=192m^2$ b. $A=196m^2$ c. $A=198m^2$ d. $A=197m^2$
9. If the side of the Square is 19inch, then find its Area.
a. $A=359inch^2$ b. $A=360inch^2$ c. $A=361inch^2$ d. $A=324inch^2$
10. If the side of the Square is 23ft, then find its Area.



- a. $A=528ft^2$ b. $A=529ft^2$ c. $A=525ft^2$ d. $A=576ft^2$
11. If the side of the Square is 13ft, then find its Perimeter.
a. $P=50ft$ b. $P=52ft$ c. $P=53ft$ d. $P=51ft$
12. If the side of the Square is 8cm, then find its Perimeter.
a. $P=32cm$ b. $P=33cm$ c. $P=29cm$ d. $P=30cm$
13. If the side of the Square is 6ft, then find its Perimeter.
a. $P=22ft$ b. $P=24ft$ c. $P=25ft$ d. $P=26ft$
14. If the side of the Square is 17inch, then find its Perimeter.
a. $P=68inch$ b. $P=69inch$ c. $P=66inch$ d. $P=64inch$
15. If the side of the Square is 18km, then find its Perimeter.
a. $P=70km$ b. $P=68km$ c. $P=74km$ d. $P=72km$
16. If the Area of the Square is $81km^2$, then find the side.
a. $s=8km$ b. $s=9km$ c. $s=10km$ d. $s=11km$
17. If the Area of the Square is $36m^2$, then find the side.
a. $s=9m$ b. $s=8m$ c. $s=7m$ d. $s=6m$
18. If the Area of the Square is $144ft^2$, then find the side.
a. $s=12ft$ b. $s=11ft$ c. $s=14ft$ d. $s=13ft$
19. If the Perimeter of the Square is 52cm, then find the side.
a. $s=12cm$ b. $s=13cm$ c. $s=14cm$ d. $s=15cm$
20. If the Perimeter of the Square is 80inch, then find the side.
a. $s=16inch$ b. $s=18inch$ c. $s=20inch$ d. $s=22inch$

Name: _____

Date: _____

Rectangle: Area and Perimeter

Multiple Choice: Encircle the letter of the correct answer.

- It is a parallelogram all of whose angles are right angles, especially one with adjacent sides of unequal length.
a. Square b. Rectangle c. Circle d. Triangle
- This can be defined as the space occupied by a flat shape or the surface of an object.
a. Perimeter b. Angle c. Area d. Line
- It refers to the total length of the sides or edges of a polygon with angles.
a. Perimeter b. Angle c. Area d. Line
- It is the formula to find the Area of a Rectangle.
a. $A=w+l$ b. $A=l+w$ c. $A=l*w$ d. $A=2(l*w)$
- How to find the Perimeter of a Rectangle?
a. $P=2l+2w$ b. $P=(l+w)^2$ c. $P=2(l+2w)$ d. $P=2(2l+w)$
- If the $l=12ft$ and $w=11ft$, then find its Area.



- a. $A=136ft^2$ b. $A=132ft^2$ c. $A=130ft^2$ d. $A=112ft^2$
7. If the $l=10m$ and $w=8m$, then find its Area.
a. $A=80m^2$ b. $A=86m^2$ c. $A=81m^2$ d. $A=84m^2$
8. If the $l=8cm$ and $w=6cm$, then find its Area.
a. $A=48cm^2$ b. $A=49cm^2$ c. $A=46cm^2$ d. $A=42cm^2$
9. If the $l=15cm$ and $w=13cm$, then find its Area.
a. $A=192cm^2$ b. $A=195cm^2$ c. $A=196cm^2$ d. $A=197cm^2$
10. If the $l=18mm$ and $w=16mm$, then find its Area.
a. $A=288mm^2$ b. $A=289mm^2$ c. $A=280mm^2$ d. $A=268mm^2$
11. If the $l=11m$ and $w=10m$, then find its Perimeter.
a. $P=40m$ b. $P=42m$ c. $P=44m$ d. $P=46m$
12. If the $l=10cm$ and $w=7cm$, then find its Perimeter.
a. $P=30cm$ b. $P=34cm$ c. $P=32cm$ d. $P=36cm$
13. If the $l=18mm$ and $w=13mm$, then find its Perimeter.
a. $P=60mm$ b. $P=62mm$ c. $P=64mm$ d. $P=58mm$
14. If the $l=14cm$ and $w=11cm$, then find its Perimeter.
a. $P=48cm$ b. $P=52cm$ c. $P=50cm$ d. $P=54cm$
15. If the $l=15yrd$ and $w=12yrd$, then find its Perimeter.
a. $P=50yrd$ b. $P=52yrd$ c. $P=54yrd$ d. $P=56yrd$
16. The Rectangle has a $P=54cm$. Find the length if the $w=20cm$.
a. $l=5cm$ b. $l=7cm$ c. $l=11cm$ d. $l=17cm$
17. The Rectangle has a $P=16ft$. Find the width if the $l=5ft$.
a. $w=5ft$ b. $w=11ft$ c. $w=3ft$ d. $w=6ft$
18. The Rectangle has a $P=36inch$. Find the width if the $l=12inch$
a. $w=4inch$ b. $w=5inch$ c. $w=6inch$ d. $w=7inch$
19. The Rectangle has a $P=14m$. Find the length if the $w=5m$.
a. $l=4m$ b. $l=3m$ c. $l=2m$ d. $l=1m$
20. The Rectangle has a $P=18mm$. Find the length if the $w=3mm$.
a. $l=6mm$ b. $l=8mm$ c. $l=4mm$ d. $l=15mm$

