Volume 3 Issue 2 October 2012

The MINDANAWAN

Journal of Mathematics

ISSN 2094-7380

Exploring The Application and Effects of TI – 84 Plus on Students' Skills In Mathematical Computation

Patrick G. Galleto[1], Craig N. Refugio[2]
[1]Jose Rizal Memorial State University, Dapitan City, Philippines
[2]Negros Oriental State University, Dumaguete City, Philippines
[1]patrick.galleto@yahoo.com, [2]craig.refugio@gmail.com

Abstract: This study sought to find out the students' skills in mathematical computation using TI – 84 Plus in teaching Mathematics among freshmen Advanced Algebra and Trigonometry students of the College of Education of Jose Rizal Memorial State University, Main Campus, Dapitan City. The skills that the students possessed in both the control and the experimental groups on the topics included in this experiment are equivalent or comparable before the intervention. The study also concludes that the experimental group performs significantly skillful than the control group after the intervention. It can be deduced further that there is a significant variation in the students' skills in mathematical computation between the control group with the traditional method of teaching and the experimental group with the used of TI – 84 Plus in teaching and learning Mathematics. In addition, the study concludes that both the interventions, traditional method of teaching and using TI – 84 Plus in teaching and learning Mathematics, make improvement in the students' skills in mathematical computation. This means that students perform skillfully better during the posttest than during the pretest. However, students' skills in mathematical computation in the experimental group are greatly influenced by the TI – 84 Plus used by teachers and students in Advanced Algebra and Trigonometry class. This concludes that students in the experimental group perform skillfully better than their counterpart.

Keywords: TI-84 plus, students' skills, mathematical computation

1 Introduction

Today's Mathematics classrooms are facing rapid change more than any other educational discipline. These changes are centered not only what is being taught, but also on how it is being taught. Educationally, [5] averred that the world is in a technological boom which Mathematics classrooms have been flooded with electronic teaching tools. There have been transitions in Mathematics classrooms, such as the evolution from blackboard to whiteboard to smartboard, but ultimately those changes do not drastically alter the way in which information is presented. Some classrooms have abandoned the use of textbooks to provide students with the chance to discover more on their own and use each other as learning resources. Despite the importance of these changes, [4] stressed that the most important change in the past few decades has been the arrival of Texas Instruments. The user-friendliness and portability of these devices have had a major effect on the access that students now have to new ways of thinking. In [2], it is pointed out that teachers and students now have a new sense of power in the classroom because of the visual nature of these Texas Instruments particularly the TI-84 Plus.

In the Philippines, one of the challenges confronting a Mathematics teacher in integrating technology like TI-84 Plus in Mathematics teaching is the unavailability and lack of the gadget for use in the classroom [1]. The TI-84 Plus has a powerful algebraic function. The use of a variety of its built in programs can carry out different kinds of calculations and transformations of polynomials, matrices, determinants, factorizations, equation solving, the seeking of limits and trigonometric functions, and many others. Such functions have not only provided strong support for the teaching of Mathematics, especially beginning calculus and other higher Mathematics content at the secondary school level, but also TI-84 Plus has become good tool for independent exploration and experiments [8].

Imbued with the quest of providing research – based decisions involving the TI-84 Plus and students' skills in mathematical computation among education students of Jose Rizal Memorial State University, Main Campus, Dapitan City, the researchers are encouraged to conduct this study to explore the application and effects of TI-84 Plus on students' skills in mathematical computation. The result of this study is expected to construct possible corrective measures in enhancing students' skills in mathematical computation using TI-84 Plus among the teachers and students.

2 Theoretical and Conceptual Framework of the Study

This study is anchored on Dreyfus' "Theory of Skill Acquisition" as cited in [7]. The theory states that as human beings acquire a skill through instruction and experiences, they do not appear to leap suddenly from rule-guided "knowing that" to experience-based "knowing-how". This emphasizes that many skills could not simply be reduced to "knowing that". The reason that many are not conscious of their "knowing how" is possibly because they take their knowing-how for granted. It is believed that there is a gradual process involved for a learner to go through in order for him to reach the stage of expertise or knowing-how. The theory illustrates the five clear stages that a learner goes through in order to evolve from knowing-that, novice, to knowing-how, expert.

