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## Project Oriented Approach in Teaching Mathematics: Effects on Engineering Technology Students' Interest and Performance

Engr. Maulana M. Dadayan, MSciEd<sup>1\*</sup>, Siteinainah S. Dadayan, LPT, CAR<sup>2</sup>

<sup>1, 2</sup> Mindanao State University – Marawi, Philippines

\*Corresponding Author email: [dadayanmaulana0912@gmail.com](mailto:dadayanmaulana0912@gmail.com)

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### Abstract

**Aim:** This study primarily aimed to investigate effects of project-oriented approach in teaching mathematics towards the students' performance and interest in math among college students in the engineering technology courses at MSU-Lanao National College of Arts and Trade in Marawi City.

**Methodology:** Using a quasi-experimental research design, the respondents were grouped into two, the Experimental Group and the Control Group. Data were gathered using achievement test in math which was administered as pretest and posttest; interest test in mathematics; POA lesson plan; field notes, and journal logs. After the data was gathered, it was analyzed using SPSS for windows.

**Results:** Findings of the study revealed that the POA positively influenced the students' mathematics performance and interest for the reason that the experimental group has gained higher mean difference compare to that of the control group for based on the mean significant difference results of Pretest (t-test value of -75.091,  $p < 0.05$ ) and Posttest (t-test value of -64.934,  $p < 0.05$ ) Experimental Group gained 10.14 which is greater than the 3.773 result of Control Group, and as for the interest test, the mean difference of Pre-interest test of the Experimental Group were 14.136 which is greater than the 4.863 result of Control Group; therefore, there is a significant difference in the mathematics performance of the two (2) groups namely the Experimental Group and the Control Group after the intervention.

**Conclusion:** The students' Mathematics performance improved significantly, especially the students under the experimental group that exposed to POA method of teaching it had gained of 10.140. Thus, putting the knowledge based on the improvement of the students' achievements at their work in classroom must be recognized. Also, the quality of the implementation of a teaching practice greatly influences its impact on students' learning. Using manipulative materials to investigate a concept, like project-oriented approach for example, depends not only on *whether* manipulative materials are used, but also on how they are used with the students.

**Keywords:** *Project-Oriented Approach, Students' Interest, Students' Performance, Interactive Approach, and Learning Skills*

### INTRODUCTION

Mathematics is a difficult and boring course/subject to many students in all levels of education (elementary, secondary and college). In fact, only few felt comfortable in taking mathematics subject. But people who believe and love mathematics know that there is no failure, only challenges in mathematics. And these challenges can be hurdled by proper way of learning. The problem as observed is students who do not have the full spirit to learn Mathematics, Science and Technology is now in anxiety and find difficulty in moving on.

The consistent poor performance of our students in mathematics as evidenced by the results of National Achievement Test (NAT, 2005) and international assessments (e.g. TIMSS, 2005) confirms the public perception that the quality of basic education is deteriorating (Brawner & Andrada, 2005). Based on data recorded within the ARMM Region, in the 2006-2007 NAT result, ARMM was still one of the poorest performing regions. Grade 6 pupils who participated in the National Achievement Test (NAT) in SY 2006-2007 that achieved a 75 % "mastery level", Basilan has (0.8 %), Lanao del Sur 1 has (0.9 %) and Marawi City has (3.6 %) which gives a total of (5.3 %) of the grade 6 pupils who achieved the 75 % "mastery level" yet hardly any of these provinces had sufficient competence in Science

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when compared to the rest of the Philippines which has a total of (8.3 %) of the Grade 6 students that achieved the 75 % "mastery level" and 37% of the grade 6 pupils achieving the 60% "near-mastery level".

In high school level, the Mindanao State University–System-Wide Admission and Scholarship Examination (MSU-SASE) results are also evidences of students' low performance in mathematics which fail to satisfy the expectations of concerned parents and teachers. The weighted average scores in percent obtained by the Mindanao State University –Lanao National College of Arts and Trade (MSU-LNCAT) feeder high school was only 11.67% in SASE 2013; 10.67% in SASE 2012; 10.44% in SASE 2011; 9.56% in SASE 2010; and 9.78% in SASE 2009, compared to the MSU-IIT students who had weighted average score of 16.67% in SASE 2013. Because of this it becomes necessary for mathematics teachers to look into different approaches that would entice the student's interest towards learning mathematics. Teachers will have to think like chefs who experiment with food presentations such that the materials they present to their students would look not only palatable but delicious.

However, the problem is that many students perceive mathematics as a very difficult area of study. Many students gained no interest towards learning the field with all the numerical figures. Students from the ARMM, Marawi City and MSU-LNCAT are not exempted from this predicament. According to Gumal (2016), Maguindanao and Lanao Del Sur including Marawi City were found to be poor in mathematics due to the mathematics teachers that are not major in mathematics, the teaching strategies were not appropriate and updated, and the student's attitudes and interest in mathematics did not directly lead to better and productive learning and teaching outcomes.

There are different approaches to teaching mathematics. Some of those are integrated approach (interdisciplinary), problem-based approach, cooperative learning, problem posing, project-oriented approach and so on. Project-oriented approach is the teaching approach used in this study. This approach is expected to promote better interest and performance of the students in learning Mathematics, Science and Technology. This study on Project Oriented Approach in Teaching Mathematics (POATM) will help solve the students clamor for a simplified approach in teaching Mathematics. This approach is becoming popular for providing enriching; cognitively demanding experiences for Limited-English-proficient (LEP) students. The project approach involves any type of group learning activity that brings about a sustained period of self-reliant effort by learners to achieve a clearly defined goal, Vigil (1996). Because of this reason, the researcher is hoping that this study POATM would also be an effective approach in teaching mathematics subjects that could enhance student's interest and performance in mathematics in Lanao Del Sur and Marawi City, particularly for the MSU-LNCAT students.

### Objectives

This study focused on the strategy in teaching Mathematics of First Year College of Engineering Technology students of MSU-LNCAT, Marawi City. Specifically, it sought to answer the following questions:

1. What is the mathematics performance of students exposed to Project-oriented Approach in Teaching Mathematics (Experimental Group, EG) and those students exposed to the Traditional Mathematics Teaching Approach (Control Group, CG) before and after intervention?
2. What is the mathematics interest of students in the experimental and control groups before and after intervention?
3. Is there a significant difference in the mean scores of students in the experimental and control groups in the mathematics performance test before and after intervention?
4. Is there a significant difference in the mathematics interest of students in the experiment and control groups before and after intervention?
5. Is there a significant relationship of students' interest in mathematics with their performance before and after intervention?
6. Is there a significant change in the students' interest and performance in mathematics in both experimental and control groups before and after intervention?
7. How do the students' interest and performance in mathematics change in both students' participants of the experimental and control groups?
8. What are the traces of students' change of interest and performance in mathematics in the experimental group?

### Hypothesis

Given the stated research problem, the following hypotheses were tested on 0.05 level of significance:

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Hypothesis 1: There is a significant change in the students; interest and performance in mathematics in both experimental and control groups before and after intervention.

Hypothesis 2: There is a significant relationship between the students' interest in mathematics with their performance before and after intervention.

**METHODS**

**Research Design**

This study used quasi-experimental research design to determine whether the Project Oriented Approach method of Teaching Mathematics is more effective than the traditional method of teaching. In this design, control and experimental groups were used in the study. The control group was exposed to traditional method of teaching while the experimental group was exposed to the treatment where the project oriented approach in teaching mathematics was used. Using a two group pretest-posttest design, pretest was given prior to the grouping of the respondents while posttest was given later after the treatment. Pre-test scores of the respondents serve as baseline for their mathematics performance. The assigning of the respondents group was done through matched pair using their grades in their previous subject Workshop Mathematics – 1 in order to be sure that the two (2) groups belong statistically the same level of thinking and capability. Moreover, interest test was used before and after the treatment to find out if there are improvements in the interest of the students towards Mathematics. Though this experiment consumed a short period of time, it is purely experiment in nature. Following is the diagram of the research design used in this study.

