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IMPROVING STUDENTS' ATTITUDE, CONCEPTUAL UNDERSTANDING AND PROCEDURAL SKILLS IN DIFFERENTIAL CALCULUS THROUGH MICROSOFT MATHEMATICS

Marie Jean N. Mendezabal, Darin Jan C. Tindowen

University of Saint Louis (Philippines)

marie_jean_mendezabal@yahoo.com.ph, djtindowenn2015@gmail.com

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Abstract

This study examined the effects of using Microsoft Mathematics on students' attitude, conceptual understanding, and procedural skills in Differential Calculus. A quasi-experimental research design was used in which two different learning environments were compared. The participants of the study were two classes of Electrical Engineering students enrolled in Differential Calculus course, assigned randomly as control and experimental groups with 30 students in each group. The control group was taught using the traditional approach of teaching Differential Calculus while the experimental group was taught the same lessons using the Microsoft Mathematics embedded activity sheets. The experimental group learned through exploration and discovery of various concepts. The findings indicated that the participants had little understanding of the concepts and processes of Calculus prior to the conduct of the study. A significant improvement in their performances was noted after the experimentation. This suggests that the use of Microsoft Mathematics in teaching and learning Differential Calculus improves students' conceptual understanding and procedural skills. It is also found that the use of Microsoft Mathematics in teaching and learning calculus is equally effective as the traditional approach. In terms of attitude, the experimental group demonstrated a "favorable" to "very highly favorable" attitude along the five (5) domains of the MTAS. A significant difference exists between the pretest and posttest attitude of the participants on the domain "learning Mathematics with technology".

Keywords – Differential calculus, Conceptual understanding, Procedural skills, Attitude, Technology, Microsoft mathematics

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1. Introduction

The 21st century learning landscape has dramatically changed due to the advent of technologies. Teaching and learning processes have become more interactive, engaging and fun through technology-based instruction. With the integration of technology in the classroom, educators continue to create learning materials that are innovative, task-oriented as well as learner-centered (Saavedra & Opfer, 2012; Kim, Choi, Han & So, 2012; Tindowen, Bassig & Cagurangan, 2017).

In the field of Mathematics education, technology has already been integrated; however, its implementation seems slow (Agyei & Voogt, 2011; De Witte & Rogge, 2014; Safdar, Yousuf, Parveen & Behlol, 2011). Moreover, studies which focused on the integration of technology in Mathematics teaching and learning present divergent results. While some researches concede that the use of technology in Mathematics teaching and learning has not led to any discernible improvements (Goodison, 2002;

Hourigan & O'Donoghue, 2007; Biagi & Loi, 2013), others have shown that the use of technology effectively enhance students' understanding and enjoyment of Mathematics (Miller & Glover, 2007; Tay, Lim, Lim & Koh, 2012). It is identified as a tool and important component to support visualization and interactive media that assist representation, reasoning, calculation construct, exploring, and solving problem (Curri, 2012).

Calculus is a branch of Mathematics which has a wide application in almost all disciplines such as engineering, science, business, computer science, and information system. It is an area of Mathematics perceived as the main source of failure in the undergraduate level because of its nature which involves abstract and complex ideas and the way it is being taught to the students (Sahin, Cavlazoglu & Zeytuncu, 2015). With these, initiatives around the world have introduced a range of innovative and interactive learning technologies such as graphic software (Robutti, 2010; Lavizca, 2010) and computer algebra system (Özgün-Koca, 2010; Mignotte, 2012; Durán, Pérez & Varona, 2014) to explore Calculus concepts. The use of these technologies offer new ways to learn and teach Calculus that help deepen students' understanding of abstract and complex ideas (Arango, Gaviria & Valencia, 2015; Šumonja, Veličković & Šubarević, 2015; Zakaria & Salleh, 2015) which include conceptual understanding (Bartell, Webel, Bowen & Dyson, 2013; Richland, Stigler & Holyoak, 2012) and procedural skills (Rittle-Johnson & Schneider, 2014; Cragg & Gilmore, 2014) and also increases positive attitude of students towards the subject (Sang, Valcke, Van Braak & Tondeur, 2010; Yuan & Chun-Yi, 2012). Further, it helps students to better visualize the concepts through graphical representation (Moses, Wong, Bakar & Mahmud, 2013). Previous researches have concluded that interactive technology especially visualization tools like graphing calculators and other Mathematics software, are an effective media to engage students in the learning and create meaningful learning (Liang & Sedig, 2010; Arsan, Kutluca & Özpınar, 2011).