The first stage is called novice. A novice has some general ideas and is in the process of learning the rules, such as knowing the functions and the uses of the keys of the TI-84 Plus. The second stage is advanced beginner stage. In this stage, the learner's performance improves to a relatively acceptable level only after the novice has had enough experience in copying the real situation. During the third stage, competence, the learner starts becoming personally involved with the task. He starts to see more than one option from which he has to choose the best one. In the fourth stage or proficiency stage, the learner, while intuitively understanding his task, still thinks analytically about his actions. The last stage is called expertise. Experts in general know what to do based on mature understanding of the task. An expert has had so much experience with the task that the skill of doing the task is a part of him. He acts upon correct intuitions without analytically thinking about his every method. These stages emphasize on the fact that practice is required for the learner to maintain the knowing-how. Without practice, the learner will gradually lose his expertise and is most likely to regress as far back as the competence stage.

This study is also grounded on the "Theory of Performance" [3] which states that "performance develops and relates concepts to form a framework that can be used to explain results as well as improvements". Accordingly, to perform is to produce valued results. The theory further stressed that developing performance is a journey, and level of performance describes location in the journey. This theory exactly connects the present investigation since the present study embraces the determination of students' Mathematics performance. Likewise, finding the level of Mathematics performance among students in College Algebra purports to performance improvements in the subject.

It is for this reason that this study was conducted to establish support and strengthen research outputs involving the use of TI-84 Plus in Mathematics classroom. The research aimed to investigate the students' skills in mathematical computation using TI-84 Plus in relation to students' Mathematics performance in College Algebra among students in the College of Education of Jose Rizal Memorial State University, Main Campus in the City of Dapitan.

In this investigation, the researcher focused and considered two teaching approaches such as TI-84 Plus utilization and the traditional model in teaching Mathematics as independent variables. It is asserted in [6] that TI-84 Plus technology is a hand-held mathematics computer that draws and analyses graphs, computes the values of mathematical expression, solves equations, performs symbolic manipulation, performs statistical analyses, makes program and communicates information between devices. Simply stated, it is considerably more versatile as a teaching or learning tool in which a graphics screen replaces that of a numerical display screen. This feature, coupled with built-in software, is capable of undertaking all kinds of mathematical work. Some of the tasks made possible are graphing functions, tabulating functions, analyzing statistical data, manipulating matrices, equation-solving, calculus, probability and complex analysis.

The researchers in this study attempted to find out the students' skills in mathematical computation using TI-84 Plus which included skill in solving zeros of function, skill in writing equations of functions, skill in solving problems involving functions, skill in solving inequalities, and skill in graphing functions.

Another important variable in the study is the traditional method of teaching Mathematics. In this model, purely the talk, chalk, board and eraser method of teaching Mathematics are employed. This conventional strategy does not employ technological gadgets since it is using chalk and talk scheme. Moreover, this technique does not allow students to see a clear and pedagogically sound connection between input parameters and output results of mathematical concepts.

There were two groups of respondents in the experiment, namely: the control and experimental groups. The two groups were exposed to the same lessons/subject matters in College Algebra, to wit: Linear Functions, Quadratic Functions, and Polynomial Functions. The experimental group was exposed to each of the topics mentioned and developed in the students the five skills, namely: solving zeros of a function, writing equations of functions, solving problems involving functions, solving inequalities, and graphing functions. Functions in this study were limited to linear, quadratic and polynomial functions.

Students' skill performance in mathematical computation was measured in two ways, the pretest and the posttest. The pretest was administered using the validated teacher–made test to the respondents in both the control and the experimental groups before the experiment commenced, after which the experiment followed. The posttest, on the other hand, was given using the same teacher – made test as administered in the pretest to the respondents in both the control and experimental groups just after the experiment. Figure 1 shows the research process of the investigation.

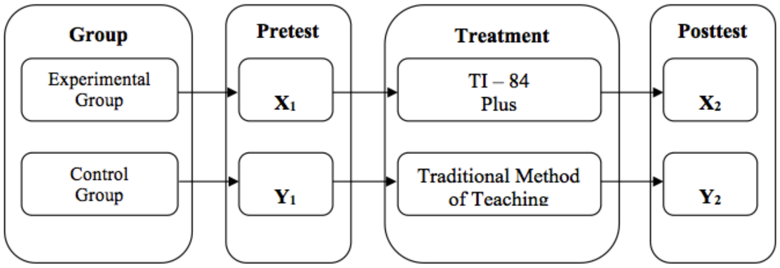

Figure 1. The Research Process

3 Results and Discussions

Problem No. 1. What is the pretest skill performance in mathematical computation of the students in the control and experimental groups?