Groups	Matched	Pretest	Treatment	Posttest
Experimental Group	M <sub>1</sub>	Q <sub>1</sub>	X	Q <sub>3</sub>
Control Group	M <sub>2</sub>	Q <sub>2</sub>	O	Q <sub>4</sub>

M<sub>1</sub> represent the Matched students for the Experimental Group, while M<sub>2</sub> are the Matched students for the Control Group. They were matched through their average grade in their previous math subject, Workshop Mathematics – 1. Q<sub>1</sub> represents the Pretest result of Experimental Group and at the same time it serves as baseline score whereas Q<sub>2</sub> represent the Pretest result of Control Group and it will also serves as baseline score.

X represents the intervention or treatment for Experimental Group whereas O represents no intervention or treatment for Control Group.

Q<sub>3</sub> represent the posttest result of Experimental Group whereas Q<sub>4</sub> represent the posttest result of Control Group.

Based on these data results, the evaluation for performance of these two groups can be made.

**Population and Sampling**

There were forty-four (44) students from the Engineering Technology Students of MSU- Lanao National College of Arts and Trades that participated in the study. This intact number of students serves as the respondents and was divided into two (2) groups through matched pairing based on the grade results of their previous grade in Workshop Mathematics-1. Group 1 serves as the Experimental Group and group 2 serves as the Control Group. Each group consists of twenty-two (22) students. The 1<sup>st</sup> group, the Experimental Group, was exposed to the Project-Oriented Approach while the 2<sup>nd</sup> group, the Control Group, was just exposed to Traditional Approach in teaching.

**Instruments**

There were five (5) types of research instruments used by the researcher to gather data on this study. These instruments are: (1) Achievement Test in Mathematics, (2) Interest Test in Mathematics, (3) POA Lesson Plan, (4) Field notes, and (5) interview. Each instruments were described below:

1. Achievement Test

This instrument was administered as the Pretest and Posttest. This test contains questions involving Fractions, Ratio and Proportions, and basic Geometry in a multiple choice and matching type (see Appendix 1 and table 3.1 in Appendix 3). The Test-questioner (see Appendix 1) consists of fifty (50) questions. Moreover, the Achievement Test content was validated by Dr. Acsara A. Gumal, a mathematics education expert from the dean's office of MSU-Lanao National College of Arts and Trades.



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2. Interest Test in Mathematics

The second instrument was the interest test in Math (See Appendix 2). This test was used to evaluate the students interest in mathematics using Likert –scale adapted from LISD Student Interest Survey - Math Motivation (9-12), Retrieved September 22, 2014 (<https://www.surveymonkey.com/r/339S5JK>).

3. POA lesson plan

The third instrument was the POA lesson plan (See Appendix 4). This instrument was designed as the treatment employed in the experimental group with the following topics covered during the duration of the experiment; 1) in the first week from April 5 & 7, 2016, which was equivalent to six (6) hours topics given includes: *Familiarization of fractions, Addition of fractions, Subtraction of fractions, Multiplication of fractions and Division of fractions.* The learning procedures were supported with visual aids and designing project model activities, 2) from April 12, 14, & 19, 2016, which was equivalent to nine (9) hours, the students were exposed to learn Ratio and Proportions. Under these topics were the comparisons of *Ratio to another Ratio, Projection of sells, Projection of measurement and Mixture problems,* 3) from April 21, 26, 28 and May 3 and 5, 2016, which was equivalent to fifteen (15) hours the students were exposed the following topics namely: *Matching type, Familiarization of some formulas, Computation of some areas, Perimeters and Volumes of some geometrical figures.*

4. Field notes

Field notes were made by the researcher during class observation recording all activities, behavior and attitudes of the respondents during the entire period of the experiment. This instrument is designed to capture the teacher-student’s interaction and how the topics maintain the student’s active participation in the classroom discussion.

5. Interview guide with the used of Journal log

The questions made for this interview were basically designed to get the perceptions of the students in POA during the sessions. Follow up questions were also asked to gain exhaustive answer from the respondents. Interviews were then documented and written by hired Research Assistance with camera to ensure the reliability of the information’s gathered.

**Data Collection**

Five (5) types of research instruments were utilized by the researchers to gather the primary data for this study namely: (1) Achievement Test in Mathematics, (2) Interest Test in Mathematics, (3) POA Lesson Plan, (4) Field notes, and (5) interview schedule.

Data were collected by observing the protocol. The first step employed was the letter of permit from the head of the MSU-LNCAT institution allowing the researcher to conduct the study. After obtaining necessary permission, the researcher oriented the possible respondents of the study giving them a brief background on the purpose of the study. As such, all 44 students engineering technology students served as the respondents of the study and they were given a pre-test on achievement test and interest test in mathematics. After the pretest, the forty-four (44) students were divided into the experimental group or control group through matched pairing based on their previous grades in the Workshop Mathematics – 1. This technique was used to ensure that each group is comparable enough in terms of their mathematics performance as measured by their previous grades in their subject WM-1.

As results of grouping, treatment for the experimental group which is the POA lesson plan and POA teaching method was employed and delivered to the respondents in the said group. On the other hand, respondents assigned in the control group were taught with the same topics in the POA lesson plan but in the TA method of teaching. During the experiment the researcher observed the class and took down notes for the field note. The respondents were asked to explain of what they had experienced and felt in the journal log and asked some interview questions posted while the researcher took note in from time to time in every class session. After the entire period of experiment, all gathered data were then tabulated and analyzed using Statistical Packages for Social Science (SPSS) for Windows.

**Treatment of Data**

The data gathered were analyzed using SPSS for Windows and the hypothesis were tested at  $\alpha = 0.05$  level of significance. Specifically using the following mathematical tools:

1. **Arithmetic mean** – the average of a set of numbers, calculated by adding them together and then dividing their sum by the number of terms (Microsoft Encarta, 2009).

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2. **Standard deviation (SD)** - a number representing how closely bunched a set of numbers is around its mean, or average value. The standard deviation is an important concept in statistics because it is a precise indicator of the degree of variability within a set of numbers. A set with a smaller standard deviation consists of more closely bunched numbers than a set with a larger standard deviation (Microsoft Encarta, 2009).
3. **Mean** – also known as the arithmetic mean, a value that helps summarize an entire set of numbers. It is used in examining large collections of numbers to be able to present a number that provides a summary of the data. Such numbers are often called descriptive statistics (Microsoft Encarta, 2009).
4. **Levene’s test** - is an inferential statistic used to assess the equality of variances for a variable calculated for two or more groups (Levene, 1960).
5. **T-test** – is a statistical examination of two population means. A two-sample t-test examines whether two samples are different and is commonly used when the variances of two normal distributions are unknown and when an experiment uses a small sample size (Levene, 1960).

**Ethical Considerations**

The researcher ensured that all research protocols involving ethics in research were complied for the protection of all people and institutions involved in the conduct of the study.

**RESULTS and DISCUSSION**

**Mathematics Performance of the Respondents**

Performance of the respondents in Mathematics was measured through the use of Achievement test in Mathematics designed by the researcher involving the concepts of fractions, ratio and proportion, and basic geometrical skills. Table 1 below presents the results of the respondents’ mathematics performance before and after treatment.

