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The Geometer's Sketchpad: A Technological Tool Enhancing Junior High School Students' Mathematics Achievement, Attitude towards Mathematics and Technology

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Abstract The objective of this study was to determine the effect on the levels of junior high school students' attitude towards mathematics and technology as well as their mathematics achievement after being exposed to geometry activities using the dynamic software, the Geometer's Sketchpad. Data collected were analyzed using mean, percentage, standard deviation and t-test for paired observations. Results revealed that junior high school students' attitude towards mathematics and technology gained a relative increase as influenced by the usage of the Geometer's Sketchpad. Furthermore, the Geometer's Sketchpad showed a positive impact on students' achievement in Geometry as indicated in the increase of their posttest scores. The researcher then recommends that mathematics teachers may consider utilizing technological tools like the Geometer's Sketchpad in discussing lessons in Geometry and other mathematics subjects to improve not only their students' mathematics achievement but also for students' attitude towards mathematics and technology.

Keywords: *achievement, geometer's sketchpad, attitude towards technology, mathematics attitude*

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1. Introduction

In the age of globalization students' nowadays are more inclined to the use of technology. Recent studies in various fields have shown that students' who are exposed to technology are performing better in the classroom compared to their counterparts. Bringing technology in the classroom ignites our students' interest and believed to perform well during evaluation. Technology is an effective tool in mathematics classroom to enhance interaction between students and teachers by allowing them to investigate their conjectures [2].

Technological tools being utilized in the classroom had long been endorsed and capitalized by mathematics educators around the globe to meet the need of today's global learners. Electronic technologies such as computers and educational software are regards as very important innovative tools for the teaching and learning of mathematics concepts. In fact, the National Council of Teachers of Mathematics (NCTM) based in the United States of America mentioned that these educational technologies can contribute and helped students in their mathematical investigations and modelling. Furthermore, studies have shown that the use of the Geometer's Sketchpad helped improved students' mathematics achievement, better retention of mathematical concepts and allows students' deeper critical thinking skills across all levels [1,3,6,7,8,9].

Geometer's Sketchpad (GSP) is a dynamic software program which offers students a tool to construct drawings, measure between points and show relationship of lengths and angles that exists in figure based on the initial construction in the environment [4]. Further, the sketchpad allows the students to investigate mathematical connections and supplied chances for students to reflect on their activities, which is central to a constructivist theory of knowing [10]. Overall, the use technology in mathematics classrooms such as the Geometers' Sketchpad has been tested to significantly enhanced students' motivation, provide maximum learning opportunities and improve students' achievement in mathematics.

Hence, this research would like to determine the impact of the Geometer's Sketchpad on the students' of Balulang National High School mathematics achievement as well as their attitude towards mathematics and technology.

2. Objectives of the Study

This research aimed to determine the effect of the use of Geometer's Sketchpad in teaching geometry among the junior high school students of Balulang National High School in Cagayan de Oro City, Philippines with their achievement in Geometry as well as their attitude towards

mathematics and technology. Specifically, this research aims to:

a) Determine the level of performance of the junior high school students in Geometry using the teacher-made diagnostic test;
b) Utilize the Geometer's sketchpad software in teaching selected topics in Geometry as an intervention to improve the performance of students in Geometry;
c) Investigate the effects of using Geometer's sketchpad in students' attitude towards mathematics and technology and achievement level in Geometry.

3. Methods

3.1. Participants of the Study

The respondents of this research were the Grade 9 or junior high students of Balulang National High School. This school was located at the heart of the city of Cagayan de Oro in Northern Mindanao, Philippines. This school belonged to the West I District under the supervision of the Department of Education (DepEd) of the Division of Cagayan de Oro. This school suffered major devastation during typhoon Haian (Sendong) last December 2011 and eventually because of the tragedy, the school became a receipt of Adopt-a-School project of ABS-CBN television network and PLDT SMART Foundation in the Philippines. Aside from infrastructure developments, the school received computer facilities and fast internet connections necessary for teacher and students work. Because of this computer facilities, the researcher was able to make use of the opportunity for students to be able to explore the internet resources and the Geometer's Sketchpad software. Trial versions were readily available in the internet but the researcher utilized a licensed version of the sketchpad. Shown below was the actual turn-over of the computer facilities by the PLDT SMART foundation:

Figure 1. Balulang National High School Principal, PLDT SMART representatives and the students during the actual computer facilities turn-over ceremony

One intact group was selected as the experimental group and this section was handled by the researcher. There were 44 students in this group where half of them are boys and the other half are girls. Another group still handled by the researcher was chosen as the control group. This group composed of 40 students, 21 are males and 19 are females. The control group was taught using the conventional teaching method in teaching geometry, that is, more on lecture method but still with students' individual and group activities. Both groups are heterogeneous groups age ranging from 14-15 years of age and was randomly selected from the five sections which the researcher handled during the school year.

3.2. Instrumentation

The students were given survey questionnaires to determine their profile of the participants of this research. Survey questionnaires measuring students' level of attitude towards mathematics and technology were given to the respondents before and after the treatment to both groups. These questionnaires undergo face and content validation with Cronbach alpha values of 0.73 (attitude towards mathematics) and 0.81 (attitude towards technology). Another validated multiple choice teacher-made questionnaire on Geometry with a reliability coefficient of 0.77 based on the expected learning competencies of the Department of Education (DepEd) in high school mathematics was then conducted to determine the level of students' achievement in Geometry. The control group was also handled by the researcher and was taught using the conventional method of teaching geometry. The Geometer's sketchpad was used in discussing selected topics in geometry and afterwards students are given the chance to use the sketchpad in the ICT laboratory and they are allowed to explore other features of the sketchpad. The Geometer's Sketchpad offers a variety of tools and students can explore more than geometry topics which can be used in higher level mathematics. For instance, the sketchpad could provide derivatives of functions, and graph functions in rectangular and polar grids. Geometric constructions, measurements such as finding perimeter, area, slopes, length of line segments, transformations such as reflections, translations, dilations, sketching the graph of functions, and providing visual animations of the sketches. Samples of geometric activities done in the classroom was shown below:

