IMPACT OF E-MODULO ART MAKING TO THE PERFORMANCE AND APPRECIATION LEVELS IN MATHEMATICS OF SELECTED VINZONS PILOT HIGH SCHOOLS STUDENTS

Torrero, Adelaida A.

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ADELAIDA A. TORRERO
Teacher III
VPHS

ABSTRACT

Many schools worldwide suspended classroom teaching due to the novel coronavirus pandemic and switched to online teaching. In this difficult time, administrators, parents, teachers, and students tried coping up with the current situation and adopt to the new trend in educational system. This descriptive research aimed to investigate the mathematical abilities of Grade 9 students of Vinzons Pilot High School and described the impact of E-Modulo Art on the performance and appreciation level of the Grade 9 students in Mathematics subject after the training on the creative application of E-Modulo Art concepts. An intervention/ innovation material was also proposed and evaluated by jurors based on standards. There were forty Grade 9 students in the mathematics subject who served as the respondents of the research.

The results revealed that 100% of the students belonged to the beginning performance level with a mean of 12.40, equivalent to 41.33% MPL. The appreciation level has a mean of 2.99 interpreted as moderate. The training on the creative application of E-Modulo Art has a positive impact on the performance of students as attested by a p-value of <.001, and to their appreciation level. The innovation/ intervention material was developed and passed the evaluation criteria for print resources based on LRMDS standards.

Keywords: Impact, Electronic Modulo Art, Performance , Appreciation level

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The Researcher

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CONTEXT AND RATIONALE

Mathematics is a fundamental part of human thought and logic, and integral to attempts at understanding the world and us. Certain qualities that are nurtured by mathematics are power of reasoning, creativity, abstract or spatial thinking, critical thinking, problem-solving ability, and even effective communication skills. Studying mathematics not only will develop more engineers and scientists, but also produce more citizens who can learn and think creatively and critically, no matter their career fields. The workforce of tomorrow, in all fields, will demand it.

According to the Mathematics Curriculum for Basic Education, the twin goals of mathematics in the basic education levels, K-10, are Critical Thinking and Problem Solving. There are also five content areas in the curriculum, as adopted from the framework prepared by MATHTED & SEI (2010): Numbers and Number Sense, Measurement, Geometry, Patterns and Algebra, and Probability and Statistics. Some of the appropriate tools necessary in teaching mathematics include manipulative objects, measuring devices, calculators and computers, smart phones and tablet PCs, and the Internet (MATHTED & SEI, 2010).

In addition, the framework cites that from K-10 math is a skills subject. By itself, it is all about quantities, shapes and figures, functions, logic, and reasoning. With the help of E-modulo, students are able to develop their number sense for it includes concepts of numbers, operations, and their applications. It also involves measurement of objects, and focuses on attributes such as length, area, and angle measure. It also applies skills on geometry because it deals with two- and three-dimensional figures and their relationships, spatial visualization, reasoning, and

geometric modelling and proofs. Finally, it is all about patterns, relationships, and changes among shapes and quantities.

In the Philippines, one of the reforms that determines the effectiveness in mathematics education is the country's participation in international research studies such as the Trends in International Mathematics and Science Study (TIMSS) and Program for International Student Assessment (PISA). Based on the results in these assessments, a dismal performance of the Filipino students in Mathematics was revealed. The Philippines scored 297 in math, according to the TIMSS 2019, and last among 79 countries in terms of mathematical literacy in the PISA 2018.

In order to address these challenges, it is vital that Mathematics be taught in the most interesting and creative way. New and innovative learning programs and activities need to be implemented, integrating available technology to stimulate students' creativity, imagination, and confidence. Also, students need more hands-on and effortful learning in order to spark their curiosity and enjoyment of learning.

Also, the COVID-19 pandemic had brought challenges to the teachers and learners. The Department of Education then issued DepEd Order No. 12, s. 2020 which is all about the adoption of the Basic Education Learning Continuity Plan. One of the features of the BE-LCP is for the provision of learning materials and implementation of strategies that would cater the needs of the learners (DO No. 12, 2020).

With this information at hand, and with the mandate and instructions of the school head of Vinzons Pilot High School, for the teachers to devise ways on how

they can help their learners cope up with the situation, the researcher was able to think of a way to teach her students with the introduction of E-Modulo Art, on which her students can enjoy the said art, and at the same time apply mathematical principles.

Moreover, based on the researcher's experience as high school mathematics teacher, some of the challenges in teaching and learning mathematics include the following: lack of prior knowledge, motivation, effort, and interest of students; and ineffective content and pedagogical knowledge, and time for reflection on instructional practices.

Modulo drawing is the art of Mathematics using number patterns to form modular arithmetic to create a unique artistically pleasing design (Steemit, 2018). By then, modulo art is done manually, but with the cause of this pandemic and the technological advancement, the researcher would like to help the students to ease out their burdens being at home by using Microsoft office in making modulo arts and designs.

Moreover, just recently, the SDO Camarines Norte and Region V-Bicol, conducted a contest on E-Modulo Art Making as one of the events in Mathematics. It was participated in by Elementary and Junior High School Students. The said contest emphasized that mathematics could also be used to highlight social issues and concerns that people need to be aware of by producing an artwork of social relevance.

In connection, the researcher, as one of the E-Modulo art enthusiasts, asked the help of her co- teachers to make this as one of their ways in teaching their

students. In a way, learners will enjoy and learn in a manner that they do the work lightly as these activities are non-graded but can also be included in their performance with the discretion of course of their teachers.

There was also integration across curriculum by which Electronic Modulo art is so applicable, just like putting wise sayings and pandemic mitigation designs and wellness awareness among our learners. These thoughts made the researcher so inspired to teach her students how to create E-Modulo art and evaluate its impact on their performance and appreciation levels.