The data which are presented in Tables 1.1 and 1.2 were results of the pretest administered to the control and experimental groups. The pretest skill performance was obtained before the groups were exposed to the assigned interventions. In scoring the students' skill performance in mathematical computation in the pretest, the five point Likert type scale format was employed with the indicated qualitative description as follows:

Range of Values 12 Points	Range of Values 60 Points	Description
9.61 – 12.00	49 – 60	Very Much Skillful
7.21 – 9.60	37 – 48	Much Skillful
4.81 – 7.20	25 – 36	Skillful
2.41 – 4.80	13 – 24	Less Skillful
0.00 – 2.40	0 – 12	Not Skillful

Table 1.1
Pretest Skill Performance in Mathematical Computation
of the Students in the Control Group

Students' Skills	No. of Items	μ	$\overline{X}$	σ	Description
Solving Zeros of a Function	12	9	2.58	1.540	Less Skillful
Writing Equations of Functions	12	9	2.38	1.441	Not Skillful
Solving Problems Involving Functions	12	9	2.46	1.515	Less Skillful
Solving Inequalities	12	9	2.10	1.568	Not Skillful
Graphing of Functions	12	9	1.86	1.429	Not Skillful
Total	**60**	**45**	**11.38**	**7.013**	**Not Skillful**

$\mu =$ hypothetical mean, σ = standard deviation, $\overline{X} =$ actual mean

Table 1.1 presents the pretest skill performance in mathematical computation of the students in the control group. Five skills were measured in the experiment, namely: skill in solving zeros of function, skill in writing equations of functions, skill in solving problems involving functions, skill in solving inequalities, and skill in graphing of functions. Sixty (60) items were used to determine the five skills broken into 12 items per skill. The expected performance of the students was set at 75 percent of the items that determined each skill. In this case, score of 9 was set as the expected performance per skill and score of 45 for the whole instrument.

As reflected in Table 1.1, the students of the control group were "less skillful" in solving zeros of a function and solving problems involving functions. Moreover, the respondents in the control group were not "skillful" in writing equations of functions, solving inequalities and graphing of functions. Overall and on average, the control group was "not skillful" to the different skills presented in the table.

Table 1.2
Pretest Skill Performance in Mathematical Computation of the Students in the Experimental Group

Students' Skills	**No. of Items**	μ	$\overline{X}$	σ	**Description**
Solving Zeros of a Function	12	9	2.25	1.100	Not Skillful
Writing Equations of Functions	12	9	2.27	1.122	Not Skillful
Solving Problems Involving Functions	12	9	2.15	1.161	Not Skillful
Solving Inequalities	12	9	2.02	1.163	Not Skillful
Graphing of Functions	12	9	1.92	1.169	Not Skillful
Total	**60**	**45**	**10.62**	**5.445**	**Not Skillful**

μ = hypothetical mean, σ = standard deviation, $\overline{X}$ = actual mean

As shown in Table 1.2, the students in the experimental group were "not skillful" in all of the five skills, from solving zeros of functions to graphing of functions.

Problem No. 2. Is there a significant difference on the pretest skill performance in mathematical computation between the control and experimental groups?

Table 1.3
Test of Difference on the Pretest Skill Performance in Mathematical Computation
Between the Control and Experimental Groups

Group	N	Mean	Mean Difference	Standard Deviation	Computed t	Critical t	Decision
Control	50	11.38	0.76	7.013	0.616	1.660	Not Significant
Experim	52	10.62		5.445			

Reflected in Table 1.3 is the t-test analysis of the pretest results of the skill performance in mathematical computation between the control and experimental groups. Based on the computed t value and the critical t value at α=0.05, it is found out that there was no significant difference between the pretest skill performance of the control and experimental groups.

Problem No. 3. What is the posttest skill performance in mathematical computation of the students in the control and experimental groups?

