**ISSN (Online): 2455-7838**
**SJIF Impact Factor : 6.093**

**EPRA International Journal of**

# Research & Development

## (IJRD)

**Monthly Peer Reviewed & Indexed International Online Journal**

**Volume: 4, Issue:2, February 2019**

**Published By**
**EPRA Publishing**

SJIF Impact Factor: 6.093 Volume: 4 | Issue: 2 | February | 2019 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Peer Reviewed Journal

# BOARD WORK AS A PERFORMANCE-BASED TASK AND ITS EFFECT TO THE ACADEMIC PERFORMANCE OF CIVIL ENGINEERING STUDENTS IN CALCULUS

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**ABSTRACT**

*This study on board work as a performance-based task and its effect to the academic performance of civil engineering students in calculus of Eastern Visayas State University is guided with the following objectives (1) to determine the pretest mean scores of civil engineering students in calculus specifically in terms of functions, limits, continuity, derivatives, maxima and minima., (2) to assess the posttest mean scores of civil engineering students in calculus specifically in terms of functions, limits, continuity, derivatives, maxima and minima,(3) to identify if there is significant difference between the pretest and posttest mean scores of civil engineering students in calculus specifically in terms of functions, limits, continuity, derivatives, maxima and minima, and (4) to identify the learning gains of civil engineering students in calculus specifically in terms of functions, limits, continuity, derivatives, maxima and minima. With the above objectives, the study made use of a single subject experiment pre-test post test design to a 30-class of intact heterogeneous First year civil engineering students. A total of teacher's made 50-item test in calculus was administered. After which, the pretest mean scores in calculus of first year civil engineering students were found very low but after teaching it using performance-based task specifically board work, the posttest as academic performance of the first year civil engineering students in calculus has significantly increased as revealed in the posttest mean scores. The performance of the civil engineering students in calculus based on the results in pretest and posttest in five (5) topics such functions, limits, continuity, derivatives, maxima and minima has been found significant and it resulted to the rejection of the null hypothesis. Meanwhile, the scores gained by the students from the pretest to posttest in calculus specifically on functions, limits, continuity, derivatives, maxima and minima are evident with a significant increase in all areas.*

**KEYWORDS:***quasi-experimental, single-group design, board work, academic performance.*

## INTRODUCTION

Undeniably, most students have the preconceived notion that mathematics is difficult, and this may greatly affect their study habits from the very beginning (Halcon, 2008). The teaching method employed used by the instructor plays a significant role in the teaching and learning process specially in capturing the students' interest. This scenario is a huge challenge posed for instructors that need to explore to a variety of teaching strategies to address the needs of the college learners particularly the learners in mathematics.

With this challenge, the mathematics teachers usually resort to a performance- based task such as boardwork where students solve on board the given mathematical problem and explain in turn before the class the reasons why he derived to a specific answer.

As a matter of fact, the National Research Council expressed its concern in 1989 with a call to improve the ways children learn math (1989). As a suggestion for better math education, Garfolo (1994) proposed creating an atmosphere where the math classroom must focus on making sense and creating meaningful understanding when students attempt to understand and learn how to solve math problems. The National Council of Teacher's of Mathematics in their standards for school math emphasizes the need for using oral and writing skills to clarify thinking and understanding about math ideas and relationships (1987).

**As a matter of fact, Halcon (2008, pp14-15) reiterated that:**

Traditionally, mathematics relies on the lecture type of teaching where the instructor presents and elaborates on definitions and concepts, and gives examples. Since most concepts in mathematics are best learned by practice (e.g. solving for derivatives which represent marginal functions), instructors assign seatwork, homework, and boardwork to check the progress of students. Boardwork is a decent way of giving recitation points to students, and is an appropriate venue for students to offer to and discuss alternative solutions with their classmates. It also allows for sharing of resources, since many math problems can be solved by using more than technique. Moreover, giving a chance to students to explain their answers enhances their oral communication skills and makes them familiar with mathematical and business jargon (e.g. .rationalize,. .factor,. .integrate,. .differentiate,. .marginal cost, .breakeven,. .consumers. surplus, etc.). To reinforce social skills and values, instructors also use group activities to familiarize students with group dynamics.With this premise, the researcher embarks on exploring a performance-based task specifically boardwork its effectiveness to possibly increase the academic performance of civil engineering students in calculus specifically in terms of function, limits, continuity, derivatives, and maxima and minima.