Table 1  
*Mathematics Performance of Students Exposed and not Exposed to make Project Oriented Approach in teaching Mathematics before and after the Intervention*

Mathematics performance of students	Before Intervention		After Intervention	
	Experimental <i>n</i> =22	Control <i>n</i> =22	Experimental <i>n</i> =22	Control <i>n</i> =22
<b>Mean</b>	17.636	17.227	28.046	21.00
<b>SD</b>	5.687	4.810	3.748	3.8669

As shown in Table 1, respondent’s performance in Mathematics before intervention was comparable considering that the mean of both groups experimental and control is almost the same. As shown, the mean scores of the control group were 17.227 before intervention and 21.000 after the intervention, while the experimental group has mean scores of 17.636 before intervention and 28.046 after the intervention. The results of the computation on Table 1 implies that the performance of the control group slowly improved whereas the performance of experimental group improves better than the control group as it has been computed in table 1. The better improvement on the performance of respondents in the experimental group might be due to the POA teaching methods. Based on the researchers’ observations it was noted on his field notes, *it has been noticed that some of them listen with full attention in the first session, and later on, it has been observed that all of them were curious everybody works with full of interest to find and get the right answers on their activity problems.*

Based on the interview of the researcher to the respondents in the experimental group, answering the question “*does the project oriented approach enhances learning strength and increases your interest in math?*”? Excerpt below are some of their opinion.



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Mathematics with activities help me a bit to understand subject matter as well as the instruction.

("Mathematics with activities helps me a lot to understand subject matter as well as the instruction", Nurs, Interview Written Response, 4/12/16)

I believe it does for it provides us an easier way to understand Math and if we know and can comprehend the nature of Mathematics, it might enhance our interest in learning it.

("I believe it does for it provides us as easier way to understand Math and if we know and can comprehend the nature of Mathematics, it might enhance our interest in learning it", Ainah, Interview Written Response, 4/12/16)

I prefer for the instruction with activities in order to supplement my understanding to the subject matter

("I prefer for the instruction with activities in order to supplement my understanding to the subject matter", Nur, Interview Written Response, 4/12/16)

I prefer most of the instruction with project activities

("I prefer most of the instruction with project activities", Nurs, Interview Written Response, 4/12/16)

### Respondents' Interest in Mathematics

Respondents' interest in math was measured using Mathematics Interest Survey 2010/2011 Adapted from LISD Student Interest Survey - Math Motivation (9-12). Table 2 below shows the tabulated results of the respondents' interest in mathematics.

Table 2

Mathematics Interests of Students Exposed and not exposed to Project Oriented Approach in teaching Mathematics before and after the Intervention

Mathematics Interests of students	Before Intervention		After Intervention	
	Experimental <i>n</i> =22	Control <i>n</i> =22	Experimental <i>n</i> =22	Control <i>n</i> =22
Mean	148.682	138.864	162.818	143.727
SD	9.959	8.610	14.670	8.525

As depicted in the table above, the mean score of pre-interest test of control group was 138.864 before and 143.727 after distribution of the lesson plan. The difference of mean of control group before and after was 4.864. the mean score of experimental group before intervention was 148.682 and 162.818 after intervention. The difference of mean score of experimental group before and after intervention was 14.136; therefore, it implies that the interest of control group increased a little while the interest of experimental group increased a lot. This also was proven on the



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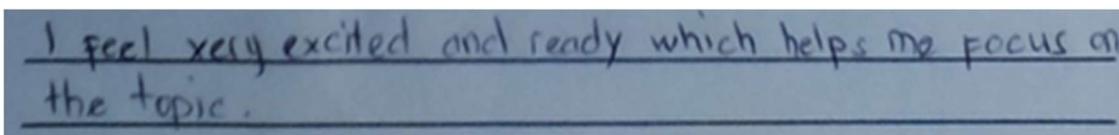
field note as the researcher observed during the second meeting of the experiment on April 7, 2016 in the morning which was quoted below;

*They finished the two activities and answered the question on it faster than what the researcher expected.*

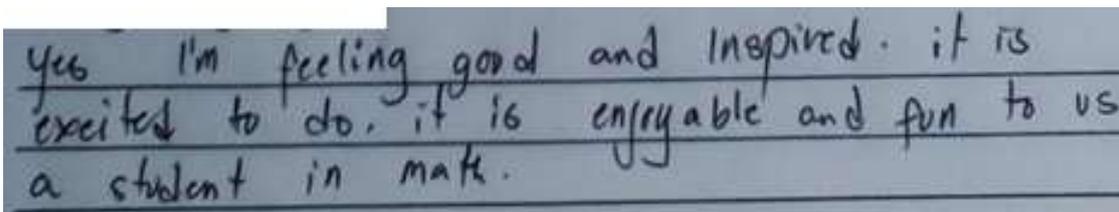
*The researcher observed that most of the students worked hard and has increased their interest and curiosity to find the right answers of the given problems on their activities they performed.*

*Most of the students ask questions on how they could properly follow the procedure as stated in the lesson plan for Experimental group. till such time they understand well and then they finished their work activities.*

In the same manner, this proof can be seen in the respondents' journal below. In addition, this can also be proven in the traces based on the student's responses on question number 4 stating "How do you feel when you are doing activities, feeling good and inspired or feeling boring?"

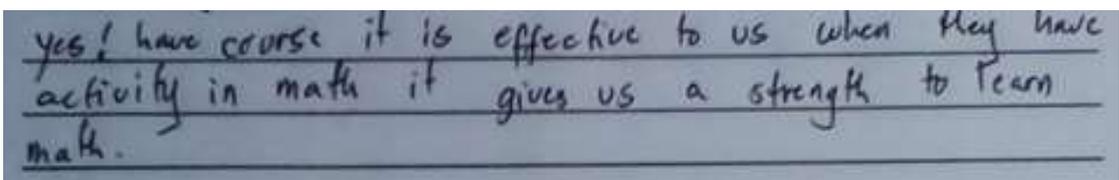


("I feel very excited and ready which helps me focus on the topic", Taslima, Interview Written Response, 4/12/16)



("Yes. I feel good and inspired. It is exciting to do. It is enjoyable and fun for us students", Cam, Interview Written Response, 4/12/16)

On question number 1, many students said that mathematics course is effective when activities in math are provided. Excerpt below is some of their common answers.



("Yes! Of course it is effective to us when the instructors give activities in Math. It gives us strength to learn Math", Cam, Interview Written Response, 4/12/16)

### **Comparison of Experimental and Control Group of students' Mathematics Performance Before and After Intervention**

To further validate the results presented in Table 1, t-test for equality of means was done comparing the pretest and posttest mean scores of the respondent's in the control and experimental group and the results were presented in Table 3.

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Table 3  
*T-test and Significance (p) Values on the Comparison between the Control Group and Experimental Group of Student's Pretest Mean and Posttest Mean*

Test	Group	N	Mean Score	t-test	p-value
<b>Pretest</b>	Control group	22	17.227		
	Experimental group	22	17.636	-0.258	0.798 (ns)
<b>Posttest</b>	Control group	22	21.000		
	Experimental group	22	28.046	-6.137	0.000 (s)

s – significant at 0.05 level of significant

It can be seen from Table 3 that during pretest, the t-value is -0.258 with a p-value of 0.798 which is greater than 0.05 level of significance. This implies that there is no significant difference between the pretest mean scores of the control and experimental groups prior to treatment in the experimental group. After the intervention, results revealed that the posttest mean scores between the groups significantly differ considering that the t-value is -6.137 with a p-value of 0.000 which is smaller than 0.05 level of significance. This implies that the respondents exposed to POA performed better than the students exposed only to TA.

On the other hand, for the Experimental Group, the mean score was 17.6364 before the intervention and 28.0455 after the intervention. The significant difference of mean score before and after intervention was 10.4091 (See Appendix 7 for the details of computation). The results clearly implied that each group, Control and Experimental group, mathematics performance differ significantly after the intervention in favor of the experimental group. This significant difference maybe the positive effects of the POA on students learning skills in mathematics. Valdez (2009) research findings support the findings of this study wherein, she pointed out that when students were exposed to modular instruction with varied activities learned more and performed better than when exposed to traditional method of teaching which is less structured and less activities provided. Moreover, Valdez (2015) also contends that the critical thinking skills of the students improved significantly if they were exposed to activity-based and cooperative learning approach. This is also consistent with the propositions as mentioned in various literature (Dizon & Sanchez, 2020; Muñoz & Sanchez, 2023; Salendab & Sanchez, 2023; Sanchez, 2023a; Sanchez & Sarmiento, 2020)

**Comparison of Experimental and Control Group of Students' Mathematics Interest Before and After Intervention**

To test whether there is a significant difference on the respondents' interest, t-test for equality of means were computed comparing their mean score during pretest and posttest. The results were presented in Table 4.

