TEACHING PARABOLA WITH DYNAMIC SOFTWARE "GEOGEBRA": A PEDAGOGICAL EXPERIMENT IN VIETNAM

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Abstract

GeoGebra is a dynamic mathematics software, it is very helpful for teaching mathematics. In Turkey, particular for topic "Parabola", Reis, Z. A., Ozdemir, S. (2010) used GeoGebra to teach Parabola and outcomes of students in experimental class were better than the ones of control class. Learning from Reis and Ozdemir, in Vietnamese context, we want to verify whether teaching Parabola by guided discovery with GeoGebra in schools could be more effective or not in comparison with teaching Parabola with traditional methods of teaching. The results of the study also showed that Vietnamese students learned in dynamic environment of GeoGebra obtained the good learning outcomes of mathematics.

Key words: SPWG model, ICT, parabola teaching, dynamic software, GeoGebra, mathematics education

Introduction

Towards the use of dynamic software GeoGebra into teaching school mathematics, there were many works of Vietnamese researchers: N. P. Loc (2014a) developed "SPWG" model which is useful for guiding students and problem solvers to solve mathematics problems with GeoGebra, Loc and Triet (2014b) applied SPWG model to help their students discover new ideas on solving Heron's the problem on light ray. Also in Vietnam, there were some other authors who showed advantages of teaching mathematics with GeoGebra such as P. T. H (2013), L. V. M. Triet (2013), L. T. Phong (2014).

In Turkey, for topic "Parabola", Reis, Z. A. & Ozdemir, S. (2010) used GeoGebra to teach Parabola and outcomes of students in experimental class were better than the ones of control class. Learning from Reis and Ozdemir, in Vietnamese context, we want to verify whether teaching Parabola by guided discovery with GeoGebra in schools could be more effective or not in comparison with teaching Parabola with traditional methods of teaching.

Background

GeoGebra is a dynamic mathematics software, it is very helpful for teaching mathematics because it "combines dynamic geometry, algebra, calculus, and spreadsheet features (which other packages treat separately) into a single easy-to-use package" (Hohenwarter & Preiner, 2007). In Vietnam, the results of an investigation on opinions of mathematics teachers by Loc & Triet (2014a) showed that advantages of GeoGebra for teaching were highly evaluated. For the students,

> GeoGebra can help students grasp experimental, problem-oriented and research-oriented learning of mathematics, both in the classroom and at home. Students can simultaneously use a computer algebra system and an interactive geometric system; by doing this, they can increase their cognitive abilities in the best way (Diković , 2009).

The pedagogical experiment on teaching parabola with GeoGebra

Purpose of the experiment: The experiment was to verify whether in Vietnamese context, teaching parabola topic by guided discovery with assistance of GeoGebra is more effective than teaching the topic with traditional method of teaching or not.

Hypothesis

H_{01}: Student's outcomes of teaching parabola topic with assistance of GeoGebra are not higher than the ones of teaching this topic with traditional method of teaching.

H_{02}: Students' achievements after experiment are not better than the ones of students before experiment.

Methodology

Mathematics contents used for experimental instruction

1. Theory of parabola which consists of the definition of parabola and the standard equation of parabola;
2. Exercises.

The above contents belong to "Geometry 10 – Advanced" (Hình Học 10- Nâng cao) curriculum for secondary mathematics education in Vietnam.

Experimental model

We conducted experiment according to the model "Two groups – posttest", in which mathematics ability of students two groups (two classes) selected is equivalent (see Table 1).

Table 1: *Experimental model of teaching parabola with GeoGebra*

Groups	***Treatment*** *(teaching Parabola with GeoGebra, denoted X)*	***Posttest*** *(Mathematics test scores, denoted O)*
Experimental class (EC)	**X**	**O**
Control class (CL)	**-**	**O**

(Note: Before experiment, the mathematics ability of EC and CL is equivalent)

Experimental class: Class $10A_1$ of 31 students. This class was taught with dynamic software GeoGebra (by teacher L. T. Phuong).