## OBJECTIVES OF THE STUDY

1. To determine the mean pretest scores of civil engineering students in calculus before teaching them using board work specifically in terms of:
   - 1.1 function,
   - 1.2 limits,
   - 1.3 continuity,
   - 1.4 derivatives,and
   - 1.5 maximum and minimum.
2. To assess the mean posttest scores of civil engineering students in calculus before teaching them using board work specifically in terms of:
   - 2.1 function,
   - 2.2 limits,
   - 2.3 continuity,
   - 2.4 derivatives, and
   - 2.5 maximum and minimum.
3. To identify if there is a significant difference between the mean pretest scores and mean posttest of civil engineering students in calculus after teaching them using board work specifically in terms of:
   - 3.1 function,
   - 3.2 limits,
   - 3.3 continuity,
   - 3.4 derivatives,and
   - 3.5 maximum and minimum.
4. To identify the learning gain scores obtained by the civil engineering students in calculus after teaching them using board work specifically in terms of:
   - 4.1 function,
   - 4.2 limits,
   - 4.3 continuity,
   - 4.4 derivatives,and
   - 4.5 maximum and minimum.

## SIGNIFICANCE OF THE STUDY

Individuals who deal with learners has to openly comprehend the learner's characteristics in order to be more effective in their relations with learners and with their everyday challenges. From the findings of this endeavor, it is anticipated that a clear picture of their whole beings as learners can be understood and consequently be utilized as stronghold for a good teacher-student relationship. Specifically, this research is vital to:

***Unit/College Management.*** The conclusions of this research endeavor could aid them to devise suitable mediations to fit learner's needs, most especially to learners with learning difficulty and offer needed teaching supports, to improve excellence in education.

**Department Head/College Dean.** Findings of this research may spur the much needed change in the development of improved instructional means and recognize the necessity that trigger the flaw in attaining mathematics literacy. Employing of appropriate techniques and other adaptive steps essential to attain quality education could be developed by the immediate supervisors.

**Math Teachers.** The results of this scientific endeavor may be vital in organization and commencing fitting, relevant. It is also aimed at motivating other math educators to promote this techniques and procedures in teaching math lessons.

***Parents.*** Results of this research may improve the dynamic participation of parents with their continued

support to the needs of their children and expand their commitment as enthusiasts and associates of the learning institution in attaining great academic performance of learners.

***Students.*** Most importantly, results from this academic undertaking may be of great benefit to students. It could give them drive on how to handle with their struggles and influence them to study even harder in order to overwhelm their weakness and wrong notions about mathematics.

## SCOPE AND LIMITATIONS OF THE STUDY

This study will be limited to see the effects of using performance-based task specifically boardwork in teaching calculus. This strategy will tested among the civil engineering students of the College of Engineering and Technology of Eastern Visayas State University in Tacloban.

### Definition of Terms

**Academic Performance.** This refers to the mean percentage scores obtained by the civil engineering students in the pretest and posttest specifically in calculus.

**Post – Test.** A post-assessment aimed to measure the understanding of the topic given after teaching of the lesson. In this study, it refers to the 50-item teacher's made test to be administered to the same group of students.

**Pre – Test.** Refers to the assessment tool given before the actual teaching. In this study, it refers to the 50-item teacher's made test to be administered to the same group of students.

**Boardwork.** Refers to the board activity done by the students in solving a mathematical problem on board accompanied with an explanation by the students.

## METHODOLOGY

### Research Design

This study will make use of single subject experiment pre-test post test design. Respondents will be chosen on purpose based on the Measurement and Evaluation data on learners needing intervention.