INNOVATION, INTERVENTION AND STRATEGY

This research is an innovation since it is the first time that a tutorial handbook on how to make E-Modulo Art will be introduced in the division of Camarines Norte. E-Modulo Art is a new concept and practice in math because before, modulo art was done manually, and not in digital version. The proposed innovation provides the teachers and learners ideas on how to do the E-Modulo Art because actual examples of outputs are showcased in the handbook.

The intervention proposed is a tutorial handbook on how to make E-Modulo Art. The output is entitled **The Basics of E-Modulo Art Making.** It is composed of three parts, the conceptual, illustrative examples, and the application part. It served as an intervention that helped address the following challenges: improvement of the conceptual and practical knowledge of the teachers and learners on the E-Modulo Art; utilization of e-modulo art making to learn the related mathematical concepts; and enhancement of the learners' appreciation of the mathematics subject.

In terms of the strategies to be employed, the output is composed of texts for the explanation of concepts on E-Modulo Art as well as the mechanics followed in making it. It is also accompanied by illustrative examples of the different kinds of E-Modulo Art. The last part presents the application where they can create their own artwork, following the principles that they learned in the conceptual and illustrative example parts.

Before the handbook will be used, it was validated first by selected mathematics teacher to ensure that it follows the guidelines and is reliable enough to be used by the students. The handbook will be beneficial to the teachers because they can use it in integrating E-Modulo Art in Mathematics subject. They can also use it as part of the performance task, especially in developing mathematical competencies where it can be integrated into.

For the students, this will help them understand and appreciate more E-Modulo Art and the mathematics subject, resulting to higher motivation and performance. The output will provide them examples that can serve as their guide in creating their own masterpieces. Finally, the handbook was created with the end goal of making mathematics learning more meaningful and relevant through E-modulo art.

ACTION RESEARCH QUESTIONS

This study determined the performance and appreciation levels of the 40 Grade 9 students in the mathematics subject for School Year 2021-2022. This study also described the impact on their performance and appreciation levels in mathematics after having been trained on the creative application of E-Modulo Art

concepts. The results became the bases for the intervention prepared that was validated by selected jurors.

Specifically, it aimed to answer the following research questions:

1. What is the performance level of the students in mathematics?
2. What is the appreciation level of the students in mathematics subject?
3. Is there an improvement in the mathematical performance of the Grade 9 students after having been trained on the creative application of E-Modulo Art concepts?
4. What is the impact of E-Modulo Art on the appreciation level of the Grade 9 students in Mathematics subject after the training on the creative application of E-Modulo Art concepts?
5. What intervention/innovation may be proposed to improve the skills of the Grade 9 students in E-modulo Art?
6. What is the evaluation of the selected mathematics teacher on the intervention/ innovation in terms of:
    a. Content;
    b. Format;
    c. Presentation and Organization; and
    d. Accuracy and Up-to-datedness of information?

ACTION RESEARCH METHODS

This study employed descriptive-development- evaluative research design. This design was used to carefully appraise the worthiness of the current study (Villanueva, 2013). The descriptive design provides a descriptive analysis of a

given population or sample (Picciano, 2021). Meanwhile, development and evaluative research is defined as a form of disciplined and systematic inquiry that is carried out to arrive at an assessment or appraisal of an object, program, practice, activity, or system with the purpose of providing information that will be of use in decision making (International Encyclopedia of Education, 2010).

In this study, descriptive research was used in answering questions on the performance level of the Grade 9 students, before and after teaching them about E-Modulo Art Making. Also, it was used to describe their appreciation level of Mathematics subject after learning and experiencing how to make E-Modulo Art. The development part was the process of making the E-Modulo Art Handbook that is intended to help improve the skills of the students on E-Modulo Art Making. The evaluative part was about the assessment of the selected mathematics teacher of the output in terms of format, content, presentation and organization, and accuracy and up-to-datedness of information.

A. PARTICIPANTS AND/OR OTHER SOURCES OF DATA AND INFORMATION

The participants to this study were the 40 Grade 9 students who were taught using online delivery modality at Vinzons Pilot High School this School Year 2021-2022. They were the primary sources of data for the variables of this study namely performance and appreciation levels. Table 1 shows the distribution of the respondents.

The sampling method used was purposive sampling. A purposive sample is a non-probability sample that is selected based on characteristics of a population and the objective of the study (Crossman, 2020). In this study, the samples were all from the two sections handled by the researcher in her online classes. The

respondents were also pre-selected based on their capacity to provide the necessary tools and equipment needed to make E-Modulo Art.

Table 1 Distribution of Respondents

Sections	Number of Respondents	Distance Learning Modality
1. Grade 9- Erbium	20	Online
2. Grade 9- Bright	20	Online
Total	**40**	

Other sources of data were the selected five (5) mathematics teacher of Vinzons Pilot High School who validated the output according to four factors in the LRMDS tool for print materials. Prior to the conduct of the study, the respondents were oriented first by the researcher on the purpose of this study. During the orientation, they were provided with parental consent for the data gathering procedures conducted in this study. They were also assured that their participation was voluntary, and that any information gathered will be treated with utmost confidentiality. Also, answers and pictures of the respondents were presented in such a way that their identities were not disclosed, and such were used solely for the purpose of this research.

B. DATA GATHERING METHODS

The researcher first sought permission from the Schools Division Superintendent and School Head to conduct the data gathering procedures. Then, orientation of the target respondents was conducted. The parental consents were also be distributed during the orientation. Then, the pretest was administered which focused on the third quarter competencies, on parallelograms and triangle similarity, being the competencies related to the concepts used in E-Modulo Art.

This answered the first statement of the problem. A survey for the level of appreciation of the respondents in mathematics was also administered to answer the second problem statement.