Table 1.4
Posttest Skill Performance in Mathematical Computation
of the Students in the Control Group

Students' Skills	No. of Items	μ	$\overline{X}$	σ	Description
Solving Zeros of a Function	12	9	5.42	1.679	Skillful
Writing Equations of Functions	12	9	5.36	1.601	Skillful
Solving Problems Involving Functions	12	9	5.38	1.563	Skillful
Solving Inequalities	12	9	5.32	1.584	Skillful
Graphing of Functions	12	9	5.28	1.642	Skillful
Total	**60**	**45**	**26.76**	**7.776**	**Skillful**

$\mu =$ hypothetical mean, σ = standard deviation, $\overline{X} =$ actual mean

Manifested in Table 1.4 and Table 1.5 is the skill performance in mathematical computation of the control and experimental groups respectively. In scoring the students' skill performance in mathematical computation in the posttest, the five point Likert type scale format was also used with the indicated qualitative description as follows:

Range of Values 12 Points	Range of Values 60 Points	Description
9.61 – 12.00	49 – 60	Very Much Skillful
7.21 – 9.60	37 – 48	Much Skillful
4.81 – 7.20	25 – 36	Skillful
2.41 – 4.80	13 – 24	Less Skillful
0.00 – 2.40	0 – 12	Not Skillful

As seen in the table, students in the control group were "skillful" in all of the five skills from solving zeros of a function to graphing of functions. Result implies that the students learned skillfully on the mentioned topics during the conduct of the lesson employing the traditional method of teaching Mathematics. However, it was noted that the control group failed to reach the indicated hypothetical mean of the study.

On the other hand, Table 1.5 reveals the posttest skill performance in mathematical computation in the experimental group. As reflected in the table, the experimental group was "very much skilful" in all of the five skills from solving zeros of a function to graphing functions.

Table 1.5
Posttest Skill Performance in Mathematical Computation of the Students in the Experimental Group

Students' Skills	**No. of Items**	μ	$\overline{X}$	σ	**Description**
Solving Zeros of a Function	12	9	10.27	0.689	Very Much Skillful
Writing Equations of Functions	12	9	10.12	0.758	Very Much Skillful
Solving Problems Involving Functions	12	9	9.90	0.823	Very Much Skillful
Solving Inequalities	12	9	9.98	0.896	Very Much Skillful
Graphing of Functions	12	9	9.83	0.834	Very Much Skillful
Total	**60**	**45**	**50.10**	**2.172**	**Very Much Skillful**

μ = hypothetical mean, σ = standard deviation, $\overline{X}$ = actual mean

Problem No. 4. Is there a significant difference on the posttest skill performance in mathematical computation between the control and experimental groups?

Table 1.6 shows the t-test analysis on the post test skill performance in mathematical computation between the control and experimental groups. Based on the computed t-value and the critical t-value at α=0.05, there was a significant difference on the posttest skill performance between the experimental and control groups. This result indicated further a significant variation in the performance of the students taught using the traditional method of teaching and those who were taught using the TI-84 Plus in teaching Mathematics.

Table 1.6
Test of Difference on the Posttest Skill Performance in Mathematical
Computation Between the Control and Experimental Groups

Group	N	Mean	Mean Difference	Standard Deviation	Computed t	Critical t	Interpretation
Control	50	26.76	23.34	7.776	20.816	1.660	Significant
Experim	52	50.10		2.172			

Problem No. 5. Is there a significant difference between the pretest and posttest skill performance in mathematical computation of the control group?

Table 1.7
Test of Difference Between the Pretest and Posttest Skill Performance in
Mathematical Computation of the Control Group

Group	N	Mean	Mean Difference	Standard Deviation	Computed t	Critical t	Interpretation
Control	50	11.38	15.38	7.013	13.313	1.677	Significant
Experim	52	26.76		7.776			

Viewed in Table 1.7 is the t-test analysis between pretest and posttest skill performance of the control group. Based on the computed t-value and critical t-value at $\alpha=0.05$, there was a significant difference between pretest and posttest skill performance of the control group.

Problem No. 6. Is there a significant difference between the pretest and posttest skill performance in mathematical computation of the experimental group?

Table 1.8
Test of Difference Between the Pretest and Posttest Skill Performance
in Mathematical Computation of the Experimental Group

Group	N	Mean	Mean Difference	Standard Deviation	Computed t	Critical t	Interpretation
Control	52	10.62	39.48	5.445	55.193	1.675	Significant
Experim	52	50.10		2.172			

Disclosed in Table 1.8 is the t-test analysis between pretest and posttest skill performance of the experimental group. Based on the computed t-value and critical t-value at α=0.05, there was a significant difference between pretest and posttest skill performance of the experimental group.