Table 4  
*T-test and Significance (p) Values on the Comparison between the Control Group and Experimental Group of Student's Interest in Math before and after the Intervention*

Test	Group	N	Mean Score	t-test	p-value
<b>Pretest</b>	Control group	22	138.864		
	Experimental group	22	148.682	-3.498	.001 (s)
<b>Posttest</b>	Control group	22	143.727		
	Experimental group	22	162.818	-5.278	.000 (s)

s – significant at 0.05 level of significant

As depicted in Table 4 respondent's interest in math significantly differ before and after the intervention. The significant different in the mathematics interest of the control group before was 138.8636 and after distribution of lesson plan was 143.7273 and the difference was 4.86 while, the significant different in the mathematics interest of the experimental group before was 148.6818 and after intervention became 162.8182 the difference was 14.1364. Now, with these results it implied that the two (2) groups Control group and Experimental group's interest in math were differ significantly. To support this implication excerpt below are some of the respondents' opinion when they were asked how they evaluate mathematics instruction with project model activities, whether it does increases their interest to learn (See Appendix 6 of this paper for more information).



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*I'm not good in math but when they would have made an activity it is add to my interest in math.*

("I'm not good in Math but when there is an activity; it promotes my interest in Math." Cam, Interview Written Response, 4/12/16)

*learn strength and interest of student based on gamagana ang utak mh.*

("It enhances my learning strength and Interest because it activates my brain." Fats, Interview Written Response, 4/12/16)

*The way I evaluate mathematics instruction w/ project model activities. It is always increases my interest in my mind*

("The way I Evaluate Mathematics instruction with Project model activities.it is always increases my interest in my mind." Ham, Interview Written Response, 4/12/16)

In the researchers' field notes (See Appendix 5), June 07, 2015, it was also observed that most of the students work hard and have increased their interest and curiosity. This claim is also supported with the findings of Tan (2016) stating that materials can be design for a purpose of changing students' interest. Hence, better performance is possible if lessons and activities address the needs of the students and could elicit their interest as well. This can also be proven and seen in photos attached in appendix 8.

### Relationship of Respondents' Performance in Mathematics and their Interest in Mathematics

Relationship on respondent's math performance and interest in math before and after intervention were computed and the results are presented in Table 5.

Table 5  
Paired Samples Statistics on Respondents Math Performance and Interest in Math before and after the Intervention

Correlated	Mean	N	Pearson -value	Sig. value
<b>Math Performance &amp; Interest in Math( Before)</b>	17.432 143.773	44	.109	0.481 (ns)
<b>Math Performance &amp; Interest in Math(After)</b>	24.523 153.273	44	0.553**	0.000 (s)

\*\*Correlation is significant at the 0.01 level (2-tailed)

As depicted in Table 5 above the mean obtained by the respondents during pre-test on math performance and interest in math are 17.432 and 143.773 respectively. After intervention the mean obtained by the respondents increases to 24.523 for math performance and 153.273 for interest in math.

Correlation analysis reveals that for both group, the respondents' mathematics performance and interest in math before intervention or during pretest showed no significant relationship considering that the computed significant value of  $r = 0.481$  is greater than 0.05 level of significance. However, mathematics performance and mathematics interest of the respondents after the intervention showed significant correlation since the computed significant value of  $r = .000$  is less than 0.05, level of significance. This result implies that the respondents' mathematics performance

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significantly correlated or influence to the respondents’ interest in math after the intervention was implemented. This claim is supported with the research findings of Valdez (2013) pointing out that the students became more motivated and eager to learn and shifted their motivation style and learning style after exposure to hands-on activities in the teaching - learning process. Based on the research findings of various studies, context-based and activities teaching and learning approach improved students’ motivation to learn shifted their attitudes towards loving the subject and increases their achievement level in the subject (Magwilang, 2016; Amihan & Sanchez, 2023; Carvajal & Sanchez, 2023; Carvajal, et al., 2024; Sanchez, et al., 2024a; Sanchez, Sanchez & Sanchez, 2023; Sanchez, et al., 2022)

Aside from the correlation test to determine the degree of the relationship among variables, paired sample test using t-test was also employed. Table 6 below presents the results of the computations.

Table 6  
*T-test and Significance (p) Values on the Comparison between the Control Group and Experimental Group of Students Mathematics Performance and Interest in Mathematics*

Test	Pair	N	Mean Difference	t-test	p-value
<b>Pre-test</b>	Math Performance & Interest in Math	44	-126.341	-75.091	0.000 (s)
<b>Post-test</b>	Math Performance & Interest in Math	44	-128.750	-64.934	0.000 (s)

ns – not significant at 0.05 level of significant  
 s – significant at 0.05 level of significant

Table 6 paired sample test shows that the respondents’ mathematics performance and interest in math during pre-test significantly differ since the p-value =0.000 is lesser than 0.05 level of significance. Moreover, mathematics performance and mathematics interest of the respondents in the control and experimental group still significantly differ with each other since p value = 0.000 is less than the 0.05 level of significance. Generally, the respondents’ performance and interest in math between groups differ significantly before and after the intervention. This claim is supported with the research findings of Valdez (2013) indicating that the performance level of the students significantly increases and improve after they had been exposed to modular instructions that has varied activities that calls for higher order thinking skills. Research findings also indicated that students learn faster and retain most of the lesson longer when they actually see what they are expected to learn (Laurente, 2016; Amihan, Sanchez & Carvajal, 2023; Carvajal & Sanchez, 2024; Carvajal, Sanchez & Amihan, 2023; Salendab, Ocariza-Salendab & Sanchez, 2023; Sanchez, 2022; Sanchez, et al., 2024b). The significant difference of the respondents in the control and experimental group mathematics performance and interest in math probably attributed by the treatment employed in the experimental group which is the project-based approach. Considering that one of the vital subjects in education is the teacher, teaching methods must be more on learner centered, interactive and manipulative just like the project-oriented approach (Sanchez, 2020; Sanchez, 2023b; Sanchez, et al., 2024c; Sanchez, et al., 2024d).

**Respondents Interests after Exposure to POA Teaching Method**

It is more advantageous in teaching Mathematics, Science and Technology to inspire the students to read their lesson in advance. Providing some reading material inspires the students to study in advance. The researcher selected topics in Mathematics and formed questions to answer in order for the students to think deeply with enthusiast.

At the start of the class, the Lesson Plan that contains the special topics which are discussed in the classroom was distributed at both the Experimental and Control group. It was observed that most of the students in the Experimental group were surprised; their faces were full of curiosity for the new environmental strategy in the teaching of Mathematics inside the classroom.

The intervention used in the experimental group was POA (Project-oriented Approach in Teaching Mathematics) that changed and triggered the attention of the Engineering Technology students of MSU- Lanao National College of Arts and Trades. This approach is unique, challenging and interactive unlike the traditional or normal Approach in teaching Mathematics which is classified as an individualistic system of learning; wherein the students get



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inside the classroom and seat to their chairs, listen to the instructions and sometime taking-note, seating on their chairs without any reaction about the discussion and not participating.

In this study, the Lesson Plan used contains activities which bring questions and answers to students and instructions that are strictly to be followed; otherwise, it will result into error-answers. This statement of changes can be seen and proven by the student's interview responses, field note of observations, interview response of the observer and the photos taken during the session (See Appendices 5, 6, & 8 for the notes and documentation).