In the Philippines, a developing country in South East Asia, students' performance in Calculus has never been encouraging. At present, Calculus is considered as one of the most challenging and difficult major courses of college students in the Philippines (Angeles, Fajardo & Tanguilig III, 2015; Salazar, 2016). In fact, the result of the Trends in International Mathematics and Science Study in 2008 revealed that the Philippines performed least among ten countries in mathematics in which students performed weak in the Calculus subject (Ogena, Lana & Sasota, 2010). Moreover, it is also viewed as boring and strictly procedural subject (Matthews, Hoessler, Jonker & Stockley, 2013). In many Calculus classes, the traditional approach which puts emphasis on computational procedures rather than on understanding the underlying concepts is still the most commonly used method by teachers (Lasut, 2015). As a result, many students fail to manifest excellent performance in the subject, more so students do not know how to apply the concepts in real life situation (Fluck & Dowden, 2013; Nobre, Meireles, Junior, De Resende, Da Costa & Da Rocha, 2016).

Teaching Calculus using the traditional approach does not help students understand the basic concepts (Axtell, 2006). Thus, the teaching and learning of Calculus should be improved focusing on the conceptual understanding of the subject, as well as the development of problem solving skills. This is to prepare students for the challenges of the 21st century society especially now that Calculus is a required subject in the STEM (Science, Technology, Engineering, and Mathematics) strand of the Senior High School (SHS) curriculum. This challenges every Mathematics teacher to employ an approach that provides opportunities for the students to investigate and explore various mathematical concepts using different representations.

This study was conducted to investigate the effectiveness of using Microsoft Mathematics in the teaching and learning of Differential Calculus. It specifically tried to look into the performances on the conceptual understanding and procedural skills of students towards Calculus subject utilizing the said mathematics software. Moreover, it will also look into the overall attitude of the students before and after the use of Microsoft Mathematics in teaching and learning Calculus subject.

1.1. The Use of Microsoft Mathematics in Mathematics Instruction

Microsoft Mathematics is a freeware made by Microsoft Corporation to help students solve and understand mathematical concepts with visual effect and easy to understand steps. The primary tool in Microsoft Mathematics is a full-featured scientific calculator with extensive graphing and equation-solving capabilities. It can be used just like a handheld calculator by clicking buttons or the computer keyboard to type the mathematical expressions that you want the calculator to evaluate. It's capable of handling subjects including Pre-algebra, Algebra, Trigonometry, Calculus, Physics and Chemistry. There are three benefits using Microsoft Mathematics in learning Mathematics, these are freeware with structured menu and some of the menu provides solution and visualization (Microsoft Corporation, 2010).

2. Methodology

The study made use of the quasi-experimental with pretest-posttest, experimental-control group design in which two different learning environments were compared. It also employed the descriptive research design where an attitudinal questionnaire was utilized to determine the effect of using Microsoft Mathematics on students' attitude. Two classes of Electrical Engineering students of a private university in the Philippines enrolled in Differential Calculus were involved in the study. The two groups were selected as these were scheduled on the same time slot but different days. One class was assigned randomly as experimental group and the other as control group. Participants in both groups were identified and matched based on their grade point average (GPA) in their previous Mathematics subjects which are pre-requisites of Differential Calculus. Students with an average grade of 75-86 were included in the study. Results of the pretest that were administered before the conduct of the study were likewise considered in the selection. To ensure that the participants in both groups were of the same level of mental ability, the significant difference in the means of the pretest was tested using t-test of independent samples.

2.1. Research Instruments

2.1.1. The Mathematics and Technology Attitude Scale (MTAS)

The Mathematics and Technology Attitude Scale (MTAS) developed by Pierce, Stacey & Barkatsas (2007) was adopted in this study; however, some modifications were made specifically on the descriptive value assigned and the technology used to suit to the present study. The scale was used to monitor five affective variables relevant to learning mathematics with technology. The subscales measure mathematics confidence, confidence with technology, attitude to learning mathematics with technology and two aspects of engagement in learning mathematics.

2.1.2. Pretest and Posttest

The pretest/posttest is a teacher-made test composed of 25-item multiple choice to assess students conceptual understanding and 15-item open-response problem solving (scored 5 points per item using a rubric with a total of 75 points) for procedural skills. The test covered the topics in Differential Calculus namely: limits, continuity, derivatives, increasing and decreasing functions, and maximum and minimum values of a function. The test was validated by Mathematics experts and revised based on their suggestions.