Appendix B

TABLE OF SPECIFICATION

Teacher-Made Assessment (Pre-test/Post-test)

Square: Area and Perimeter

Content Outline	No. of items	Item Placement	Cognitive Levels						% of items
			Remembering	Understanding	Applying	Analysing	Evaluating	Creating	
Definition of terms	3	1, 2, 3	3						15%



Definition of formula	2	4, 5	2					10%
Finding the Area	5	6, 7, 8, 9, 10		5				25%
Finding the Perimeter	5	11, 12, 13, 14, 15		5				25%
Finding the Side when Area is given	3	16, 17, 18				3		15%
Finding the Side when Perimeter is given	2	19, 20				2		10%
Total:	20		5	10		5		100 %
Percentage:	100 %		25%	50%		25%		

TABLE OF SPECIFICATION

Teacher-Made Assessment (Pre-test/Post-test)

Rectangle: Area and Perimeter

Content Outline	No. of items	Item Placement	Cognitive Levels					% of items
			Remembering	Understanding	Applying	Analysing	Evaluating	
Definition of terms	3	1, 2, 3	3					15%
Definition of formula	2	4, 5	2					10%
Finding the Area	5	6, 7, 8, 9, 10		5				25%
Finding the Perimeter	5	11, 12, 13, 14, 15		5				25%
Finding the Width when Perimeter and Length are given	2	17, 18				3		10%
Finding the Length when Perimeter and Width are given	3	16, 19, 20				2		15%
Total:	20		5	10		5		



Percentage:	100 %		25%	50%		25%		100 %
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Appendix D

TMA Results

	Score		
	Square	Rectangle	Total
Item Number:	20	20	40
Student 1	15	17	32
Student 2	13	10	23
Student 3	20	19	39
Student 4	20	18	38
Student 5	9	10	19
Student 6	16	12	28
Student 7	20	19	39
Student 8	13	12	25
Student 9	19	19	38
Student 10	15	12	27
Student 11	19	17	36
Student 12	9	10	19
Student 13	17	18	35
Student 14	20	20	40
Student 15	19	18	37
Student 16	20	19	39
Student 17	19	19	38
Student 18	18	17	35
Student 19	14	15	29
Student 20	9	10	19

Pilot Testing Using Virtual Manipulative

The data were calculated using Microsoft Excel 2019 with the Cronbach Alpha's result of 0.490577 or 49.0577 percent reliable.

Number of items	Sum of item variance	Variance of total score	Cronbach Alpha
40	28.03628	53.7415	0.490577

Appendix E

Validator's Name: _____

Date: _____



Name of school: _____

Number of years in the academe: _____

Validity Questionnaire

Direction: Put a check on the appropriate column that corresponds to your answer. Use the scale below.