After the pretest, the researcher integrated E-Modulo Art in teaching the mentioned competencies for three (3) weeks. Then, a posttest was administered. To determine if there was an improvement in the performance of the students in understanding the key concepts of parallelograms and triangle similarity, paired sample T-test was employed. Paired sample T-test is where one run a test on dependent samples which are essentially connected. They are tests on the same person or thing (Glen, 2021). An example is this study wherein the test results before and after teaching E-Modulo Art were compared. The result answered the statement of the problem on the impact on the performance level of the students.

Meanwhile, the impact on the appreciation level in mathematics subject after being taught how to make E-Modulo Art was answered using a survey questionnaire. There were ten indicators rated by the students using a 5-Point Likert Scale with the following interpretations: 5 for very high impact; 4 for high impact; 3 for moderate impact; 2 for poor impact; and 1 for very poor impact. There were also informal interviews conducted that helped the researcher have a clearer grasp of the impact of the E-Modulo Art on the students.

The results of the first to fourth SOPs became the bases for the intervention material prepared. The sixth problem statement was answered using the standards set by DepEd LRMDS for print materials in terms of the format, content, presentation and organization, and accuracy and up-to-datedness of information.

The criteria for evaluation were rated using a 4-point Likert Scale with 4 being Very Satisfactory; 3- Satisfactory; 2- Poor; and 1- Not Satisfactory. If an evaluation criterion was Not Applicable, the material was rated 3 on that criterion (DepEd LRMDS Manual).

For ethical considerations, the availability of the respondents and validators were highly considered by the researcher in the conduct of the data gathering procedures. Any information used from the different sources were ensured to be with consent from the original owner or source. Further, all data from articles and studies used in any part of this paper were duly acknowledged and properly cited.

C. DATA ANALYSIS PLAN

Descriptive statistics was used in analyzing and interpreting the data on the on performance and appreciation levels. The following statistical treatment were used: frequency, class interval, percentage, weighted mean, and ranking. For the comparison of the performance level before and after teaching the respondents about the E-Modulo Art, paired sample t-test was used.

For the impact on appreciation level, this overall interpretation was used: 4.50-5.00 for very high, 3.50-4.49 for high, 2.50- 3.49 for moderate, 1.50-2.49 for poor, and 1.00-1.49 for no impact. The qualitative responses in the interviews shall be used to refute or support the result of the survey.

In terms of the evaluation of the handbook to be developed, the assessment rules set by the LRMDS were used. The researcher ensured that all indicators were met based on the evaluation of the validators.

DISCUSSION OF RESULTS AND REFLECTION

This section presents the data gathered by the researcher on the impact of E-Modulo Art Making on the performance and appreciation levels in mathematics of selected Vinzons Pilot High School students. The gathered data were tabulated on tables, analyzed, and interpreted. The implications and effect of the findings of this study on the researcher were also added to this section.

The succeeding paragraphs include the discussions on the following: performance level of the students in mathematics; appreciation levels of the students in mathematics; improvement in the mathematical performance of the respondents after having been trained on the creative application of E-Modulo Art concepts; impact of the E-Modulo Art on the appreciation levels in mathematics of the respondents; the proposed intervention/ innovation material developed by the researcher; and the evaluation results on the developed material in terms of content, format, presentation and organization, and accuracy and up-to-datedness of information.

Performance Level of the Students in Mathematics Subject

Mathematics subject provides an effective way of building mental discipline and encourages logical reasoning and mental rigor. In addition, mathematical knowledge plays a crucial role in understanding the contents of other learning areas such as science, social studies, and even music and art. Table 2 shows the performance of the 40 student respondents in mathematics based on the pretest conducted by the researcher.

Table 2
Frequency Distribution of Pretest
(N=40)

Class Interval	Frequency	Percentage
27-30	0	0
23-26	0	0
19-22	0	0
15-18	13	33
11-14	16	40
7-10	6	15
3-6	5	12
Total	40	100

Table 2 revealed the frequency of the scores of the Grade 9 students .The table shows that there were 13 students who obtained a score between 15 and 18, which is equivalent to 33%, and 5 students who got scores between 3 and 6,which is equivalent to 12%.The data further show that the scores with the highest frequency was between 11 and 14, with 16 students, equivalent to 40%.This is followed by the class sizes of 15 and 18 with 13 students which is equivalent to 33%, while the class size of 7 and 10 with 6 students is equivalent to 15%.

The pretest consists of 30- item questions that measure students computational and problems skills. The expected score must be equal to 23 and above. The data showed that all 40 respondents did not meet the required mean score. These data reveal that there is a need to investigate on the causes and possible solutions to improve the performance level of the students in mathematics.

The results further imply that teachers must implement remediation or intervention that would help the students master the competencies in math. If students do not have the prerequisite skills, mathematics will continue to be a difficult subject for them. Teachers must extend help like preparation of intervention

materials that would first address the motivational and affective aspects of the students. They must first feel that math is not complicated and that they can also enjoy learning the concepts.

According to the study of Ayebale (2020), there are several factors affecting students' achievement in mathematics secondary schools in developing countries. The teaching methods, teachers' attitudes, and students' attitude towards mathematics were noted as key factors. Also there seemed to be consistency too that parents can exert a positive influence on their children's mathematical performance, classroom environment, students' appreciation level of math and gender related factors.

Moreover, to know the performance of students in mathematics, assessments are done. Assessment in mathematics is more than forming judgments about a learner's ability. It monitors the learner's understanding of the mathematical language, concepts and skills and what they need to do to succeed. This requires and understanding of how learning develops; what skills and knowledge learners need to progress; and the common misunderstandings that can delay learning (Victoria State Government, 2019).