2.1.3. Technology-based Activity Sheets

The technology-based activity sheets were developed for use by the experimental group. These activity sheets were designed following the principle of Rule of Three: graphical, numerical, and analytical approach. Each activity or lesson included the following parts:

1. *Topic* which is the lesson to be learned which includes limits, continuity, derivative, increasing and decreasing functions, and maximum and minimum values of a function;
2. *Learning Outcomes* which describes what the learner should manifest after conducting the activity;

3. *Activity* which is performed with specific purpose;
4. *Further Exploration* to enrich students understanding of Calculus concepts;
5. *Key Concept* which is a definition, formula, etc.
6. *Self-Test* which consists of items for more drills and practice; and
7. *Evaluation* to assess students' learning.

The activity sheets were critiqued by Calculus teachers and other experts in the field. These activities were revised based on the comments and suggestions provided by the evaluators.

2.2. Data Analysis

The data gathered were analyzed using descriptive statistics such as frequency count and mean to describe the pretest and posttest performances of the participants in both groups. The t-test for Independent Samples was used to compare the pretest and posttest performances of the two groups. Similarly, the t-test for Paired Samples was employed to compare the performance and attitude of the experimental group before and after the experimentation.

To measure the attitude of the experimental group toward learning mathematics with technology, a Likert-type scoring format was used for each of the subscales: Mathematics Confidence [MC], Confidence with Technology [TC], Attitude to learning Mathematics with Technology [MT], Affective Engagement [AE] (scored from 5-strongly agree to 1-strongly disagree). A different but similar response set was used for the Behavioral Engagement [BE] subscale. A five-point system was again used – Always, Often, Regularly, Rarely, Never (scored again from 5 to 1).

3. Results and Discussion

3.1. Pretest and Post-test Performance of Participants in the Experimental and Control Groups on Conceptual Understanding and Procedural Skills Tests

Table 1 presents the pretest and posttest performances of the participants from the experimental and control group. As reflected in the table, majority of the students in both groups have pretest scores ranging from 6-10. This result indicates that they performed fairly in the pretest. The table also reveals that the experimental and control groups have the same pretest mean score of 8.27 which means both groups have fair performance before the conduct of the study. The value further indicates that the students do not have much knowledge of the important concepts in Differential Calculus.

Scores	Experimental Group (n = 30)				Control Group (n = 30)			
	Pretest		Posttest		Pretest		Posttest	
	F	%	F	%	F	%	F	%
21 – 25								
16 – 20							2	6.70
11 – 15	4	13.30	14	46.70	4	13.30	15	50.00
6 – 10	24	80.00	16	53.30	23	76.70	11	36.60
0 – 5	2	6.70			3	10.00	2	6.70
Mean	8.27[d]		10.60[c]		8.27[d]		10.50[d]	

[a]Excellent; [b]Very Satisfactory; [c]Satisfactory; [d]Fair; [e]Poor

Table 1. Pretest and Posttest Performances of the Participants on Conceptual Understanding

The result of this study is confirmed by the previous study in which it was found out that students enrolled in Engineering Technology courses were lacking a strong Calculus foundation as evidenced by their low achievement in the said subject (Zakaria & Salleh, 2015). Accordingly, one of the reasons behind the low performance of students in Calculus is the deficiency in conceptual understanding (Liang & Martin, 2008).

With regard to the posttest performance of the subjects, the table shows an improvement in the scores in both groups. Students in the experimental group have performance ranging from fair to satisfactory. The same performance is exhibited by majority of the students in the control group. The data likewise reveal that the mean score of the experimental and control groups are nearly equal. The experimental group obtained a mean score of 10.6 while the control group is 10.5. As reflected by the post-test mean scores, the conceptual understanding of the subjects in the experimental group is satisfactory while fair for the control group. The mean scores suggest that students have little understanding of the basic concepts in Calculus. Many students cannot achieve a deep understanding of the concepts and find that Calculus is very hard and abstract (Tiwari, 2007). The result of this study shared similar findings of previous studies conducted which have shown that students have difficulties in understanding the concepts of Integral Calculus (Liang & Martin, 2008; Salleh & Zakaria, 2011).