1 – Strongly Disagree (SD)

2 – Disagree (D)

3 – Uncertain (U)

4 – Agree (A)

5 – Strongly Agree (SA)

	Domains	SD	D	U	A	SA
	Structure	1	2	3	4	5
1.	The instruction in TMA is easy to understand.					
2.	The number of words in TMA is appropriate for Grade 7 students.					
3.	The words/terms in TMA are easy to understand and appropriate for Grade 7 students.					
4.	The words/terms in TMA are clearly and well encoded.					
5.	The words/terms in TMA are at appropriate difficulty level for the test.					
6.	The TMA is ideal for independent understanding.					
7.	The TMA shows cultural appropriacy (political, social, or religious mores).					
8.	The TMA is free from biases (e.g. gender, class, ethnic, cultural).					
9.	The number of items in TMA are appropriate for the test.					
10.	The number of items in TMA are appropriate for an hour of exam.					
11.	The TMA support the target objectives					

*Teacher-Made Assessment (TMA)

Comments/Suggestions:

Signature: _____



Appendix F

Validity and Reliability Test Result

1 – Strongly Disagree (SD)

2 – Disagree (D)

3 – Uncertain (U)

4 – Agree (A)

5 – Strongly Agree (SA)

	Year/s in the academe	Item Number										
		1	2	3	4	5	6	7	8	9	10	11
Teacher 1	9	5	5	5	5	5	5	5	5	5	5	5
Teacher 2	7	5	5	5	5	5	5	5	5	5	4	5
Teacher 3	3	5	5	5	5	5	5	5	5	4	5	5
Teacher 4	4	5	5	5	5	5	4	5	5	5	4	5
Teacher 5	3	5	5	5	5	4	5	5	4	4	5	4
Teacher 6	8	5	5	5	5	5	5	5	5	5	5	5
Teacher 7	5	5	5	4	3	4	5	4	4	5	5	4
Teacher 8	4	4	5	5	3	4	5	5	5	3	5	5
Teacher 9	8	5	4	5	5	5	5	5	5	5	5	5
Teacher 10	2	5	5	4	5	5	5	5	5	5	5	5
Total:		49	49	48	46	47	49	49	48	46	48	48

The data were calculated using Microsoft Excel 2019 with the Cronbach Alpha's result of 0.65098 or 65.098 percent reliable.

Number of items	Sum of item variance	Variance of total score	Cronbach Alpha
11	2.29	5.61	0.65098

Appendix G

Pre-test and Post Test Results

Legend:

S – Struggling Students

NS – Non-Struggling Students

Kalayaan National High School

S.Y. 2019-2020

Grade 7 Population: **1,327**

Combined Population of Participating Sections: **116**

Combined Absentees on Pre and Post-Test of Participating Sections: **19**

Combined Scores of Participating Sections

Stu- den- t No.	Squ- are	Rect- angl- e	P- re- - test	Descr- iption	Squ- are	Rect- angl- e	Pos- t- - test	Descr- iption	Stu- den- t No.	Squ- are	Rect- angl- e	P- re- - test	Descr- iption	Squ- are	Rect- angl- e	Pos- t- - test	Descr- iption
1	6	4	10	S	13	12	25	NS	50	12	7	19	NS	17	14	31	NS
2	13	8	21	NS	18	15	33	NS	51	5	12	17	S	13	17	30	NS
3	10	2	12	S	17	10	27	NS	52	8	4	12	S	15	14	29	NS
4	5	10	15	S	13	17	30	NS	53	2	10	12	S	10	17	27	NS
5	3	7	10	S	11	14	25	NS	54	9	5	14	S	16	13	29	NS
6	11	8	19	NS	16	15	31	NS	55	4	9	13	S	12	15	27	NS
7	8	3	11	S	15	11	26	NS	56	12	10	22	NS	17	13	30	NS
8	13	9	22	NS	18	16	34	NS	57	7	7	14	S	13	11	24	NS
9	13	4	17	S	18	12	30	NS	58	8	12	20	NS	15	14	29	NS
10	5	6	11	S	6	6	12	S	59	3	9	12	S	10	13	23	NS
11	9	2	11	S	16	10	26	NS	60	9	4	13	S	14	15	29	NS
12	0	5	5	S	8	14	22	NS	61	10	5	15	S	16	8	24	NS
13	1	6	7	S	9	13	22	NS	62	4	8	12	S	9	13	22	NS
14	3	7	10	S	11	14	25	NS	63	6	12	18	NS	10	17	27	NS
15	12	8	20	NS	17	15	32	NS	64	12	10	22	NS	14	14	28	NS
16	3	9	12	S	11	16	27	NS	65	11	5	16	S	17	10	27	NS
17	7	10	17	S	14	17	31	NS	66	7	12	19	NS	15	17	32	NS
18	8	11	19	NS	15	16	31	NS	67	10	7	17	S	7	2	9	S
19	12	14	26	NS	17	18	35	NS	68	4	8	12	S	9	14	23	NS
20	11	5	16	S	16	13	29	NS	69	0	3	3	S	10	11	21	NS
21	6	7	13	S	16	13	29	NS	70	3	8	11	S	8	12	20	NS
22	3	13	16	S	3	12	15	S	71	9	6	15	S	14	13	27	NS
23	9	12	21	NS	16	17	33	NS	72	13	7	20	NS	15	9	24	NS
24	10	5	15	S	17	13	30	NS	73	10	12	22	NS	13	16	29	NS
25	6	9	15	S	13	15	28	NS	74	5	9	14	S	12	15	27	NS
26	13	7	20	NS	18	14	32	NS	75	12	6	18	NS	17	15	32	NS
27	4	10	14	S	12	16	28	NS	76	8	8	16	S	16	14	30	NS