### ***The changes in the Student's Interest and Performance***

In the observation regarding the changes of Mathematics performance and Mathematics interest of both Experimental and Control groups before and after intervention revealed that there was a significant change of Mathematics performance and Mathematics interest of both the Experimental and Control groups after intervention. It had been appeared that the changes of Mathematics performance and Mathematics interest of the students in the Experimental group was more rapid and significant compared to the students in the Control group, though Mathematics performance and Mathematics interest of the students in Control Group had a gradual change because the only new for them was the Lesson plan handout that the researcher provided.

On the other hand, the mean difference between the pre-test and post-test of the two (2) groups were all positive. The mean pretest of Experimental group was 17.636 while the mean posttest was 28.046 which give a positive mean of 10.410. This implies that the student's performance and interest have improved. Also, the mean result of pre-interest test was 148.682 while the mean result of Post-interest test was 162.818, hence the changes is 14.136 which is positive. Therefore, the changes of the performance and interest test of Experimental group were both positive and significant.

In the case of the Control group, the mean pretest was 17.227 and the mean posttest was 21.000 the change was 3.773 which is positive, for the interest test, the mean pre-interest test was 138.864 and the mean post-interest test was 143.727, the changes was 4.863 which was positive. The changes of mean performance test and the mean interest test were both positive, thus, in the since that the changes were all positive in result, therefore, the researcher concluded that there were improvement in the performance and interest of the students in the control group regardless of how smaller the changes was compare to Experimental group, but it has been shown that the result of performance and interest tests of Control Group were both positive and then considered as slightly improved.

Mathematics had been accepted to many students that it is not easy but a hard to understand. This could be a challenge for Mathematics teachers to change and disproof of what the students' belief. During the intervention period, most of the students in Experimental group like to adopt the new instruction of POA. This approach is a group-working and is fitted to the interest of the students, each group has a group leader to compile the idea of the group members and finalize their agreed ideas and answers. Each of them had a copy of the instruction to analyze; this can also be considered as sharing of works and ideas. At that time of activity, everybody is busy in analyzing and performing the work activities, all of them were participating in the class working-activities, as it had been observed and seen in the captured photos (see in appendix 8) and besides, at the start of intervention in experimental group, the students never had an absent in the class as it had been mentioned by the observer in the later part.

The students of both experimental and control groups had improved in terms of performance and interest in Mathematics as it had been reflected in the statement above. The changes of performance and interest test of Experimental group were both positive, 10.41 for performance changes and 14.136 for interest test changes. It had been proven that the performance and interest tests had significantly changed. The Control group had also a slightly changes which is 3.773 for performance changes and 4.863 for interest-test changes, both were also positive. Although the changes of Control group in terms of student's performance and interest test were smaller compare to Experimental Group but still the changes of performance and interest tests were both positive.

In addition to the above mentioned which proves that the performance and interest of both groups (Experimental and Control groups) had been improved, the researcher picked-up six (6) students, three (3) students from the experimental group and three (3) students from the Control group, and then observed their performance and interest. The researcher start observing before intervention from prelim examination, the three (3) consecutive quizzes up to the midterm examination and after intervention, the three (3) consecutive quizzes and the final examination. One of the students in experimental group got a score of 30% in the prelim, 38%, 35%, 36% in the three (3) quizzes and 36% in the midterm examination before intervention but after the intervention, he got a score of 82%, 78%, 85% in the three (3) quizzes and 88% in the final examination.



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The second student got a score of 26% in the prelim, 36%, 34%, 35% in the three (3) consecutive quizzes and 38% in the midterm examination before the intervention but after the intervention, he got a score of 75%, 78%, 84% in the three (3) consecutive quizzes and 85% in the final examination.

The third student chosen in the experimental group had got a score of 28% in the prelim, 30%, 29%, 32% in the three (3) consecutive quizzes and 40% in the midterm examination before intervention but after the intervention, he got a score of 50%, 56%, 64% in the three (3) consecutive quizzes and 78% in the final examination.

The scores achieved by the three (3) students from the experimental group implied that before intervention, all of them had got low scores but after the intervention, their scores had improved. The researcher noticed that the three (3) students failed in their prelim exam, the three quizzes, as well as their midterm exam but after intervention their scores had improved a lot. Based on the observation of the researcher, it can therefore be concluded that POA is effective method in teaching Mathematics. Interest can be seen in the student's activeness in the classroom discussion. Most of the students in the experimental group were active and fully participating in the classroom work-activities. They were always present in the work activities and come earlier unlike before when there is no intervention yet, they always came late as it has been mentioned by the observer on her reaction statements.

The researcher also observed three (3) students from the Control group before and after releasing of lesson plan. Before the releasing of lesson plan, the researcher let them attend their prelim examination, three quizzes and midterm examination. One of the students in Control group got a score of 32% in the prelim examination, 28%, 30%, 36% in the three (3) consecutive quizzes and 32% in the midterm exam. But after providing the lesson plan for them to study in advance, he got a score of 60%, 68%, 78% in the three (3) consecutive quizzes and 78% in the final examination.

The second student got a score of 28% in the prelim examination, 32%, 30%, 38% in the three (3) consecutive quizzes and 43 % in the midterm examination. But after releasing the lesson plan, he got a score of 60%, 64%, 64% in the three (3) consecutive quizzes and 66% in the final examination. The third student got a score of 32% in the prelim examination, 34%, 35%, 38% in the three (3) consecutive quizzes and 40% in the midterm examination. But after the releasing of lesson plan for them to read in advance, she got a score of 64%, 60%, 67% in the three (3) consecutive quizzes and 68% in the final examination. Therefore, the researcher concluded that giving lesson plan to the students for them to study in advance can help a lot to the students to cope-up in the subject matters.

In this observation, it shows the mental configuration of the six (6) students taken from the experimental and control group based on their scores achieved in every quizzes and examinations had attended before and after intervention as indicated. The first three (3) are the students taken from experimental group while the other three (3) were the students taken from control group. All of them had their respective scores achieved from the two (2) examinations (First Prelim and Mid Term Examinations) and the three (3) consecutive quizzes before intervention, their four scores were based on the three (3) consecutive quizzes and the Final Examination which was given after the intervention. It appears that the performance and interest of the students were poor before the intervention and turned better after the intervention.

### ***The traces of influence on students' performance and interest***

The traces of influence on student's performance in MSU-Lanao National College of Arts and Trades, Engineering Technology students. There were 6 students taken from experimental group and control group whom the researcher asked and interviewed regarding the traces of influence of Project-Oriented Approach towards the performance and interest in Mathematics of the Engineering Technology students of MSU-LNCAT.

The following are the responses of the students regarding the students' feeling during intervention period.

- Researcher: Does the POA enhance learning strength and increase the interest of the students? Why?
- Student 1: Sa tutuo lang sir, hindi ako gaano ka talino sa Math. Mahirap mag analys pero kung may kasama ako na nagpeperform sa activities, hindi ako nababahala dahil pwede ako maka pagtanong sa kagropo ko. (*"Actually sir, I am not that good in Mathematics. It is difficult to analyze the problem but if I have a companion while doing the activity, I feel at ease for I can easily ask my co-members"*, Pre, Interview Response, 9/05/16)
- Her scores are 30% in the prelim, 38%, 35%, 36% in the three (3) quizzes and 36% in the midterm examination before intervention but after the intervention, she got a score of 82%, 78%, 85% in the three (3) quizzes and 88% in the final examination.