Table 2 shows the performance of the participants in the procedural skill test. As gleaned from the table, all students from the experimental and control groups performed poorly in the pretest with scores ranging from 0-15. Moreover, the table reveals a very low pretest mean scores for both groups. Further analysis of students' work shows that some students did not attempt to solve the given problems. Others tried but they failed to continue because of lack of knowledge or understanding of the Calculus ideas to solve problems. This result indicates that the students have little intuition about the concepts and processes of Calculus which confirms the previous result. It is possible that students simply guessed their answers in the conceptually-oriented test since the given test is a multiple choice type. Procedural and conceptual knowledge are complementary (Bossé & Bahr, 2008) since procedural knowledge is part of conceptual knowledge (Tall, 2008).

The data also reveal that more than three-quarters (76.7%) of the experimental group and over half (56.7%) of the control group have at least satisfactory performance in the posttest. Moreover, the experimental group obtained a mean score of 36.83 while the control group had a mean score of 33.77, both of which indicate a satisfactory performance. This result implies that both groups improved in their performance after the experimentation. However, the experimental group has achieved higher posttest mean score than the control group. This result suggests that the use of the traditional approach and the technology-based approach in Mathematics teaching and learning can improve Mathematics performance.

Scores	**Experimental Group (n = 30)**				**Control Group (n = 30)**			
	Pretest		**Posttest**		**Pretest**		**Posttest**	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**
61 – 75							2	6.70
46 – 60			3	10.00			2	6.70
31 – 45			20	66.70			13	43.30
16 – 30			7	23.30			13	43.30
0 – 15	30	100			30	100.00		
Mean	4.77[e]		36.83[c]		3.93[e]		33.77[c]	

[a]Excellent; [b]Very Satisfactory; [c]Satisfactory; [d]Fair; [e]Poor

Table 2. Pretest and posttest performances of the participants on procedural skills

3.2. Test of Significant Difference in the Pretest and Posttest Performances of the Experimental and Control Groups

As shown in the table, there is no statistically significant difference between the pretest mean scores of the experimental and control groups in both conceptually-oriented and procedural skill tests. This implies that the two groups have comparable mathematical ability prior to the conduct of the study.

The posttest mean score of the two groups reveals no statistically significant difference. The t-value of 0.146 and p-value of 0.884 for the conceptually-oriented test and t-value of 1.178 and p-value of 0.243 for the procedural skill test indicates that the posttest performances of the experimental and control groups do not differ significantly. The result suggests that the integration of technology in the teaching and learning of Calculus is equally effective as the traditional approach.

The research findings are supported by many studies who tried to compare the procedural skills of students in experimental groups, taught by using ICT with those from control groups taught traditionally (Code, Piccolo, Kohler & MacLean, 2014; Arslan, 2010; Czocher, Tague & Baker, 2013). Result of these studies found that there is no significant difference between the two groups. Also students' achievement taught by using Microsoft Mathematics was higher than those taught by traditional teaching method (Purwanti & Pustari, 2013). However, the finding of the study likewise revealed that the difference between groups in terms of the improvement score was not significant. Furthermore, Calculus knowledge in students exposed to teacher-centered and student-centered teaching approach found no statistical significance in success between the two groups of students (Schumacher & Kennedy, 2008).

Domain	Group	Mean	t-value	p-value
Conceptual Understanding	Experimental	8.27	0.000	1.000
	Control	8.27		
Procedural Skills	Experimental	4.77	1.335	0.187
	Control	3.93		

*Significant at 0.01 level

Table 3. Significant Difference in the Pretest Performances of the Experimental and Control Groups

Domain	Group	Mean	t-value	p-value
Conceptual Understanding	Experimental	10.60	0.146	0.884
	Control	10.50		
Procedural Skills	Experimental	36.83	1.178	0.243
	Control	33.77		

*Significant at 0.01 level

Table 4. Significant Difference in the Posttest Performances of the Experimental and Control Groups

3.3. Test of Significant Difference in the Pretest and Posttest Performances of the Experimental Group

Domain	Test	Mean	Mean Difference	t-value	p-value
Conceptual Understanding	Pretest	8.27	2.333	4.436	.000*
	Posttest	10.60			
Procedural Skills	Pretest	4.77	32.067	22.067	.000*
	Posttest	36.83			

*Significant at 0.01 level

Table 5. Significant Difference in the Pretest and Posttest Performance of the Experimental Group

As disclosed in the table, the pretest mean score for the conceptually-oriented test is 8.27 while the post-test mean score is 10.6. The difference of 2.33 in the pretest and posttest scores reflects a significant increase in the performance of students in the experimental group. This indicates that the mean score after the experimentation is significantly higher than the mean score before the experimentation. The paired t statistic that resulted is 4.436 with statistical significance $p = 0.000 < .01$. This result implies a significant difference in the scores.