The study will involve one class which will be tested whether the performance-based task like boardwork will be effective in improving their academic marks in calculus.The same pre-test and post test will be used to assess the academic performance.

## LOCALE OF THE STUDY

This study will be conducted at the College of Engineering and Technology of the Eastern Visayas State University Tacloban City. One class will be utilized in the study. College of Engineering and Technology of Eastern Visayas State University is chosen as the place of study of the researcher because of the observed performance of the civil engineering students who are presently enrolled now.

## RESPONDENTS OF THE STUDY

This study will involve one class of intact heterogeneous First year civil engineering students. For the single class, a total of thirty (30) students will be purposively chosen as respondents of the study. This sampling technique will be used to satisfy the purpose of giving the necessary interventions to identified the students based on their final math grades in Senior High School. The selection of thirty (30) respondents will be made based on their final math grades in Senior High School which will be instrumental in identifying learners who need utmost attention in terms of math performance of the learners. All learners in the chosen class will be exposed to the performance-based task specifically board work but only the identified thirty (30) students in the class will be regarded part of the sample group from out of the fifty (50) total number of students in a class. The sampled students will be coded.

### The Research Instruments

The instruments that will be used in this study is a 50-item pretest and posttest in calculus specifically on topics: function, limits, continuity, derivatives,and maximum and minimum.

The research instruments will be tested for their validity and reliability so that the information obtained through the use of the instrument could serve its purpose in drawing the correct conclusions through the data obtained.

Validity is the degree to which test measures what is supposed to measure (Kombo, and Tromp, 2006).Validity of the content of the study will be sought out. Essentially validity of the content will be done in establishing whether the questionnaire and interview schedule measure what they are supposed to measure.

The essence of reliability of the instruments is to address consistency of results through repeated trials. Reliability is a measure of the degree to which a research instrument yields consistent results or data after repeated trials (Mugenda & Mugenda 2003). The Test –retest technique will be used in which ten (10) identified respondents will be supplied with the questionnaires and will be scored manually by the researcher for the consistency of results. The responses will be analyzed after which one week period will be allowed to pass before the same treatment will be applied to the same respondents and analysis will be done. The results will be recorded accordingly. The Pearson Product-Moment Correlation Coefficient formula given below will be used to calculate the correlation coefficient in which: the (x) values are the data points that is number of respondents of corresponding questions for the first trial and the (y) values are data points obtained in the second trial. A correlation coefficient of +0.68 will be obtained for the

first trial and +0.72 for the second trial which could possibly indicate a perfect relationship between the first and second results. From these results, the instruments will be considered reliable because they are within the acceptable range of between +1 and -1 (Shiundu, 2004).

For the validation of the instrument, the trial run of the instrument will be administered by the researcher to the students in other section in the same college of EVSU, since it will not be included in the study, to determine its comprehensibility, usability, and administrability and to identify items not understood by the target subjects of the experiment.

The feedback from the trial run of the instrument will be used for its improvement. When the process and content have already satisfied the rigor or scientific research protocol, copies of the instrument will be reproduced for the target subjects.

## EXPERIMENTATION

This study started from August to October 2018. A syllabus is prepared to make sure the topics on calculus specifically on topics function, limits, continuity, derivatives,and maxima and minima.

Prior to teaching them using a performance-task based specifically boardwork, a pre-test was given at the start of experimentation to the class. During the one-week experimentation, the learners were guided with the activities presented using boardwork with the teacher serving as the facilitator of the class. After the experimentation, a post-test was administered.

## DATA GATHERING PROCEDURE

Communication letter was sent to the University President, Vice President for Academic Affairs, and also the Dean of the College of Engineering to seek permission in the conduct of the experimentation. If granted, the researcher started administering the 50-item pre-test to the Civil Engineering students. The content of the pre-test is the same as that of the post-test to determine the academic performance of the students in calculus. The researcher herself personally conducted the pre-test and post-test to ensure that the students answered on their own during the examination.