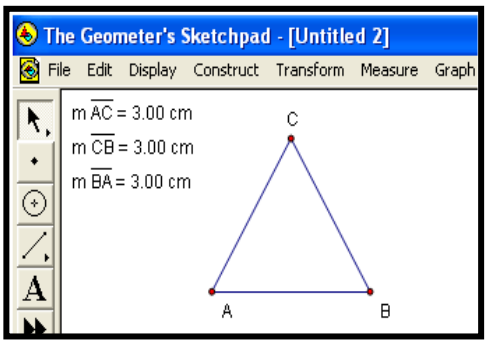

Figure 2. Equilateral Triangle Activity

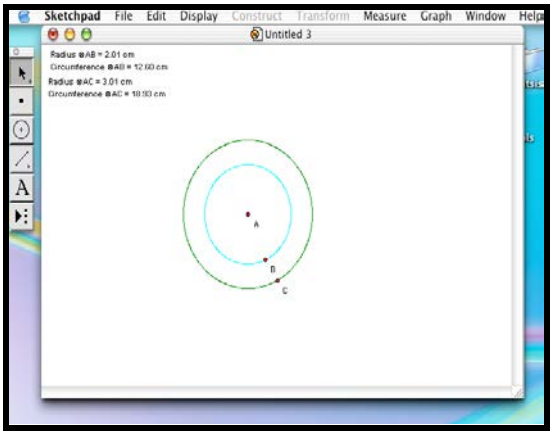

Figure 3. Radius and Circumeference of Circles Activity

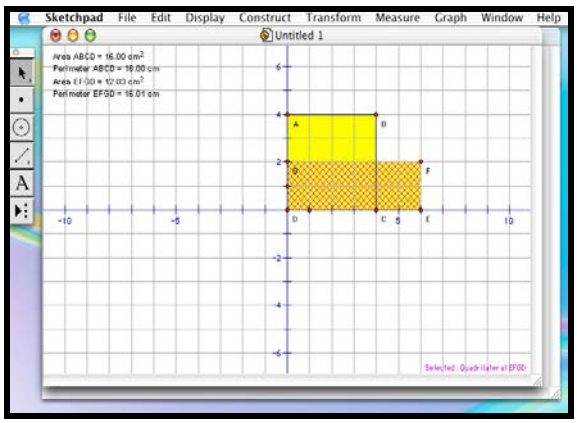

Figure 4. Finding Area and Perimeter Activity

3.3. Statistical Tools

In order to determine the demographic characteristics of the respondents and the level of students' attitude towards mathematics and information technology, frequency, percentage, mean and standard deviation was utilized. To test the significant difference of the pretest and posttest scores in the teacher-made test in Geometry, t-test for dependent samples was used.

4. Results and Discussion

Table 1. Mean Level of Students Attitude towards Mathematics and Technology

Groups	Test	Before the Experiment		After the Experiment		t-value
		Mean	SD	Mean	SD	
Experimental Group	MA	2.23	0.987	3.64	1.004	3.093*
	TA	3.51	1.310	3.78	1.125	2.882*
Control Group	MA	2.30	0.751	3.06	1.795	7.901*
	TA	3.69	1.209	3.74	0.949	6.003*

Mathematics Attitude (MA) *significant at 0.05 alpha level
Technology Attitude (TA)

Mean Level	Attitude Description
4.75 – 5.00	Highly Positive
3.50 – 4.74	Positive
2.25 – 3.49	Negative
1.00 – 2.24	Highly Negative

Table 1 above shows the scenario of the effect of the use of the Geometer's Sketchpad on students' attitude towards mathematics as well as their attitude towards technology. It showed that in the experimental group it has a significant increase in their mean level in both the mathematics attitude and technology attitude. The students' attitude towards mathematics had an increase of 1.41 units while their attitude towards technology got an increase of 0.27. Furthermore, the t-value for both attitudes showed significant improvement. This result showed that before the experiment, both groups already have a negative attitude towards mathematics while they possessed a positive attitude towards technology. After the experiment, these students showed an improvement of their attitudes to both mathematics and technology. In terms of mathematics attitude, the experimental group got a mean level of 3.64 which was now positive as compared to a highly negative attitude before the experiment as indicated by the mean level of 2.23 while the control group had still a negative attitude towards mathematics even after the treatment period. On the other hand, students' attitude towards technology after the treatment, both groups showed significant increase but still not on a highly positive level. This means that the Geometer's Sketchpad software used in discussing topics in geometry contributed to the progress of their feelings about mathematics and technology. In the control group, it also showed significant increase of their mathematics attitude and technology attitude even without the exposure to the Geometer's Sketchpad which could be attributed to some other factors which are not within the scope of this research. The t-values showed significant difference from the pretest and posttest scores of students in both questionnaires.

Overall, it can be concluded that the power of technology in its many forms, already been absorbed by students at present. They were surrounded with so much technologies and these students would think that it is an important aspect in their lives to survive and be competitive in this generation. With respect to the students' attitude towards mathematics, teachers need to integrate technology in their mathematics classes as well as finding methods or strategies on how to improve students' level of mathematics attitude. In this case, using the Geometer's Sketchpad could be one of the many possible ways in the progress of the mathematics attitude.

Table 2. Comparison of the Pretest and Posttest Scores of the Participants in the Achievement Test in Geometry

Groups	Tests	Mean	SD	t-value
Experimental Group	Pretest	7.80	3.66	8.063*
	Posttest	12.60	4.85	
Control Group	Pretest	8.98	3.99	4.851*
	Posttest	10.06	2.38	

Mean Level Description *significant at 0.05 alpha level

18.50– 20.00	Outstanding
13.50 – 18.49	Very Satisfactory
8.50 – 13.49	Satisfactory
4.50 – 8.49	Fairly Satisfactory
1.00 – 4.49	Did Not Meet Expectations