Control class: Class $10A_2$ of 30 students. This class was taught with traditional methods by the teacher N. C. Binh.

Both the above classes belong to the "Tay Do" Secondary School, Long My district, Hau Giang province.

Experiment was carried out in second semester of academic year 2014 – 2015. Before experiment was conducted, mathematics learning outcomes of students of experimental class and control class were equivalent. Particularly, after finishing the first semester of academic year 2014 – 2015 (before experiment) average marks of mathematics of students in experiment class and control class were 6.296774 and 6.106667, respectively; and according to data analysis of Excel 2003. we obtained the results of t –Test with two – sample assuming unequal variances as follows (see Table 2).

Table 2: Comparing the mathematics ability of experiment and control class before the pedagogical experiment

t-Test: Two-Sample Assuming Unequal Variances		
	Experimental class	*Control class*
Mean	6.296774	6.106667
Variance	4.190323	3.86823
Observations	31	30
df	59	
t Stat	0.369917	
P(T<=t) two-tail	0.712769	
t Critical two-tail	2.000995	

Table 2 indicated that t-value is 0.369917 and P – value is 0.712769. The result is not significant at $p \leq 0.05$. Therefore, means is not different and so, mathematics learning outcomes of students in experimental classes and control class is not different before experiment was carried out.

Teaching methods applied in experimental class: We applied “Guided discovery” with the help of dynamic software GeoGebra for teaching parabola topic. In teaching process, teacher operated GeoGebra to guide his students to discover knowledge or to find out how to solve exercises on parabola. Figure 1 illustrates the teaching definition of parabola in classroom; Figure 2 and Figure 3 illustrate teacher’ s the guidance for his students to find out the solution of the problem: “ In plane Oxy, given (P): $y^2 = 4x$ and two points: A (0; -4), B(-6; 4). Find C on (P) so that the area of triangle ABC has the greatest value”.