28	5	4	9	S	6	7	13	S	77	11	12	23	NS	15	18	33	NS
29	12	9	21	NS	17	16	33	NS	78	0	3	3	S	5	5	10	S
30	5	10	15	S	13	17	30	NS	79	6	5	11	S	12	16	28	NS
31	8	11	19	NS	15	16	31	NS	80	2	8	10	S	10	13	23	NS
32	3	9	12	S	11	16	27	NS	81	8	4	12	S	10	8	18	NS
33	7	5	12	S	14	13	27	NS	82	5	8	13	S	13	12	25	NS
34	6	12	18	NS	13	17	30	NS	83	11	7	18	NS	14	10	24	NS
35	2	9	11	S	10	16	26	NS	84	8	12	20	NS	10	13	23	NS
36	10	6	16	S	17	13	30	NS	85	9	5	14	S	15	10	25	NS
37	5	10	15	S	13	17	30	NS	86	1	2	3	S	8	6	14	S
38	2	5	7	S	4	6	10	S	87	0	4	4	S	10	13	23	NS
39	8	8	16	S	15	14	29	NS	88	10	8	18	NS	14	12	26	NS
40	13	11	24	NS	18	17	35	NS	89	11	10	21	NS	15	13	28	NS
41	9	7	16	S	16	14	30	NS	90	6	8	14	S	10	12	22	NS
42	10	5	15	S	17	13	30	NS	91	7	4	11	NS	10	9	19	NS
43	1	9	10	S	3	113	16	S	92	5	11	16	S	10	14	24	NS
44	11	7	18	NS	16	14	30	NS	93	12	4	16	S	17	9	26	NS
45	6	12	18	NS	13	17	30	NS	94	3	8	11	S	11	13	24	NS
46	3	8	11	S	11	15	26	NS	95	9	4	13	S	15	13	28	NS
47	9	11	20	NS	16	16	32	NS	96	0	5	5	S	5	9	14	S
48	12	7	19	NS	17	14	31	NS	97	9	13	22	NS	14	16	30	NS
49	6	10	16	S	13	17	30	NS									

Manuel L. Quezon High School

S.Y. 2019-2020

Grade 7 Population: **1,213**

Combined Population of Participating Sections: **129**

Combined Absentees on Pre and Post-Test of Participating Sections: **27**

Combined Scores of Participating Sections

Student No.	Square	Rectangle	Pre-test	Description	Square	Rectangle	Post-test	Description	Student No.	Square	Rectangle	Pre-test	Description	Square	Rectangle	Post-test	Description
1	10	11	21	NS	12	15	27	NS	52	13	6	19	NS	15	10	25	NS