Table 4 shows the summary of the descriptive statistics of the pretest. It is revealed that the range which is the difference of the highest and lowest values is 12. This supports the value of the variance which is 12. 913, meaning there is high variability in the results. The mean is 12.40 which has a descriptive equivalent of beginning (B). The skewness is -.804. It is a negative skew which means that there is a longer or fatter tail on the left side of the distribution. On the other hand,

Kurtosis is computed at -.386. It means that the distribution of values is flat and has thin tails. The standard deviation is 3.593 which implies greater amount of variation or dispersion in the results in relation to the mean. It indicates that the data are more spread out.

Table 3

Summary of the Descriptive Statistics of the Pretest

Indicators	Pretest
Range	12
Minimum	5
Maximum	17
Mean	12.40
Std. Deviation	3.593
Variance	12.913
Skewness	-.804
Kurtosis	-.386

From these results, the researcher strongly believes that it is important to know the reasons why the students were low and did not meet the expected mean value. It is also important to determine how the innovation could help improve the mathematical skills of the students, as well as their level of appreciation in mathematics.

According to Laerd Statistics (2021), descriptive statistics are very important because it does not only present raw data but enables teachers to present the data in a more meaningful way, which allows simpler interpretation. Therefore, the researcher advise that teachers also make use of descriptively analyzing the test results for a clearer picture of the true performance of the class, especially if a teacher has a large class size. This would also help the teacher in providing data for planned interventions to the students.

Appreciation Level of the Students in Mathematics Subjects

Self-concept in mathematics can be defined as student ratings of their skills, ability, enjoyment, and interest in mathematics is seen as an essential factor in their achievement in math. This study assessed the appreciation levels in math of selected Grade 9 students of Vinzons Pilot High School by answering a survey. The assembled information was dealt with measurably utilizing recurrence, weighted mean, and rank.

Table 3 reveals the result on the respondents' appreciation level of mathematics. The data show that 4 out of the 10 indicators received poor appreciation level among the respondents, while the other 6 were moderately appreciated by the students. The general weighted mean is 2.71 which is interpreted as moderate appreciation on the ten indicators.

Moreover, the indicators with the highest ratings were math as a secure subject, dealing with routine procedures and established rules (3.40), followed by math to be dealing with situations and ideas that come from the real world (3.20). On the other hand, the lowest means were on creating new knowledge from already established structures (2.20) and emphasizing the wonder, fascination, and mystique of surprising ideas (3.20).

The result means that students viewed math to be composed of routines and rules. This is true because routines support management and foster positive mathematics relationships. There are routines in problem solving, number sense, and other topics in math. Number routines are effective for reinforcing underemphasized skills. They are opportunities for practice and student

engagement setting the tone for a lesson that will be rich in sense-making and discussion.

Table 4

Appreciation Level of the Respondents in Mathematics

(N=40)

Indicators	Mean	VI	Rank
1. Math develops creativity, basing alternative and new ideas on established ones.	2.38	P	7
2. It develops rational thinking and logical argument.	2.75	M	5
3. It develops articulation, explanation and criticism of ideas.	2.85	M	4
4. It provides an understanding of the world around us.	3.05	M	3
5. It is a secure subject, dealing with routine procedures and established rules.	3.40	M	1
6. It emphasizes the wonder, fascination and mystique of surprising ideas.	2.28	P	9
7. It deals with situations and ideas that come from the real world.	3.20	M	2
8. It emphasizes the control of situation through its application.	2.63	M	6
9. New knowledge is created from already established structures.	2.20	P	10
10. It is full of fascinating ideas which seem to exist independently of human actions.	2.33	P	8
General Weighted Mean	**2.71**	M	

Legend:

4.50-5.00	-	Very High (VH)
3.50-4.49	-	High (H)
2.50- 3.49	-	Moderate (M)
1.50-2.49	-	Poor (P)
1.00-1.49	-	Very Poor (VP)

Another is that math deals with situations and ideas that come from the real world. This means that students appreciate connecting mathematics with its real-life applications. It shows students the relevance of what they are learning and

helps to foster a deep understanding of math in life. Letting the students make sense of the mathematical content they learn can have a significant positive impact on their lives.

On the other hand, the indicator least appreciated about math by student respondents were on it emphasizes wonder and fascinating ideas. Math is more on practical problems and application of principles. It does not cover much of the fantastical side of situations, it deals with numbers and values accuracy. These could be the reasons why students rated it the least. Another is on creating new knowledge from already established structures. There are times when math becomes too strict with rules, formula, and routines that sometimes restrict students to be creative.

These results mean that the appreciation level of the students is moderate and needs to be improved. In some ways, math can be very informative orderly to simplify and quantify things, but teachers can also use it to apply ideas and creativity when using it to explain how things in the surroundings work. It is important to emphasize to students that when learning about math, it is partly explaining how someone came to a particular conclusion and partly on how this idea can bring on other conclusions.

According to Levy (2018), there are several ways to improve student success and appreciation for math. First is to build confidence among the students that they can do and succeed in math. Second is encourage questioning and make space for curiosity. Third is to emphasize conceptual understanding over procedure. Fourth is to provide authentic problems that increase students' drive to

engage with math. And last is to share positive attitudes about math.

Significant Difference in Mathematical Performance of the Grade 9 Students After Having Been Trained on the Creative Application of E- Modulo Art Concepts

The researcher created two sets of questions, each with 30 items based on the third quarter competencies, on parallelograms and triangle similarity, being the competencies related to the concepts used in E-Modulo Art. The test questions were administered before and after the training of the respondents on the E-Modulo Art concepts. Based on the outcomes, the data were gathered, processed and evaluated to determine the effectiveness of the intervention to the students. The DepEd Memorandum No. 18, s. 2012 was also used to determine the level of mastery of the respondents before and after the training on the creative application of E-Modulo Art concepts.