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- Student 2: So instruction a adun a actibity-on na malubod a kapuka sabota-on ago ditambokl'n ka puka-kaog permi so lawas ago kapakay tapun a phagisa ko mga pud ta. (*"An instruction with activity are not difficult to understand and it is not also boring because our body and brain acting on different working-styles, we can also refer our works to group co-member"*, Tam, Interview Response, 9/05/16)  
His scores are 26% in the prelim, 36%, 34%, 35% in the three (3) consecutive quizzes and 38% in the midterm examination before the intervention but after the intervention, he got a score of 75%, 78%, 84% in the three (3) consecutive quizzes and 85% in the final examination.
- Student 3: Sa bagay, nakakatulong din ang instruction na may activities lalo na sa Mathematics. Ang hirap kasi ang Math. Pero kung may matanongan ka kasabay yong instruction, lalawak ang kaalaman natin at mawawala ang tamad at hirap sa ating isipan. (*"In fact, instruction with activity help a lot more over in mathematics, it is not easy to understand and analyze but if ever there is instruction in which to be followed plus you can ask to other classmates, surely it will strengthen our performance, laziness and anxiety be minimized"*, Fats, Interview Response, 9/05/16)  
Her score of 28% in the prelim, 30%, 29%, 32% in the three (3) consecutive quizzes and 40% in the midterm examination before intervention but after the intervention, she got a score of 50%, 56%, 64% in the three (3) consecutive quizzes and 78% in the final examination.
- Student 4: ana sakn sir na aya kiagudama koron igira ana activity na maka e-enjoy ako. Dita maaluk, puki-iza ta so dita katawan ko mataoron. (*"For me sir, I feel better and enjoyed in every activity, I don't feel worry about to answer the questions and perform the activity, I can ask and refer my works to my classmates who are knowledgeable on the activity"*, Saf, Interview Response, 9/05/16)  
His score of 29% in the prelim, 32%, 33%, 37% in the three (3) consecutive quizzes and 39% in the midterm examination before the intervention but after the intervention, he got a score of 73%, 76%, 82% in the three (3) consecutive quizzes and 84% in the final examination.
- Student 5: Yes, sir, phakala so sabot ta ko kang group-working ka phuka-izaaan ta so group leader ko dataon sabota ago igira kang groupo a activity na ditawn thoratod'n. interesado tawn p'n ka and magaan mapasad. (*"Yes sir, group working will strengthen our knowledge because we can ask question to the group-leader, we are interested to finish the activities as early as possible and not to be sleepy"*, Nuri, Interview Response, 9/05/16)  
His score of 22% in the prelim, 31%, 30%, 34% in the three (3) consecutive quizzes and 34% in the midterm examination before the intervention but after the intervention, he got a score of 74%, 76%, 83% in the three (3) consecutive quizzes and 86% in the final examination.
- Student 6: Oway sir, igira ana activity na phagisug so sowata. Balabaw igira ana activity kang-groupo. Puka correctionan o isa so p'dian na puka-l'bodan ta ko kaanswer ago kambaal sa project-model. (*"Yes sir, if ever there is activities it will widen our knowledge moreover if it is in the form of group-working we can refer our work to others, so it is not hard for us to find answer and perform work activities"*, Ham Interview Response, 9/05/16)  
His score of 24% in the prelim, 34%, 33%, 35% in the three (3) consecutive quizzes and 37% in the midterm examination before the intervention but after the intervention, he got a score of 76%, 78%, 82% in the three (3) consecutive quizzes and 84% in the final examination.

In consolidation of the six (6) students' interview response for the question number 1, all of them were convinced that instruction with activities improved their learning strength and increased their interest in learning Mathematics, as reflected on their respective scores achieved from the different types of examinations and quizzes. This can be supported by the claims of the study of Vigil (1996) which says that hand-on project can motivate students to communicate using Math and Science language in order to produce a final product.

- Researcher: Which do you prefer in learning Math, with or without activities? Why?  
Student 1: Ana oway sir, mas-tomo so adun a activity ron ka dita toratodun, ma-iinspired ta para mapiya i paras so pasad ta. (*"yes sir, it's better to have activity in instruction because we do not feel sleepy, we are also inspired to work hard to make our project better"*, Didan, Interview Response, 9/05/16)



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- Student 2: Ana masgusto ko sir yong may activity kay kung hindi mo maintindihan pwede ka maka pagtanong sa kagropo mo. (*"Sir, I like the instruction with activity, because if ever you did not understand the instruction, you can ask from your co-member in your group", Salic, Interview Response, 9/05/16*)
- Student 3: Tomo sir so ana activity ron ka dita mbokl'n. ana manga pud ta a dinggalb'k. ana dita di mipagshare-a sa idea paano magawa at masolve yong problem. (*"Sir, it's better to have instruction with activity, we don't feel boring, we have companion to work together, we can share ideas on how to make the projects better and solve the problems", anifah, Interview Response, 9/05/16*)
- Student 4: Tomoon akun sir so adun a activity ron ka khapakay a aya kasabota ko dataon sabota na igira pangbaal ta sa project-model ago phukamosawiran ta o leader ko gropo o antonaa i ikhidia-on. (*"Sir, for me, I preferred to the instruction with activity, probably we can understand instruction through doing of project and seek advice from our group-leader on how to make our project", Sam, Interview Response, 9/05/16*)
- Student 5: Mas mapiya rakun sir so adun a activity ron adi so da. Ago mapiya pun so kapag-activity a by group ka phuka sowata so dita katawan. Puki-iza ta ko pud ta a matao ron. (*"For me, I'd rather prefer to have instruction with activity because doing work by group is enjoyable, we can learn a lot from others classmates", Magarang, Interview Response, 9/05/16*)
- Student 6: Sakun sir na aya pukababayaang ko na so kanggroupo a kapag-activity. Pukhailay ta so pusuwaan ta ko pud ta ago siipun ko pud a groupo. (*"For me sir, I like to work by group because we can see and observe in our co-member on how to do the project and solve the problems", Naser, Interview Response, 9/05/16*)

The six interviewed students have unanimously agreed that instruction with activities is better than the instruction without activities, it increased the interest and modified the comfort ability of the students inside the classroom. This can be supported by the statements made in the International Congress on Mathematics Education Program (ICMEP, 2012) that project-modeling in a cyclical process of process of creating and modifying models of empirical situations to understand then better and improve decision-making. The role of project-modeling in school mathematics has received increasing attention as generating authentic learning and reading the ways of thinking that produced it.

- Researcher: How do you evaluate Math instructions with Project-model activities? Does it increase your interest to learn? Why?
- Student 1: Igira ana activity tapus na kanggroupo pun a diron di kanggalub'ka na dita mbokul'n. phuka enjoy ta ko diron di kapamagoyawai ko kagaan ago kapiya o project. (*"When there is activities then we work by group, we should not be bored but to enjoy working together then take consider the majority decision to make the work fast and better", Naser, Interview Response, 9/05/16*)
- Student 2: Mas gusto ko sir so ana activity ron adi so da. Dikambokl'n ka madakul a pud-ta.odata sabota na maputaro o pud-ta. (*"For me it's better to have activity rather than nothing, we will not be bored because we have co-member, if ever something which we do not understand in the instruction some member can tell and correct the words" Pre, Interview Response, 9/05/16*)
- Student 3: Para sa akin sir na mas maganda yong may activity ka phuka panamaraan ta i kagaan a kapasad o galb'k sa dipun maoma so oras. Ditaon bokl' ka mafocus a otuk ta ko dita dimbaalan. (*"For me sir, I prefer to have instruction with activity, we will be forced to finish the work before to finish on time without boring felt", Magarang, Interview Response, 9/05/16*)
- Student 4: oway sir, phag-increase so interest ta igira madakul a dita di mipagogopa ko galb'k. (*"Yes sir it increases our interest if group working together to finish the work", Didaagun, Interview Response, 9/05/16*)
- Student 5: Syempre sir, phakala so interest ta ka ph'ka pwersa ta ko galb'k-on oda a miyapasad ta na damambo a grades tawn. (*"Of course sir our interest increases because we will be forced to work on the activity, without work activity finished there will be no grade also" Tam, Interview Response, 9/05/16*)
- Student 6: Ang na observe ko sir na igira adun a experiment na da-a bok'l ta. Mapiiya a ginawa ta. Kombaga na phukababayata ko dita dinggalbk'n. mapopokos so pamikiran ta kung paano mo magagawa yong project niyo. Phaka answer tap'n kagaan ka khaipos so oras. (*"I have observed when there is an experiment. We will not be boring, our body is condition our body act comfortable position to work, our brain always be focused on to have correct answer and follow the instruction properly on or before time allotted", Salic, Interview Response, 9/05/16*)



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Based on the common responses of the six (6) students, it is shown that they all agreed that activities molded the instruction and increases the interest of the students. This is supported by the claim of the Mathematics teacher MT (2008) that teachers who hold model of teaching and learning certainly exercise professional care for their pupils and help them achieved an important measure of Science in public examination.