Similar result is demonstrated for the procedural skill test. The mean difference of 32.067 provides evidence that students' performance in the post-test is higher than in the pre-test. The probability value of .000 also reveals a significant difference in the pretest and posttest scores of the participants.

Overall, students achieved higher scores on the posttest than on the pretest after integrating Microsoft Mathematics in Calculus teaching and learning. The result clearly shows that the use of Microsoft Mathematics improved both students' conceptual understanding and procedural skills in Differential Calculus. The results of this study are consistent with the findings of similar studies on the utilization of mathematics software in teaching such as on Applications of Geogebra into Teaching Some Topics of Mathematics at the College Level (Diković, 2009). The study confirmed that the use of the applets created with the help of GeoGebra and used in Differential Calculus teaching had a positive effect on the understanding and knowledge of the students. The paired samples t-test revealed a significant difference in scores before and after the GeoGebra workshops. Moreover, studies were conducted examining the effect of integrating technology in students' conceptual and procedural understanding of Integral Calculus and concluded that students benefitted from the integration of mathematics software in learning Integral Calculus (Salleh & Zakaria, 2013). Both types of understanding were found to be successfully enhanced using the mathematical software.

3.4. Attitude of the Experimental Group towards Learning Mathematics with Technology Before and After the Experimentation

Dimensions	Pretest		Posttest	
	Mean	Qualitative Description	Mean	Qualitative Description
Mathematics Confidence	3.38	Favorable	3.48	Highly Favorable
Confidence with Technology	3.40	Highly Favorable	3.40	Highly Favorable
Learning Mathematics with Technology	2.63	Favorable	3.56	Highly Favorable
Affective Engagement	4.37	Very Highly Favorable	4.29	Very Highly Favorable
Behavioral Engagement	3.77	Highly Favorable	3.82	Highly Favorable
Overall Mean Attitude	3.51	Highly Favorable	3.71	Highly Favorable

Table 6. Students' Overall Attitude Toward Learning Mathematics with Technology

Table 6 presents the students' overall attitude along five dimensions of learning mathematics with technology. The findings show improvement in the attitude of the students towards learning mathematics in terms of their mathematics confidence. An increase of mean score from "favorable" to "highly favorable" signifies that the use of technology in learning Mathematics improved students' mathematics confidence. In addition, the students' strongly agreed that they have a mathematical mind and can handle difficulties in Mathematics.

Moreover, as observed in the table, students have highly favorable attitude related to confidence with technology which is revealed in the overall mean score. The students strongly agreed that they have the ability to use technology. Students stated that they are good users of computers and other things like VCRs, DVDs, MP3s and mobile phones. This result is expected as today's students are "digital natives". Students likewise asserted that they can master any computer program needed for school; however, they only agree that they can fix a lot of computer problems. The finding of this study concurs with the findings of Zakaria and Salleh (2015) that the students involved in the study on "Using Technology in Learning Integral Calculus" had very high positive value towards using computers in their daily activities. Also, in the study of Oktaviyanthi and Supriani (2014), it was found out that students had very good attitude in terms of computer confidence, but their proficiency level related to educational technology is average.

Meanwhile, learning mathematics with technology has greatly changed the attitude of the students from "favorable" to "highly favorable". This means that the attitude of the students regarding the use of technology in learning Mathematics improved after the implementation of the technology-based activities. The students became more interested in learning Differential Calculus through the use of Microsoft Mathematics and this has resulted in more engagement in learning. The integration of Microsoft Mathematics in the teaching and learning process enabled the students to explore and link the different relations and concepts in Calculus through the different representations (i.e. graphical, numerical, and analytical) which were difficult to explain without technology. Further, the students disclosed that the use of technology in learning mathematics is worth the extra effort. The finding of this study supports the research findings of many researchers that applying technology in mathematics learning increases students' motivation (Nguyen & Kulm 2005; Ekawati, 2008) and engagement in classroom learning activities (Prasek, Schwartz & Vorst, 2012; Al-Absi & Abed, 2014; Al-Ammary, 2012).