Before the treatment, the experimental group had an achievement mean score of 7.80 which was only fairly satisfactory performance. There was a relative increase in the mean score of their achievement test, from 7.80 to 12.60. The increase however was not really that outstanding but it showed significant leap from fair to satisfactory level. Also, it shows that the posttest scores have a wider spread compared to the pretest score. The computed t-value of 8.063 which is greater than the critical t-value of 2.021 at the level of significance of 0.05, the null hypothesis was rejected. This implies that there was really a significant difference between the pretest and posttest scores. More specifically, there was a relative increase in the students' scores and concluded that the use of Geometer's Sketchpad helped improve the students' performance in the test.

On the other hand, the control group also showed a relative increase of their achievement test scores from 8.98 to 10.06 in the posttest which were both in the satisfactory level. In fact, this group had a higher pretest mean score as compared to the treatment group. This means that teaching methodology of the teacher and other relevant factors could somehow cause the slight increase of their scores which is not within the scope of this

research. The t-value supported the scores which clearly explained the slight significant increase of their mean achievement test scores. Further, this could also mean that students nowadays find their own ways on how to develop their mathematical skills with the presence of available materials around them supported with the excellent teaching skills of mathematics teachers. The slight increase of the students mean achievement scores requires teachers to design activities which can elevate the performance of the students in their classes as well as performing in national and international comparisons on mathematics achievement.

5. Conclusions & Recommendations

In conclusion, students' attitude towards mathematics and technology has been improved after using the Geometer's Sketchpad in the class. Moreover, the scores of the students in the posttest generally increased after they are taught using the Geometer's Sketchpad. This implies that the software has a positive impact on the students' performance in the teacher-made test. Thus, in this research, it is highly recommended that teachers or schools may utilized or perhaps integrate technology in discussing their lessons in their respective classes, particularly in mathematics, the Geometers Sketchpad can be a helpful tool in discussing lessons in Geometry. Additionally, mathematics teachers should give emphasis in improving the students' attitude towards mathematics. Future studies can be conducted in determining the effect of using Geometer's Sketchpad in other mathematics subject in a bigger population and for a longer time frame. Other factors which affect students' performance in mathematics could also be studied and other mathematical software's could be explored and be utilized in the mathematics classroom.

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References

[1] Awe, W.G. (2007). How Geometer's Sketchpad Improves Student Learning, Retrieved online from www.faculty.bemidjistate.edu dated August 23, 2016.

[2] Choi-Koh, S.S. (1999). A student's learning of geometry using the computer, Journal of Educational Research, 92 (5) (1999), pp. 301-331.

[3] Dekker, D., (2011). "Effect of Geometer's Sketchpad on Student Knowledge and Attitude" (2011).Master of Education Program Theses. Paper 37.

[4] Hollebrands, K. F. (2003), Preparing to Teach Mathematics with Technology.

[5] Jackiw, N. (2002). Sketchpad in Algebra: The case of slope. Retrieved online in January 2006 from http://www.ict-education.com.

[6] Meng, C.C. & Lim Chap Sam (2011). Encouraging the Innovative Use of Geometer's Sketchpad through Lesson Study, Creative Education 2011. Vol.2, No.3, 236-243.

[7] Nurulhidayah Lucy (2001). The Effectiveness of Using Dynamic Geometric Software on Students' Achievement in Geometry. University of Malaya.

[8] Thaller, J. (2005). The Effect of Geometer's Sketchpad on Seventh Graders' Understanding of Area and Perimeter. Retrieved from www.ase.tufts.edu. Date August 2016.

[9] Teoh B.T & Fong S.F. (2005). The Effects of Geometer's Sketchpad and Graphic Calculator in the Malaysian Mathematics Classroom. School of Educational Studies, Universiti Sains Malaysia. Retrieved online in March 2006. http://pppjj.usm.my/mojit

[10] Von Glasersfeld, E. (1995). Radical constructivism: A way of knowing and learning. London, UK: Falmer Press.