Table 5
Summary of the Descriptive Statistics of Pretest and Posttest

Indicators	Pretest	Posttest
Range	12	10
Minimum	5	18
Maximum	17	28
Mean	12.40	24.93
Std. Deviation	3.593	2.712
Variance	12.913	7.353
Skewness	-.804	-1.127
Kurtosis	-.386	1.091

Table 5 shows the summary of the descriptive statistics of the pretest and posttest. It shows that the mean of the pretest is 12.40 while the mean of the posttest is 24.93. It indicates an increase of 12.53. The standard deviation of the pretest and the posttest are 3.593 and 2.712, respectively. It shows that there is a

decrease in the standard deviation of 0.881. It reveals that the scores are clustered closely to the mean.

The data shown tells that there is an increase in the performance of the Grade 9 student respondents after the training on the creative application of E-Modulo Art. For a clearer presentation of the data, Table 6 is shown below. The table shows the mean and the Mean Performance Level (MPL) of the Grade 9 student respondents.

Table 6
Mean Performance Level of the Grade 9 Students
(N=40)

Test	Mean	MPL	Descriptive Equivalent
Pretest	12.40	41.33	Average Mastery
Posttest	24.93	83.10	Moving Towards Mastery

Legend:

96-100	-	Mastered
86-95	-	Closely Approaching Mastery
66-85	-	Moving Towards Mastery
35-65	-	Average Mastery
15-34	-	Low Mastery
5-14	-	Very Low Mastery
0-4	-	Absolutely No Mastery

Table 6 presents the mean performance level of the respondents before the conduct of the training on E-Modulo Art concepts which was 41.33 with a descriptive equivalent of Average Mastery. After the training, the mean performance level increased to 83.10 with a descriptive equivalent of Moving

Towards Mastery. The mastery level of the respondents leveled up because of an increase of 41.77.

This result is supported by the study of Hinton, et al. (2018) wherein they cited that interventions are implemented in education classes to resolve academic difficulties and help to mitigate contextual variables. Their findings also pointed to the importance of igniting interest among students with lower performance given its strong link to mathematics performance. They also cited about the Interest-Driven Creator (IDC) theory in learning mathematics that suggests that students can be nurtured as creators after they have engaged in interest-driven learning activities regularly with technology support.

Table 7

Paired Sample T-Test Result
(95% Confidence Level)

Indicators	Pretest	Posttest
Mean	12.40	24.93
Std. Deviation	3.593	2.712
Paired Samples Test	**Pretest-Posttest**	
Mean	-12.525	
Std. Deviation	2.891	
95% Confidence Interval of Difference	-13.450 (Lower) -11.600 (Upper)	
t Stat.	-27.400	
P-value	<.001	

Meanwhile, according to the study of pretest-posttest design are very common in studies. A characteristic common to true pretest-posttest designs is that two or more measurements are taken on each experimental unit. Table 7 presents the paired sample T-Test result of the pretest and posttest administered before and after the training of the respondents on the creative application of E-Modulo Art

concepts.

The data show that the mean of the posttest is greater than the pretest. It has a difference of 12.53. The p-value for the two tail is <.001 which is less than the p-value of 0.05, which means that the training made by the researcher to the Grade 9 students on E-Modulo Art had a significant difference on the MPL of the students before and after the implementation. The significant difference between the mean indicates that training on the creative application of E-Modulo Art concept is an effective tool in increasing the mathematical abilities of Grade 9 students.

These findings were agreed by the article of Weber (2017) which stated that when art is used to teach mathematics, it can impact students' understanding and retention of key concepts and vocabulary. Both fields observe, describe, and imitate our natural world, which is important as students advance not only in mathematics or art, but also in science, technology, and engineering. Integrating art to math and vice versa provide students with tools to improve learning and strengthen skills needed to retain mathematics content.

Impact of E-Modulo Art on the Appreciation Level of the Grade 9 Students in Mathematics.

The researcher re-administered the tool used for determining the appreciation level of the respondents in mathematics. Table 8 reveals that 1 out of 10 indicators was rated moderate, 7 were high, and 2 were very high. The average mean is 4.04, interpreted as high.

In addition, the indicators with the highest ratings received were on being full of fascinating ideas which seem to exist independently of human actions (4.63)

and it provides an understanding of the world around us (4.50). The lowest ratings were on development of rational thinking and logical argument (3.68) and emphasis on the control of situation through its application (3.08).

Table 8

Appreciation Level of the Respondents in Mathematics

(N=40)

Indicators	Mean	VI	Rank
1. Math develops creativity, basing alternative and new ideas on established ones.	4.08	H	5
2. It develops rational thinking and logical argument.	3.68	H	9
3. It develops articulation, explanation and criticism of ideas.	3.73	H	8
4. It provides an understanding of the world around us.	4.50	VH	2
5. It is a secure subject, dealing with routine procedures and established rules.	4.48	H	3
6. It emphasizes the wonder, fascination and mystique of surprising ideas.	3.90	H	7
7. It deals with situations and ideas that come from the real world.	3.98	H	6
8. It emphasizes the control of situation through its application.	3.08	M	10
9. New knowledge is created from already established structures.	4.33	H	4
10. It is full of fascinating ideas which seem to exist independently of human actions.	4.63	VH	1
General Weighted Mean	4.04	H	

Legend:

4.50-5.00	-	Very High (VH)
3.50-4.49	-	High (H)
2.50- 3.49	-	Moderate (M)
1.50-2.49	-	Poor (P)
1.00-1.49	-	Very Poor (VP)

The result means that students learned to appreciate math more after their training on the creative application of E-Modulo Art concepts. All indicators had higher means as compared to the previous result before they were trained about E-modulo. It implies that they found math more relevant and meaningful to their lives. It could be that their interest in math improved due to the enjoyment of creating their own designs through the application of mathematical concepts.

Intervention/Innovation Material Proposed to Improve the Skills of the Grade 9 Students in Modulo Art.

The proposed innovation is entitled Electronic Modulo Art Design Handbook. It is a 27-page output printed in a short size bond paper, substance 20. The pages were printed in colored so that students will find it appealing, and realistic.