Problem No. 7. Is there a significant difference in the pretest and posttest mean gain on skill performance in mathematical computation between the control and experimental groups?

Table 1.9
Test of Difference on the Pretest and Posttest Mean Gain on Skill Performance in
Mathematical Computation Between the Control and Experimental Groups

Group	N	Mean	Mean Difference	Standard Deviation	Computed t	Critical t	Interpretation
Control	50	15.38	24.10	8.169	17.889	1.660	Significant
Experim	52	39.48		5.158			

Table 1.9 discloses the t-test analysis of the pretest and posttest mean gain on skill performance in mathematical

computation between the control and experimental groups. Based on the computed t-value and critical t-value at α=0.05, there was a significant difference of the pretest and posttest mean gain on skill performance between the control and experimental groups.

4 Findings

Base on the analysis and interpretation of the data collected in this study, the following findings were revealed: (1) The pretest skill performance in mathematical computation of the control and the experimental groups was described as "not skillful". Pretest performance of the control group was 11.38 while in the experimental group was 10.62 in which both were far behind the 75 percent of the total items tested; (2) There was no significant difference in the pretest skill performance in mathematical computation between the control and experimental groups; (3) The posttest skill performance in mathematical computation of the control group which was 26.76 was described as "skillful" while the posttest skill performance in mathematical computation of the experimental group which was 50.10 was described as "very much skillful"; (4) There was a significant difference in the posttest skill performance in mathematical computation between the control and experimental groups; (5) There was a significant difference between the pretest and posttest skill performance in mathematical computation of the control group; (6) There was a significant difference between the pretest and posttest skill performance in mathematical computation of students in the experimental group; and (7) There was a significant difference in the mean gain obtained on students' skills in mathematical computation between the control and experimental groups.

5 Conclusions

Based on the findings, the skills that the students possessed in both the control and the experimental groups on the topics included in this experiment is equivalent or comparable before the intervention. The study also concludes that the experimental group performs significantly skillful than the control group after the intervention. It can be deduced further that there is a significant variation in the students' skills in mathematical computation between the control group with the traditional method of teaching and the experimental group with the used of TI-84 Plus in teaching and learning Mathematics. In addition, the study concludes that both the interventions, traditional method of teaching and using TI-84 Plus in teaching and learning Mathematics, make improvement in the students' skills in mathematical computation. This means that students perform skillfully better during the posttest than during the pretest. However, students' skills in mathematical computation in the experimental group are greatly influenced by the TI-84 Plus used by teachers and students in Advanced Algebra and Trigonometry class. This concludes that students in the experimental group perform skillfully better than their counterpart.

References

[1] *De Las Peñas, Ma. Louise Antonette and Bautista, Debbie Marie (2012). On Maximizing Technology Resources and Their Benefits In Teaching and Learning Mathematics*. Ateneo de Manila University, Philippines.www.tsg.icme11.org/document/get/223

[2] Edwards, M. T., Meagher, M., &Ozgun-Koca, S. A. (2008). *When is a good fit not a good fit? Dynamic regression with the TI-nspire graphing calculator*. Mathematics Teacher, 102(4), 300-304.

[3] Elger, Don (2011). *Theory of Performance*. Mechanical Engineering, University of Idaho. http://www.pcrest2.com/fol/1_2_1.htm

[4] Heid, M. K., & Edwards, M. T. (2001). *Computer algebra systems: Revolution or retrofit for today's mathematics classrooms?* Theory into Practice, 40(2), 128-36.

[5] Huoppi, David (2009). *The Evolution of Technology in Mathematics Classrooms*. www.math.harvard.edu/.../HuoppiTechnology...

[6] Jones, Keith (2005). *Graphing Calculators in the Teaching and Learning of Mathematics: A Research Bibliography*. Contemporary Issues in Technology and Teacher Education (2005) Volume: 21, Issue: 1990, Pages: 31-33. http://www.mendeley.com/research/graphing-calculators-in-the-teaching-and-learning-of-mathematics-a-research-bibliography/#

[7] Sedaei, Sam (2003). *Theory of Skill Acquisition by Hubert and Stuart Dreyfus*. http://samsedaei.com/HubertAndStewartDreyfus.pdf

[8] Shore, M. A., & Shore, J. B. (2003). *An integrative curriculum approach to developmental mathematics and the health professions using problem-based learning*. Math Computation Education, *37*(1), 29-38.