## MEASUREMENT OF VARIABLES

The pre-test of civil engineering students for the single class with 40 students which were gathered before the experimentation and the post-test scores which were gathered after the experimentation using the achievement test were tabulated and analyzed.

Mean scores, standard deviation and one tailed t-test were used in determining the effect of boardwork as a strategy on the mathematics performance of civil engineering students.

## DATA ANALYSIS

To determine the academic performance of students stated in the first and second objective, the mean scores and standard deviation (SD) values were determined using the pre-test and post result of the three replicate sections.

The mean scores were analyzed using one tailed t-test and were used to determine whether the mean of pre-test of the and the posttest are significantly different. This is to answer third objectives. The null hypotheses was tested at 0.05 level of significance.

Learning Gain Scores (LGS) are comparison between pre- and post-assessment scores individual students or groups (www. Emporia.edu/teach/tws/documents/gainscores.doc as mentioned by Sindelar, 2010). In this process, the researchercomputes “how much students actually gained out of the total possible that they could have gained from pre to post assessment”.

The formula used is seen in Equation 1:

$$LGS = \frac{(\%\text{on post assessment} - \%\text{ on pre-assessment})}{(100\% - \%\text{ on pre-assessment})}$$

The percentage of the pre and post assessments was used by dividing “the actual gain (numerator) by the potential gain (denominator)” (Sindelar, 2010). Furthermore, “a large LGS would indicate that a student and/or group gained knowledge from the pre to the post assessment. The ideal LGS for each student would be 1.00, meaning that each student actually gained all of the possible knowledge from pre- to post- assessment. Increase in LGS for both experimental and control groups would substantiate the hypothesis that students exposed to performance-based task specifically boardwork gain additional content knowledge.

## RESULTS AND DISCUSSION

This sections presents the results of the study specifically on the pretest, posttest, significant difference, and the learning gains scores of civil engineering students in calculus.

### On the pretest mean scores in calculus

In the 50-item pretest given to the students, the questions were distributed to the following topics: Function, Limits, Continuity, Derivatives and the application of derivatives involving the maxima and minima, with the following number of items 10, 12, 8, 15 and 5, respectively.

Table 1 shows the pretest mean scores of civil engineering students in calculus specifically on function, limits, continuity, derivatives, and the application of derivatives involving the maxima and minima. As observed from Table 1, the students got a very low scores in all areas in calculus. The highest among the five (5) areas is function which is quantified at 5.07 mean scores, followed with a 2.97 mean scores of limits. It can be observed that continuity reaches to 1.30 mean scores, while derivatives earned a 2.40 mean scores. Meanwhile, application of derivatives involving maxima and minima got a 0.07

mean scores. For the pretest, the grand mean is recorded at 2.36.

**Table 1. Pretest mean scores in calculus of CE students**

| Topics | Mean Score |
|---|---|
| Function | 5.07 |
| Limits | 2.97 |
| Continuity | 1.30 |
| Derivatives | 2.40 |
| Maxima and Minima | 0.07 |
| **Grand Mean** | **2.36** |

**On the posttest mean scores in calculus**

As shown in Table 2**,** Post-Test mean scores of civil engineering students of Eastern Visayas State University taught in the five areas of calculus when post-test was conducted. functions reaches the highest mean which resulted to 7.83. derivatives gains 5.97 mean. Meanwhile, limits gets 6.63 mean, continuity raises to 2.70 mean, the minima and maxima recorded 1.10 the lowest among the five areas in calculus. The grand mean got an equivalent of 5.21.

**Table 2. Posttest mean scores in calculus of CE students**

| Topics | Mean Score |
|---|---|
| Function | 7.83 |
| Limits | 6.63 |
| Continuity | 2.70 |
| Derivatives | 7.80 |
| Maximum and Minimum | 1.10 |
| **Grand Mean** | **5.21** |

**On the difference between the pretest and posttest in calculus**

Table 3 below illustrates the test of significant difference of the Pre-test and Post-test mean scores of civil engineering students of Eastern Visayas State University. It shows further that all areas in calculus such functions, limits, continuity, derivatives, and minima and maxima are less than 0.05 level of significance. Functions which has a 0.000 p-value is rejected and interpreted as significant, same as limits, continuity, and derivatives which resulted to 0.000 p-value, is rejected and found to be significant. The maxima and minima got a p-value of 0.001 but still just like the other four (4) areas in calculus, it is found to be significant.