Plate 1 shows the preliminary pages which include the cover page, short introduction, learning outcomes, and table of contents. The introduction gives a background information about modulo art. Learning outcomes were also provided so that the learners will have the idea on what are expected of them as they go through the activities in the handbook. Technical terms used in the handbook were defined in the vocabulary part. The handbook has 6 chapters which are as follows: Clock Arithmetic, Modular Arithmetic, Different Types of Modulo Art Grids, Generating Patterns with 3 Rs, Complete Examples of Modulo Art Design, and Tips and Tricks in E-Modulo Art.

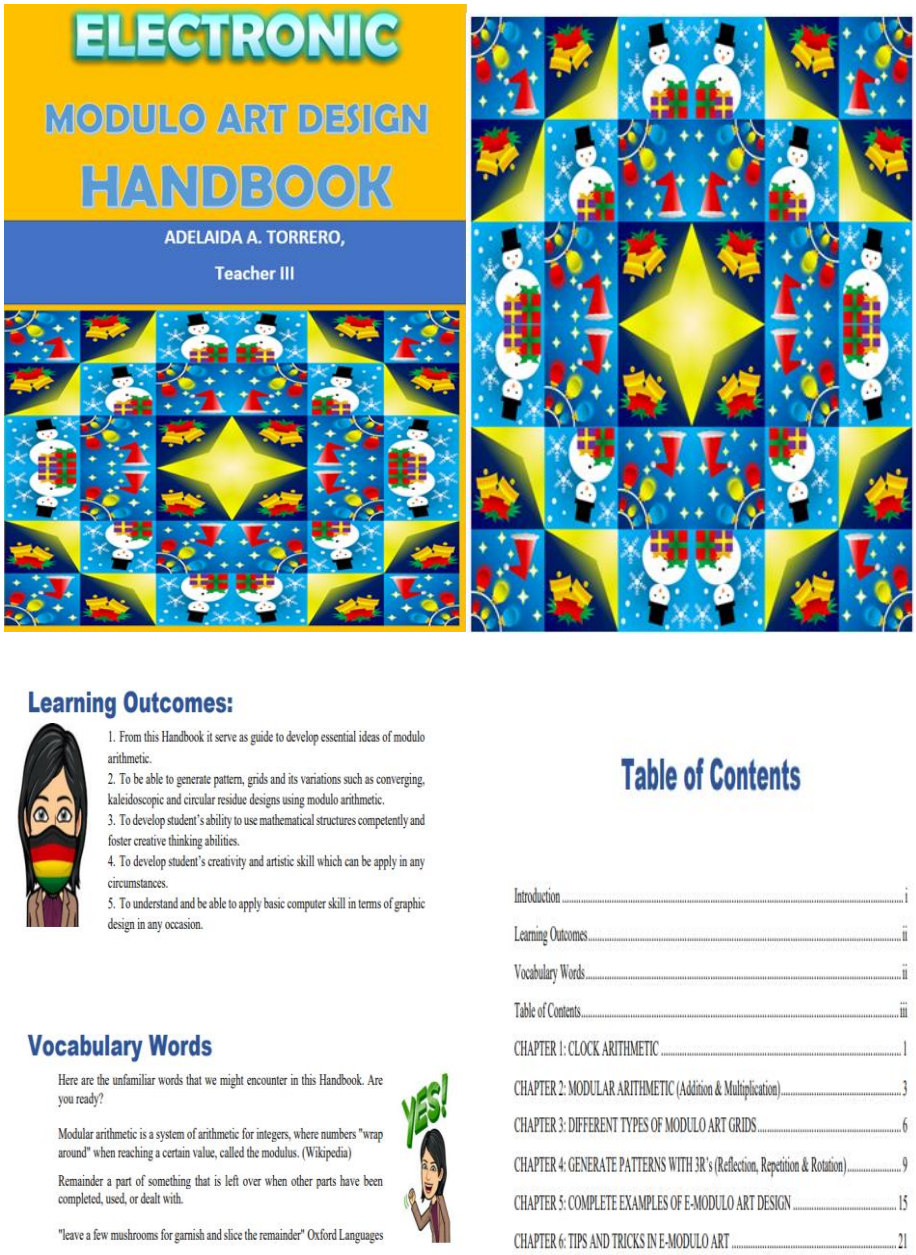

Plate 1
The Preliminary Pages

Plate 2 shows an example of what the students will see on each chapter. Plate 3 shows the sample designs provided. Plate 4 shows the tips and tricks on how to make life easier in creating designs electronically. The handbook is basically a tutorial handbook for beginners and those who would like to learn the

concepts behind modulo art.

CHAPTER 2: MODULAR ARITHMETIC (Addition & Multiplication)

From the previous chapter we tackle the Clock Arithmetic. Now let us apply the Clock Arithmetic to be able to construct an arithmetic table of modular numbers.

A.

+	0	1	2	3	
0	0	1	2	3	Row 1
1	1	2	3	0	Row 2
2	2	3	0	1	Row 3
3	3	0	1		Row 4
	Column 1	Column 2	Column 3	Column 4	

Type: ADDITION (Modulo 4) or ADDITION (mod 4)

In this Modulo 4 as shown that it can carry on to only 0, 1, 2 ,3 and the exceeding number will be the remainders.

Problem:

There is a missing modular number in the green square and the enclosed are in *Column 4 & Row 4* which correspond to 3 + 3. What is the exact number to be put on in the missing modular number?

Given:

4^{th} Column = 3

4^{th} Row = 3

(Mod 4)

Solution:

To solve that we can use the equation of Clock Arithmetic.