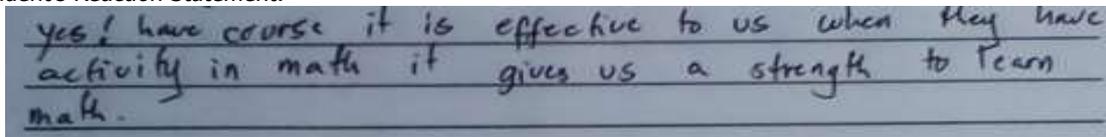
- Researcher: How do you feel when doing your activities? Feeling good and inspired or feeling boring? Why?
- Student 1: Ana sak'n sir na basta kanggalb'k na diyakombokl'n. feeling-well ako kagia mintin tawn phkakaog. Kapakay a montod ta kapakay a gomanat ko dita kanggalubuk na dita mambo bokulun ago mapaparota. (*"For me sir, in every work, I don't feel boring but feeling well because sometimes I am standing then seating again, my body feel well and comfortable"*, Fats, Interview Response, 9/05/16)
- Student 2: so sak'n-on sir na diya ko bobokl'n mag-activity. Nakaka enjoy panga ie, so kasi so kawntod ago kapamakinug bo na kakaboring, torotorogun tawn. (*"For me sir, I don't feel boring during activities actually I enjoy performing some project rather than seating and listening only without acting"*, Tam, Interview Response, 9/05/16)
- Student 3: mapiya sir so ana activity ron adi so da. Ditambokl'n ka ditap'n khitanod so oras. Matutumbang ta ko galb'k ta. (*"It is better sir if there is activity rather than no activity, we will not be bored and felt time is to short, we were entertaining on working"*, Saf, Interview Response, 9/05/16)
- Student 4: Nakaka enjoy sir pag may activities. Puki-iza ta so dita katawan ko manga kagroupo ta. Puki-compare tap'n so pasad ta ago answer ta ko p'd ta. (*"We are enjoying sir, if there is activity we can ask and compare our work to our co-member"*, Pre, Interview Response, 9/05/16)
- Student 5: Sakun sir na para rakn na mapiya so ana activity on ka dika khazero. Apiya kasi dinga sabot'n na khapakay a khi-iza aka ko matao ron. (*"For me sir, I am feeling good because I am sure if I work well a good grade will receive, but if I do not work, no grade will receive, if I don't understand the instruction I can ask to the knowledgeable one"*, Nurs, Interview Response, 9/05/16)
- Student 6: Mapiya sir so ana activity ron ka phukabint'ng a otuk ta ko diron di kaphlanowi ko kakhasowa a tawn. Kakokonsentretan ta oba maribat. (*"It is better sir if there is activity our brain will be forced to think and plan to follow the instruction properly and recognize error"*, Anifah, Interview Response, 9/05/16)

These six students commonly response that all of them felt good during classroom activities and no one (1) feels boring and sleepy during performing activity inside the classroom. This can be supported by the statement in the study of cheng (2001) that model or project can be considered a simplification of a complex real model problem into a Mathematical form, models or project in Mathematics help interpreting and translating problems into real and simplified terms.

***In addition, the following were the various reactions statements of some students as well as the observers' findings during intervention inside the classroom***

Question 1: *Does the POA enhances learning strength and increases the interest of the students? Explain.*

Student's Reaction Statement:



(*"Yes! Of course it is effective. To us, when they have activity in Math, it gives us a strength to learn Math"*, Sam, Interview Written Response, 4/12/16)

Observer's Reaction Statement:



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*Sa begin ko ay effective yong POA dahil nakatabing itong maintindihan ng mga studente ang buhok ng kanilang mga kausap sa kanilang mga magulang at magulang sa kanilang guro. Karamihan kasi sa kanila nasa ay hindi nakikinig pero napapasin kung nagbago na kanilang sikap.*

("I think it is effective because it helps the students understand their lessons and it encourage them to study and listen to their instructor because at first, they don't listen to their instructor but that attitude of them changed after the intervention "ipah, Interview Written Response, 7/21/16.)

Question 2: Which do you prefer most in learning Mathematics, learning with or without project activities? Explain Student's Reaction Statement:

*For me mathematics instruction with project model activities is a nice method and it increases our interest and it motivates us to learn. Because it will not be boring because of the activities.*

("for me, Mathematics instruction with project model activities is a nice method and it increases our interest and it motivates us to learn. Because it will not be boring because of the activities", Fats, Interview Written Response, 4/12/15)

Observer's Reaction Statement:

*Effective yong pagbibigay ng activities ng mga guro sa kanilang klase. Hindi lang yang interested nila mag mag improve. Pati narin ang kanilang performance*

("The approach wherein the instructor gives activities is much more effective. Not only does it increase their Interest but it also improves their Performance ", ipah, Interview Written Response, 7/21/16)

**Reaction statement of the three (3) students from control group as well as their respective scores achieved from different types of examinations and quizzes.**

Researcher: How does the lesson plan help the student to learn mathematics? Explain

Student 1: So lesson plan na pakaogop igira pamatiya so studeante sa walay, pero igira da Pamatiya na dimagisug so learning strength iyan. (Lesson plan can help the students if the student read the lesson plan at home but if the student did not read at Home, his learning strength never increase.)

His score of 32% in the prelim examination, 28%, 30%, 36% in the three (3) consecutive quizzes and 32% in the midterm exam. But after providing the lesson plan for them to study in advance, he got a score of 60%, 68%, 78% in the three (3) consecutive quizzes and 78% in the final examination.

Student 2: So lesson plan na pupakaogop sa mala ko mapasang I kapagistadi sa walay, Puki dobli ko text book. (Lesson plan can help a lot for the student whose Studious at home).

Her score of 28% in the prelim examination, 32%, 30%, 38% in the three (3) consecutive quizzes and 43 % in the midterm examination. But after releasing the lesson plan, he got a score of 60%, 64%, 64% in the three (3) consecutive quizzes and 66% in the final examination.

Student 3: Mapiya so lesson plan ka anapukabatiya ta sa walay a reference. (Its' better to Have lesson plan. We can have extra reference to read at home).

His score of 32% in the prelim examination, 34%, 35%, 38% in the three (3) consecutive quizzes and 40% in the midterm examination. But after the releasing of lesson plan for them to read in advance, she got a score of 64%, 60%, 67% in the three (3) consecutive quizzes and 68% in the final examination.

For the Project Oriented Approach (POA), there was a new approach that changes the environmental teaching style. In every class lecture, the researcher gives Lesson Plan for the students to analyze and solve problems written below the instruction. Everyone was given a chance to find way to understand instruction and solve related problems. They were also given a time to consult each other's works. What happened during the session was enjoyable. Everybody



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looks busy during activities and were full of excitement. Changes in the teaching environment made the students active and increased their interest; this can be proven and seen on the photos taken during the session. When it comes to the performance of both groups, the Experimental and the Control group became better because of the treatment done, providing Lesson Plan to each group to study and analyze the topics, plus each of the students were free to ask and clarify instructions and problems to their Co-group member and to their teacher, consequently the result of the Experimental group in their Exam and quizzes were all passed and some have gained higher scores compared to the Control group. This implies that the Experimental group have improved prominently as compared to that of the Control group. This traces or illustration can be seen and proven in the interview response of the students, the field-note of the researcher, the narrative report of the observer as well as the Photos taken during intervention, (See Appendix 5, 6, and 7). This learning is more related to the claim of constructivist learning environments in which requires the students to use their prior knowledge and experiences to formulate new, related, and or adaptive concepts in learning, (Termos, 2012). Under this framework the role of the teacher becomes that of a facilitator, providing guidance so that learners can construct their own knowledge, this framework is very much related and similar with the framework of K-12 and this research POA.