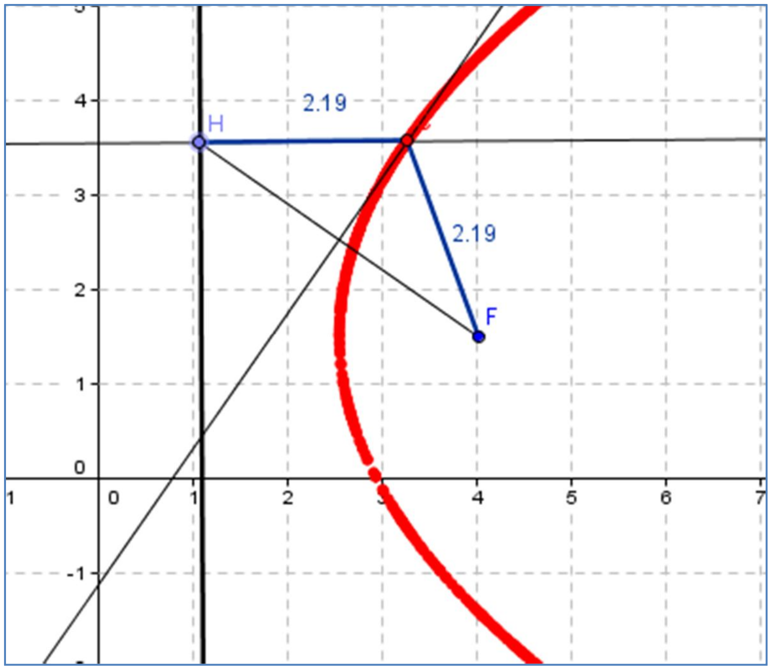

Figure 1

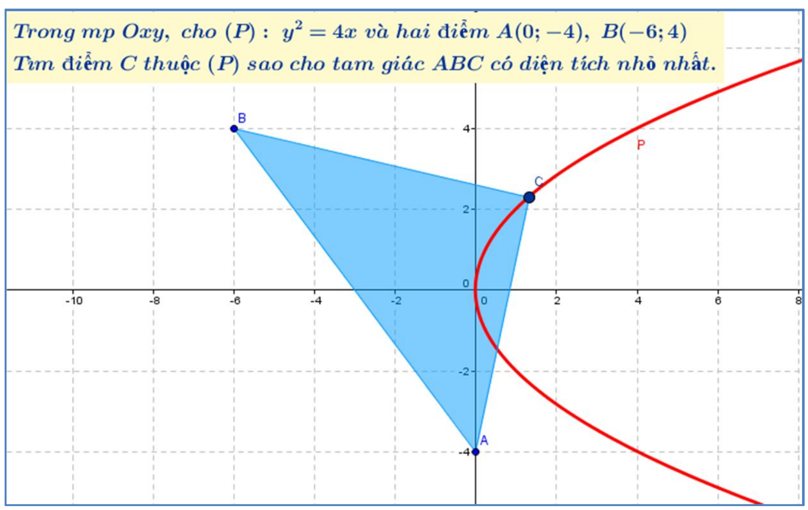

Figure 2

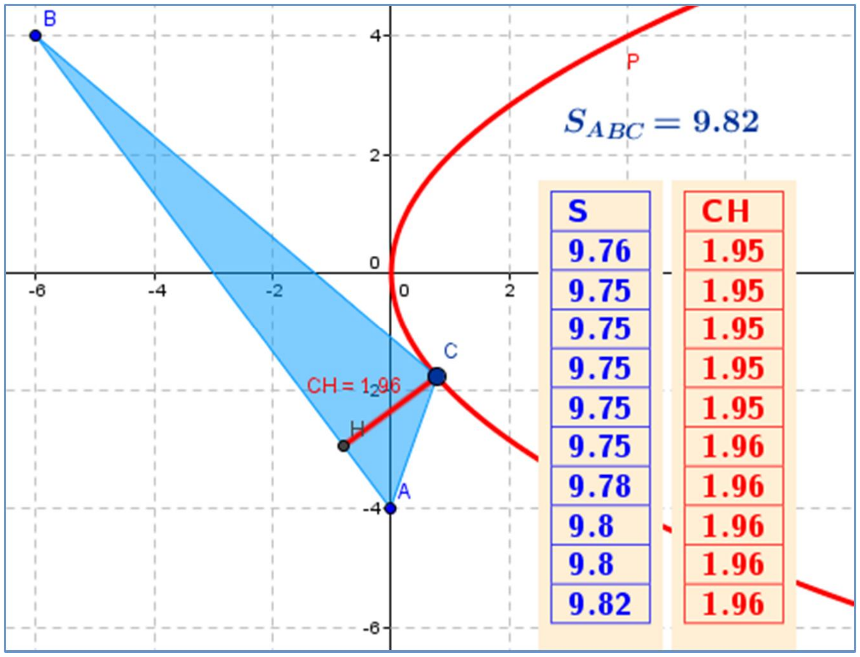

Figure 3

Results

1. ***Comparing learning outcomes of experimental and control classes after the experiment***

After finishing the experiment, students of experimental and control classes were required to do the same test consisting of six items with four choices and three essay exercises. Table 3 presents the results of students (according to mark scale of ten):

Table 3: Test scores of experimental and control classes after the experiment

Mark / Class	0	1	2	3	4	5	6	7	8	9	10	Average mark	The number of students
Experimental class	0	0	0	1	2	4	3	6	6	7	2	7.16129	31
Control class	0	0	0	2	3	6	6	6	5	2	0	6.13333	30

Table 4: Comparing the results of experiment and control class after the pedagogical experiment

t-Test: Two-Sample Assuming Unequal Variances		
	Experiment class	*Control class*
Mean	7.16129	6.13333
Variance	3.473118	2.74023
Observations	31	30
Df	59	
t Stat	2.279418	
P(T<=t) one-tail	0.013137	
t Critical one-tail	1.671093	

Table 4 indicates that t-value is 2.279418 and P – value is 0.013137. The result is significant at $p \leq 0.05$; the null hypothesis H_{01} is rejected. So, the mean of experimental class is higher than the one of control class. In other words, mathematics learning outcomes of students in experimental class are better than the ones of control class.