Equation: Column + Row = 3 + 3 = 6 – 4 = 2

or

3 + 3 = 6÷4 = 2 is the remainder

+	0	1	2	3	
0	0	1	2	3	Row 1
1	1	2	3	0	Row 2
2	2	3	0	1	Row 3
3	3	0	1	2	Row 4
	Column 1	Column 2	Column 3	Column 4	

Answer:

The missing number inside the grid entry is 2

Plate 2
Sample Chapter Content

CONVERGING SEGMENT

LEGEND:

DESIGN PATTERN:

Modular Operation:
Multiplication

Generated Design:
Repetitive

MOD #4
NUMBER PATTERN:

0	0	0	0
0	1	2	3
0	2	1	2
0	3	2	1

Plate 3
Sample Completed Design

CHAPTER 6: TIPS AND TRICKS IN E-MODULO ART

In E-Modulo Art Design use Microsoft PowerPoint Presentation instead of Microsoft Word Document. In fact it gives more comfortable editing tool for creating simple shapes, illustrations and others.

There are also a lot of Keyboard Command or Shortcut in PowerPoint:

- Ctrl + C "Copy"
- Ctrl + X "Cut"
- Ctrl + V "Paste
- Ctrl + Shift +] "to Send Forward"
- Ctrl + Shift + ["to Send Backward"
- Ctrl + Z "Undo AutoFormat"
- Ctrl + Y "Redo the last action
- Hold Ctrl + Left Click "to Select Multiple Shapes"
- Ctrl + G "after selecting multiple shapes you want to Group Object"
- Ctrl + Shift + G "after selecting the group object that you want to Ungroup Object"

The First thing to do in modulo art is to Insert Shapes you can find it at the Tab. There is various shape to choose from and you can make one object by merging two or more shape.

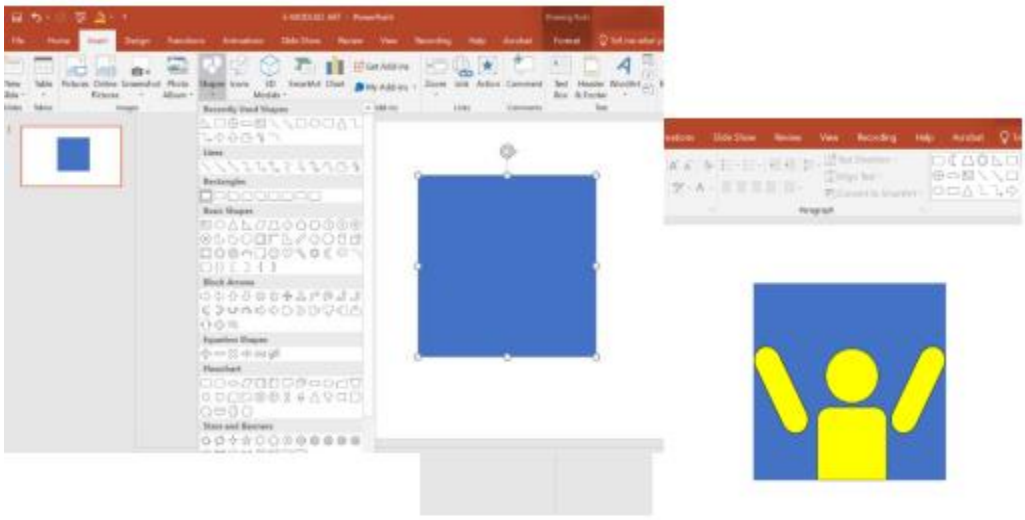

Plate 4
The Tips and Tricks on E- Modulo Art

As one could notice, the handbook has two parts, the conceptual and illustrative, and practical part. The terms used were simple and understandable

and it is hoped that students and teachers will be able to easily learn modulo art with this handbook.

EVALUATION RESULT ON THE DEVELOPED INTERVENTION/ INNOVATION MATERIAL

In this study, the jurors of the handbook were the 5 Mathematics Teachers of Vinzons Pilot High School. They were chosen since they are considered knowledgeable with the Mathematics Curriculum and the teaching and learning process.

a. Content

Table 9
Handbook's Content
(N=5)

Evaluation Criteria	Overall Rating	
	Mean	VI
1. Content is suitable to the student's level of development.	4	VS
2. Material contributes to the achievement of specific objectives of the subject area and grade/year level for which it is intended.	4	VS
3. Material provides for the development of higher cognitive skills such as critical thinking, creativity, learning by doing, inquiry, problem solving, etc.	4	VS
4. Material is free of ideological, cultural, religious, racial, and gender biases and prejudices.	4	VS
5. Material enhances the development of desirable values and traits.	4	VS
6. Material has the potential to arouse interest of target reader.	4	VS
7. Adequate warning/cautionary notes are provided in topics and activities where safety and health are of concern.	3	N/A
Total	27	Passed

Legend:
Resource must score at least 21 points out of a maximum 28 points to pass this criterion.

For the content, the handbook must be able to attain 21 points out of a

maximum 28 points to pass this criterion. Based on the data in Table 2, the content of the worksheets passed the required total points. The jurors rated it with 27 points. Only one indicator did not receive a very satisfactory rating due to its inapplicability.

b. Format

For the format, the handbook must score at least 72 points out of a maximum 72 points to pass this criterion. Based on the data in Table 3, the format of the handbook passed the required total points. The five jurors rated it with the maximum points of 72.