Furthermore, the data in the table also show that generally students have very highly favorable attitude in terms of the affective engagement. Based on students' responses, they stated that learning mathematics is enjoyable. This has been observed in the students while working on the technology-based activities wherein they are actively involved in the mathematics learning process. The students strongly believe that in Mathematics they get rewards for their efforts. Furthermore, the students avowed that they are interested in learning new things in mathematics and they find it emotionally satisfying when they solve mathematics problems as revealed in their responses which is "very highly favorable"; although there is a slight decrease in the posttest mean attitude of the students which may be attributed to the nature and complexity of the subject.

In addition, the table reveals a highly favorable attitude of the students as to behavioral engagement as shown in the pretest and posttest mean attitude. The students stated that they concentrate hard in mathematics. The students further affirmed that if they cannot do a problem, they keep on trying different ideas or approaches. With these, the implementation of technology in learning makes students very attentive and engaged in learning (Prasek, Schwartz & Vorst, 2012). Moreover, the use of student-centered and active learning approach develops the potential of individuals to be more creative and critical in their thinking (Mokhtar, Tarmizi, Ayib & Tarmizi 2010).

In summary, the data reveal that generally students have "highly favorable" attitude toward learning mathematics with technology even before the experimentation, although the posttest mean attitude of the subjects is higher than the pretest mean attitude. The table further reveals an improvement in the attitude of the subjects in terms of their mathematics confidence and learning mathematics with technology. The data suggest that the participants have more favorable attitude in terms of these dimensions after their exposure to the technology-based approach of teaching and learning Mathematics.

3.5. Test of Significant Difference in the Pretest and Posttest Attitude of the Experimental Group

As shown in the table, there is a statistically significant difference in the pretest and posttest mean attitude of the students with regard to learning Mathematics with technology. The mean difference of 0.933 denotes a significant increase in the posttest mean attitude of the students. This is further validated by the t-value of 3.336 and probability value of 0.002, which is less than the 0.05 level of significance. This result implies that the use of Microsoft Mathematics in Differential Calculus positively influenced the attitude of students toward learning mathematics with technology.

Dimension	Test	Mean	Mean Difference	t-value	p-value
Mathematics Confidence	Pretest	3.3750	.10556	.971	.339
	Posttest	3.4806			
Confidence with Technology	Pretest	3.4000	.00000	.000	1.000
	Posttest	3.4000			
Learning Mathematics with Technology	Pretest	2.6250	.93333	3.336	.002*
	Posttest	3.5583			
Affective Engagement	Pretest	4.3667	.07500	.619	.541
	Posttest	4.2917			
Behavioral Engagement	Pretest	3.7667	.05000	.588	.561
	Posttest	3.8167			

*Significant at 0.05 level

Table 7. Significant Difference in Students' Attitude Before and After the Use of Microsoft Mathematics

The data likewise reveal that although there is no significant difference in the attitude of the subjects in terms of mathematics confidence, confidence with technology, affective engagement, and behavioral engagement, a favorable attitude along these domains has been demonstrated by the students. The increase in the posttest mean attitude of the students in terms of mathematics confidence mirrors an increased confidence in doing mathematics.

4. Conclusion and Implications for Further Research

The use of Microsoft Mathematics in teaching and learning Differential Calculus improves students' conceptual understanding, procedural skill, and attitude toward learning the subject; it is equally effective as the traditional approach. With the Microsoft Mathematics embedded activities, students are afforded the opportunities to learn Calculus concepts and processes by exploration and discovery allowing them to be more engaged in learning.

In view, mathematics teachers are encouraged to integrate technology in Mathematics instruction to diversify their teaching approach and make it more interactive. Calculus teachers can use the Microsoft Mathematics embedded activity sheets to supplement lectures and to enable the students gain further understanding of Calculus concepts and develop their problem-solving ability.

Moreover, teachers should continue to engage students in meaningful learning by providing technology-based learning environment that allows students to experience the process of mathematical investigation and foster positive attitude toward the subject. Mathematics educators must continue to examine current practices for teaching Mathematics with technology to determine its effectiveness and to explore new ways to harness the potential that it brings as an instructional and learning tool.

A possible extension of this study is to look into other technology-driven instructional strategies and activities such as mathematics software that will also enhance students' attitude, conceptual skills, ad procedural skills in Calculus and other mathematics courses.

Similar study may also be conducted to other programs such as Technical and other engineering programs since the participants of this present study were the Electrical Engineering students.

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