2. ***Comparing learning outcomes of experimental class after the experiment with learning results of this class in the first semester of academic year 2014 -2015***

Table 5: t-Test: paired two sample for means of class before and after experiment

t-Test: Paired Two Sample for Means		
	After Experiment	*Before Experiment*
Mean	7.16129	6.296774
Variance	3.473118	4.190323
Observations	31	31
Df	30	
t Stat	1.873286	
P(T<=t) one-tail	0.035401	
t Critical one-tail	1.697261	

Table 5 shows that calculated t exceeds the critical value (1.8733 > 1.697261) and the result is significant at $p \leq 0.05$ (0.035401 < 0.05). Therefore, the null hypothesis H_{02} is rejected and the achievement of class after experiment is better than the one of class before experiment.

Conclusion

The experiment showed that the use of GeoGebra software to assist parabola teaching was more effective than teaching with traditional method. In the case of learning in the dynamic environment created by GeoGebra software, students could predict, discover new knowledge. From the results of this experiment, we have the same opinion that "to integrate the educational technology into lesson improves the academic achievements, because of appealing to more sense organs. Especially, the visual and dynamic figures increase the students' attention towards mathematics lessons which predominantly consist of abstract concept" (Reis, Z. A.& Ozdemir, S., 2010).

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Appendix:

QUESTIONS USED FOR EVALUATING STUDENTS AFTER EXPERIMENT (in Vietnamese)

ĐỀ KIỂM TRA THỰC NGHIỆM

I. TRẮC NGHIỆM *(3 điểm)*

Câu 1 (0.5đ): Điểm nào là tiêu điểm của parabol có phương trình (P): $y^2 = 5x$.

A. F(5; 0) B. F(5/2; 0) C. F(-5/4; 0) D. F(-5/4; 0)

Câu 2 (0.5đ): Đường thẳng nào là đường chuẩn của parabol có phương trình (P): $y^2=4x$.

A. x = 4 B. x = -2 C. x = 1 D. x =-1

Câu 3 (0.5đ): Parabol (P) có trục Ox và đi qua điểm M(1; 3) có phương trình chính tắc là:

A. $y^2 = 3x$ B. $y^2 =9x$ C. $x^2 = 9y$ D. $y^2= -9x$

Câu 4 (0.5đ) : Parabol (P) có tiêu điểm F(-p/2; 0) có phương trình chính tắc là:

A. $y^2 = -2px$ B. $y^2 = 2px$ C. $x^2=-2py$ D. $x^2=2py$

Câu 5 (0.5đ):Parabol (P) có trục Oy và phương trình đường chuẩn y =3 có phương trình chính tắc là:

A. $y^2 = -12x$ B. $x^2 =-12y$ C. $x^2 =12y$ D. $x^2 = -6y$

Câu 6 (0.5đ): Tham số tiêu của parabol (P): $5y^2 = 12x$ là :

A. p=12/5 B. p=6/5 C. p=-6/5 D. p = 6

II. TỰ LUẬN *(7 điểm)*

Câu 7: *(3 đ)* Lập phương trình chính tắc của parabol (P) biết :

a. (1 đ) (P) có tiêu điểm F(1 ; 0).

b. (1đ) (P) có tham số tiêu p = 5.

c. (1đ) (P) nhận đường thẳng d : x = -2 là đường chuẩn.

Câu 8:*(3 đ)*Cho Parabol (P): $y = \frac{1}{2}x^2$ và đường thẳng d: 2mx-2y+1=0.

a. (1đ) Xác định tọa độ tiêu điểm và viết phương trình đường chuẩn của (P).
b. (2đ) Chứng minh rằng d luôn cắt (P) tại hai điểm phân biệt M, N. Tìm quỹ tích trung điểm I của MN khi m thay đổi.

Câu 9: *(1 đ)*Cho Parabol (P): y^2=x và hai điểm A(9;3), B(1;-1) thuộc (P). Tìm điểm M thuộc cung AB sao cho tam giác MAB lớn nhất.