Table 10
Handbook's Format

Evaluation Criteria	Overall Rating	
	Mean	VI
1.Prints		
1.1 Size of letters is appropriate to the intended user.	4	VS
1.2 Spaces between letters and words facilitate reading.	4	VS
1.3 Font is easy to read.	4	VS
1.4 Printing is of good quality (i.e., no broken letters, even density, correct alignment, properly placed screen registration).	4	VS
2. Illustrations		
2.1 Simple and easily recognizable.	4	VS
2.2 Clarify and supplement the text.	4	VS
2.3 Properly labelled or captioned (if applicable).	4	VS
2.4 Realistic / appropriate colors.	4	VS
2.5 Attractive and appealing.	4	VS
2.6 Culturally relevant.	4	VS
3. Design and Layout		
3.1 Attractive and pleasing to look at.	4	VS
3.2 Simple (i.e., does not distract the attention of the reader).	4	VS
3.3 Adequate illustration in relation to text.	4	VS
3.4 Harmonious blending of elements (e.g., illustrations and text).	4	VS
4. Paper and Binding		
4.1 Paper used contributes to easy reading.	4	VS
4.2 Durable binding to withstand frequent use.	4	VS
5. Size and Weight of Resource		
5.1 Easy to handle.	4	VS

5.2 Relatively light.	4	VS
Total	72	Passed

Legend:
Resource must score **at least 54 points** out of a maximum **72 points** to pass this criterion.

c. Presentation and Organization

For the presentation and organization, the handbook must score at least 15 points out of a maximum 20 points to pass this criterion. Based on the data in Table 11, the presentation and organization of the handbook passed the required total points. Three jurors rated it with the maximum points of 20.

Table 11
Handbook's Presentation and Organization

Evaluation Criteria	Overall Rating	
	Mean	VI
1. Presentation is engaging, interesting, and understandable.	4	VS
2. There is logical and smooth flow of ideas.	4	VS
3. Vocabulary level is adapted to target reader's likely experience and level of understanding.	4	VS
4. Length of sentences is suited to the comprehension level of the target reader.	4	VS
5. Sentences and paragraph structures are varied and interesting to the target reader.	4	VS
Total	20	Passed

Legend:
Resource must score **at least 15 points** out of a maximum **20 points** to pass this criterion.

d. Accuracy and Up-to-datedness of Information

For the presentation and organization, the handbook must score 24 out of a maximum 24 points to pass this criterion. Based on the data in Table 12, the accuracy and up-to-datedness of information of the handbook passed the required perfect score of 24 points. All jurors rated the material with the perfect score of 24

in all criteria.

The jurors have not identified any computational errors, factual errors and obsolete information after the second validation. During the first validation, the jurors noted some errors which were already corrected by the researcher such as typographical errors.

Table 12
Handbook's Accuracy and Up-to-datedness of Information

Evaluation Criteria	Overall Rating	
	Mean	VI
1. Conceptual errors	4	VS
2. Factual errors	4	VS
3. Grammatical errors	4	VS
4. Computational errors	4	VS
5. Obsolete information	4	VS
6. Typographical and other minor errors (e.g., inappropriate or unclear illustrations, missing labels, wrong captions, etc.).	4	VS
Total	24	Passed

Legend:
Resource must score **24** out of a maximum **24 points** to **pass** this criterion.

SUMMARY

In summary, the results revealed that the performance of the students are at the beginning level and their appreciation level was moderate. After they were trained on the creative application of E-Modulo Art Concepts, their performance improved as revealed by the significant difference in the pretest and posttest results. Also, there was a positive impact of the intervention made on the appreciation level of the students. A handbook was created by the researcher as the output of the study. It was validated and as per result, it passed in terms of the LRMDS criteria for print resources.

REFLECTION

This study had positive impact on the researcher. First, the researcher was able to help improve the performance and appreciation levels of her students in the math subject. Second, she was able to make a handbook that she can use in class, and also other teachers who are interested in introducing E-modulo art to their students. Third is that she was able to understand more the rigors of research. The experience was very informative for her because she was able to read a lot of literature and studies on the subject being investigated.

The researcher also realized the importance of identifying the real problem when students have low performance. Teacher must also be creative and innovative on addressing problems so that learners will be more engaged due to the novel learning experiences you are introducing to them. Finally, she recommends that the output be further enhanced by being evaluated at the division level so that it is not just VPHS teachers who will be benefited and could use the material, but also other teachers in the division.

ACTION PLAN

This section provides the plans of the researcher in the dissemination, utilization, and advocacy of the results of the study. There were three strategies indicated with supporting activities, the key players, timeline, and means of verifying the successful implementation of the activities.

Goal: To disseminate the research report and output to all teachers in Vinzons to help improve the assessment practices and address the challenges faced not just by Grade 9 Math teachers but to all Math teachers .

Strategies	Activities	Person (s) Responsible	Timeline	Mode of Verification
Integrate in the School-based LAC sessions topic on the dissemination and implementation of the E-Modulo Handbook	1. Request for a meeting with the Math teachers 2. Prepare training proposal 3. Conduct of the training and evaluation of the activity	School Heads, PSDS, Teachers, Proponent	November 2022	Approved training proposal Training Accomplishment Report Narrative report of the school-based LAC session indicating the inclusion of the topics
Assist teachers in the utilization of the handbook	1. Assist teachers in the utilization of the handbook 2. Serve as speaker to E-modulo training	Teachers, Proponent	December 2022- July 2023	Certification
Validation of the material for further improvement and recommendation to be used in the Division of Camarines Norte	1. Have the material validated by the school up to the Division LRMDS team 2. Revision or modification of the output based on the recommendations given 3. Revalidation of the material 4. Seek for recommendation to use the material in the Division	School LRMDS Team, School Head, Division LRMDS Team, Proponent	December 2022	Uploaded material in the Division LRMDS Portal

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FINANCIAL REPORT

ACTIVITY	CASH OUT	BALANCE
ACTION RESEARCH FUND(BERF) FACILITY GRANT		15,000
Notarization of Proposal Sent to DepEd-ROV RELC, Rawis, Legaspi City	330.00	14,670
Materials used for crafting proposals from Pretest to Posttest implementation	3,200	11,470
Food expenses for making intervention materials	2,500	8,970
Repair of E -Modulo Art Learning Hub	8,970	0.00

Prepared by:

ADELAIDA A. TORRERO

Teacher III/Proponent