To prove these statements, the researcher took three students in the Experimental group as a sample. First of them is Lam. Before the intervention, he is a very world-weary guy. He is always using his Cellphone inside the classroom despite the teacher presence, but when the POA was applied, he become lively and asks questions always. Maybe because this approach and his friends/companions were motivated and their interest in learning Math had been promoted.

*Student Reaction Statement after Intervention:*

*"I'm not good in Math but when there is an activity, it adds to my interest in Math", Fam, Interview Written Response, 4/12/16)*

*Observer Reaction Statement during Intervention:*

*"You'll think that Fam is taking down notes but when you look at him clearly, you'll see that he just playing on his phone which is hidden in his notebooks. But after the intervention, I can say that Cam has changed his attitude. he participating in the class discussion, probably because he attracted with the activity ", ipah, 7/21/16)*

*Student Reaction Statement After Intervention:*

*"for me, Mathematics instruction with Project model activities is very interested, it increases our interest and motivates us to learn Mathematics", Fats, Interview Written Response, 4/12/16)*

*Observer Reaction Statement during Intervention:*



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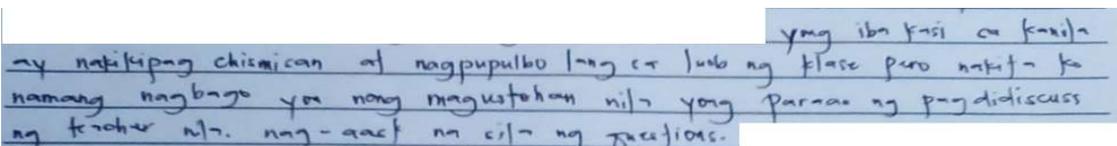
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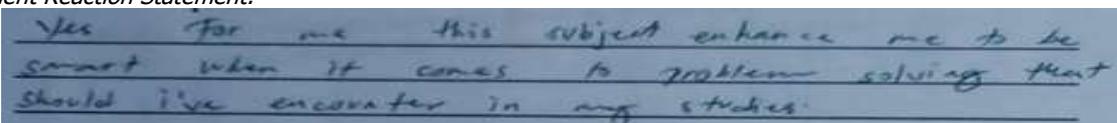


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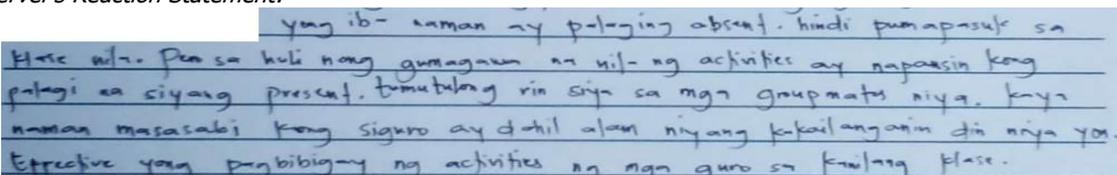
(Second student which was taken as a sample was Fats. Before intervention, she is not participating in the discussion and always applies face powder and make-up even if we are in the middle of the discussion and she keeps on talking to her classmates about the latest k-pop video, but after the intervention, she become enthusiastic and always asks the next steps when they're performing an activity. doing activities doesn't make the students feel bored but to makes the participate in the class discussion", ipah, 7/21/16)

Student Reaction Statement:



("Yes. For me this approach POA enhances my attitude to be smart when it comes to problem solving that I've encounter in my studies" Sam, Written Response, 4/12/16)

Observer's Reaction Statement:



(The third student is Sam. Before intervention, he always comes to class late and sometimes absent and come to class whenever he feels almost time to go home but after intervention, he become reliable and comes to class at the scheduled time because he realized that mathematics is useful in our day-to-day lives, ipah, 7/21/16).

Observer's Reaction Statement:

("Some of them are always absent but at the time they are doing their project-activities, I saw him personally, he had changed his attitude. He always present in the class and helps his group mates doing of their project-activities.", ipah, Observer, Interview Response, 7/21/16)

The noted change on student's interest and performance in mathematics in the experimental group was the result of the intervention, considering the fact that the Post- interest test and performance test were better than the result of Pre-interest and performance test. Experimental group had a significant change on interest and performance in mathematics as compared to the control group without intervention, maybe because of the POA method of teaching. These two sets of results can be an evidence that the interest of the students of Engineering Technology had increased. In addition, this was also seen and proven in the field note of the observer, the interview responses of the students and the photos taken during the sessions (see the student's responses: Appendices 5, 6, & 8 in the documentation).

Another sign or evidence that the student's performance and interest in math had dramatically changed to both experimental and control groups was due to the intervention of the experimental group and only lesson plan for the control group. However, again the experimental group had better result in Posttest as compared to the Posttest result of the control group, but these two groups had better performances and interest compare to other groups with no intervention and lesson plan used. This statement can be seen and proven in the field notes of the observers, the interview responses of the students and the photos taken during the sessions (See Appendices 5, 6, & 8 for the notes and documentation). Excerpt below are some of respondents' response that is quoted relevance to support the claims that using POA really improve students' performance in math and interest in math in a written interview. The statements below were verbatim transcript as how the respondents wrote it in their journal logs (See Appendix 6 for the details of the written interview of student's journal log). This claim is the same with the claim of Mathematics Teacher (MT 141, Dec. 1992) that teacher who hold model of teaching and learning certainly exercise professional care for their pupils and help them achieve an important measure of success in public examination.



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Based on the excerpts presented, it can be manifested that the POA mathematics teaching helped students to learn much. They can manage the demands of the instructions through manipulations according to their pace of learning. Moreover, POA motivated the students to learn and love learning, inspiring them, making fun in learning, taking challenges, enough space for initiative and creativity and learn to be independent. More of this conversation that can be considered as evidence effects of POA can be seen in Appendix 6 of this paper, and some observations of the researcher written in the field notes place in Appendix 5 of this paper. Moreover, photos as documentation are also attached in this paper as Appendix 8.

According to Novak (2011), creative teacher and true learning method, can stimulate student to grow up leadership skill. So, teaching approaches that with all of its creative learning can make student into future leader. Teaching and learning mathematics are complex tasks. The effect on student learning of changing a single teaching practice may be difficult to discern because of the simultaneous effects of both the other teaching activities that surround it and the context in which the teaching takes place. Thus, as teachers seek to improve their teaching effectiveness by changing their instructional practices, they should carefully consider the teaching context, giving special consideration to the types of students they teach.

### Conclusion

Based on the results and findings of the study, the following conclusions were forwarded:

The mathematics performance and interest in math of the students who were exposed to Project-oriented approach of Teaching Mathematics (Experimental Group, EG) and those students exposed to traditional Mathematics Teaching Approach (Control Group, CG) differ significantly. There is a significant relationship between mathematics interest and mathematics performance of the students before and after intervention. The student's interest and performance in mathematics improved when students are exposed to Project-oriented Approach in Teaching Mathematics.

### Recommendations

In view of the aforementioned conclusions drawn from the study, the following recommendations were presented:

As seen by the findings of the study that using an interactive/ participative approach through activity based learning's will affect the interest and performance of students in such a difficult subject such as mathematics. Thus, in teaching it is strongly suggested that it would be more effective if the teachers can employ more and better pedagogy to better designed lesson plan which consists of lectures, activities, and project-based orientation with higher order questions as the post assessment. Teachers should let their students be exposed to the actual application of the topics into activities (making of Project-models) especially on real-life scenarios in order to improve the student's learning skills in Mathematics, and other subject areas like Science and Technology.

Another recommendation is a parallel study could be conducted using different sample and subject matter as well as with more variables for triangulation and comparisons of results to validate the findings of this study.

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