2	7	9	16	S	10	12	22	NS	53	4	8	12	S	9	12	21	NS
3	8	5	13	S	10	11	21	NS	54	5	12	17	S	10	13	23	NS
4	3	12	15	S	9	13	22	NS	55	12	6	18	NS	15	10	25	NS
5	9	9	18	NS	12	14	26	NS	56	5	5	10	S	7	9	16	S
6	6	7	13	S	10	9	19	NS	57	4	0	4	S	10	9	19	NS
7	13	7	20	NS	15	10	25	NS	58	5	10	15	S	12	14	26	NS
8	10	10	20	NS	11	14	25	NS	59	12	11	23	NS	15	14	29	NS
9	5	7	12	S	9	13	22	NS	60	9	6	15	S	13	11	24	NS
10	3	8	11	S	8	14	22	NS	61	3	8	11	S	10	10	20	NS
11	9	3	12	S	12	10	22	NS	62	9	8	17	S	12	15	27	NS
12	7	9	16	S	13	15	28	NS	63	6	3	9	S	10	7	17	S
13	12	4	16	S	14	10	24	NS	64	13	9	22	NS	15	11	26	NS
14	0	3	3	S	9	9	18	NS	65	4	6	0	S	10	9	19	NS
15	6	4	10	S	8	10	18	NS	66	5	13	18	NS	12	13	25	NS
16	13	5	18	NS	15	10	25	NS	67	12	10	22	NS	14	11	25	NS
17	10	13	23	NS	12	16	28	NS	68	5	5	10	S	9	7	16	S
18	5	8	13	S	13	9	22	NS	69	10	3	13	S	11	9	20	NS
19	3	6	9	S	12	11	23	NS	70	7	6	13	S	12	11	23	NS
20	5	1	6	S	9	9	18	NS	71	8	8	16	S	15	12	27	NS
21	3	0	3	S	9	8	17	S	72	3	12	15	S	11	14	25	NS
22	7	10	17	S	12	13	25	NS	73	9	6	15	S	13	10	23	NS
23	10	11	21	NS	10	15	25	NS	74	4	5	9	S	8	13	21	NS
24	7	6	13	S	11	15	26	NS	75	8	6	14	S	10	8	18	NS
25	8	6	14	S	16	10	26	NS	76	4	13	17	S	11	15	26	NS
26	3	8	11	S	9	14	23	NS	77	5	4	9	S	8	12	20	NS
27	9	12	21	NS	14	16	30	NS	78	13	5	18	NS	15	7	22	NS
28	6	6	12	S	11	13	24	NS	79	8	12	20	NS	10	13	23	NS
29	8	5	13	S	15	12	27	NS	80	3	5	8	S	7	11	18	NS
30	12	7	19	NS	15	11	26	NS	81	9	7	16	S	14	12	26	NS
31	6	8	14	S	10	14	24	NS	82	4	8	12	S	9	12	21	NS
32	5	3	8	S	15	16	31	NS	83	6	3	9	S	13	10	23	NS



33	2	9	1 1	S	12	15	27	NS	84	10	9	1 9	NS	12	15	27	NS
34	7	10	1 7	S	15	12	27	NS	85	11	5	1 6	S	11	10	21	NS
35	6	11	1 7	S	9	15	24	NS	86	7	9	1 6	S	12	11	23	NS
36	7	9	1 6	S	10	11	21	NS	87	10	2	1 2	S	14	9	23	NS
37	8	5	1 3	S	13	9	22	NS	88	4	7	1 1	S	10	12	22	NS
38	11	12	2 3	NS	14	13	27	NS	89	0	6	6	S	9	13	22	NS
39	7	9	1 6	S	8	10	18	NS	90	11	7	1 8	NS	12	12	24	NS
40	10	6	1 6	S	13	2	15	S	91	9	8	1 7	S	14	11	25	NS
41	4	8	1 2	S	10	13	23	NS	92	5	3	8	S	13	10	23	NS
42	0	4	4	S	6	9	14	S	93	12	9	2 1	NS	15	12	27	NS
43	7	6	1 3	S	12	14	26	NS	94	9	10	1 9	NS	13	16	29	NS
44	13	5	1 8	NS	16	13	29	NS	95	0	3	3	S	7	11	18	NS
45	4	5	9	S	11	9	20	NS	96	8	10	1 8	NS	13	13	26	NS
46	5	8	1 3	S	10	12	22	NS	97	6	7	1 3	S	9	11	20	NS
47	8	4	1 2	S	13	9	22	NS	98	8	8	1 6	S	10	13	23	NS
48	3	8	1 1	S	11	14	25	NS	99	12	3	1 5	S	15	9	24	NS
49	9	4	1 3	S	16	12	28	NS	100	6	9	1 5	S	8	14	22	NS
50	4	5	9	S	10	9	19	NS	101	5	8	1 3	S	11	9	20	NS
51	6	13	1 9	NS	10	17	27	NS	102	3	6	9	S	10	13	23	NS

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