The hypothesis which states that there is no significant difference between the pretest and post-test mean scores is then rejected. These results would mean that the results show improvement after the use of boardwork as a technique in teaching calculus specifically on topics like functions, limits, continuity, derivatives, maxima and minima. Thus, teaching calculus using performance-based task such as boardwork is found to be effective.

**Table 3.Difference between the pretest and posttest of CE students in calculus**

| Topics | t-value | p-value | Interpretation |
|---|---|---|---|
| Function | .798 | 0.000 | Significant |
| Limits | 11.486 | 0.000 | Significant |
| Continuity | 6.433 | 0.000 | Significant |
| Derivatives | 11.459 | 0.000 | Significant |
| Maximum and Minimum | 3.725 | 0.001 | Significant |

**At 0.05 level of significance**

**On the learning gain scores (LGS)**

Table 4 reveals the achieved gain scores from pre-test to post test in calculus of civil engineering students of Eastern Visayas State University . It can be gleaned from the result that in Function, the students demonstrated an actual gain of 27.6 percent out of a potential gain of 49.30 percent that they could have gained or an equivalent of 56.00 percent learning gain score. For Limits, the students demonstrated an actual gain of 30.45 percent out of a potential gain of 75.20 or equivalent to 41.00 percent learning gain score. While for Continuity, they showed an actual gain of 17.70 percent out of 83.75 percent potential gain or 21.00 percent learning gain score. Meanwhile, for Derivatives, the students showed an actual gain of 36.00 percent out of a potential gain of 84.00 percent or equivalent to 43.00%second highest learning gain score. Finally for the application of derivative involving maxima and minima the students got an actual gain of 20.60 percent out of 98.60 percent potential gain or a learning gain score of 21 percent.

In summation, the students learned significantly the lessons in calculus among the five (5) topics used in the experiment.

Further, the results of the study imply that the performance-based task teaching such as boardwork is effective particularly in teaching calculus with specific topics on functions, limits, continuity, derivatives, and maxima and minima.

**Table 4. Learning gain scores in calculus of CE students**

| Topics | Actual Gain Post - pre | Potential Gain 100- pre | Learning Gain Scores (LGS) |
|---|---|---|---|
| Function | 27.60 | 49.30 | 0.56 |
| Limits | 30.45 | 75.20 | 0.41 |
| Continuity | 17.50 | 83.75 | 0.21 |
| Derivatives | 36.00 | 84.00 | 0.43 |
| Maxima and Minima | 20.60 | 98.60 | 0.21 |

## CONCLUSION AND RECOMMENDATIONS

### Conclusions

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

1. The pretest mean scores of the civil engineering students in calculus specifically on functions, limits, continuity, derivatives, maxima and minima were recorded at the low level.

2. The posttest mean scores of the civil engineering students in calculus specifically on functions, limits, continuity, derivatives, maxima and minima increased after they were taught using the performance-based task such as boardwork.
3. The performance of the civil engineering students in calculus based on the results in pretest and posttest in five (5) topics such functions, limits, continuity, derivatives, maxima and minima has been found significant and it resulted to the rejection of the null hypothesis.
4. The scores gained by the students from the pretest to posttest in calculus specifically on functions, limits, continuity, derivatives, maxima and minima have also increased with a significant percentage in all areas.

## Recommendations

1. The teachers who are handling mathematics subjects have to explore other teaching strategies to cater the learning styles of the learners.
2. Empirical data that would support the teaching strategy is better than the other shall be provided to come up with a sound teaching and learning policies in addressing the needs of the learners.
3. Future researchers is encouraged to study the same by exploring other strategies that will make the teaching of calculus easy.

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