EUROPEAN ACADEMIC RESEARCH
Vol. II, Issue 6/ September 2014

Impact Factor: 3.1 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Dynamic Software "Geogebra" for Teaching Mathematics: Experiences from a Training Course in Can Tho University

NGUYEN PHU LOC, PhD.
Associate Professor in Mathematics Education
School of Education, Can Tho University
Vietnam
LE VIET MINH TRIET, MSc.
Doctoral student in Mathematics Education
Pacific College, Can Tho City
Vietnam

Abstract:

In Vietnam, using ICT in teaching and learning all subjects in secondary schools has been encouraged since many years ago; particularly for mathematics, Geometer's Sketchpad have been popular. As we knew, in the fast-growing trend of information technology, much of software appeared which was very helpful for users. Among dynamic software packages for teaching and learning mathematics, GeoGebra was one such new software; the strong point of this software is the combination of dynamic geometry, algebra, calculus and spreadsheet; therefore, it is very comfortable for teachers and students. As a lecturer of the School of Education, Can Tho University, I found it necessary to introduce GeoGebra to the teachers of provinces in Mekong Delta – Vietnam. In 2014, we have just opened a training course on how to apply GeoGebra to teaching mathematics; there were 27 secondary school teachers in Mekong Delta (Vietnam) attending. The result was that all participants began to prefer GeoGebra, also agreed that it is very handy and helpful in teaching mathematics.

Key words: GeoGebra, dynamic mathematics software, ICT, mathematics education, educational technology.

1. Introduction

In Vietnam, the use of ICT as a tool to increase the quality of secondary education was concerned for many years ago. Particularly for teaching mathematics, secondary school teachers were learned some dynamic software packages which could assist their instruction in an effective way. However, through our observations of several classrooms in which teachers used dynamic software last years, we discovered that applying software of teachers to their jobs had some limitations. It seemed they only used the software to construct figures to illustrate intuitively their lectures; there were only a few teachers who knew how to help students to discover mathematics knowledge by themselves although the dynamic software packages "can be used to encourage discovery, experimentation and visualization in traditional teaching of mathematics" (Diković , 2009). So, as a mathematics education lecturers, we found it necessary to design the dynamic software "GeoGebra" course to improve the ability of secondary school teachers of mathematics in applying dynamic software packages to teaching mathematics.

2. Why to choose GeoGebra

We chose GeoGebra because of the following reasons:

1. GeoGebra is an open - source dynamic mathematics software. Therefore, students and teachers can use in learning and teaching without any fee. For lower – income country as Vietnam, it is very important because the teachers' salary has been relatively low; especially for provinces in Mekong Delta of Vietnam, most parents of students have been poor farmers.

2. GeoGebra "combines dynamic geometry, algebra, calculus, and spreadsheet features (which other packages treat separately) into a single easy-to-use package" (Hohenwarter & Preiner, 2007). This strong point makes it comfortable for learning and teaching mathematics in Vietnamese secondary schools. Teachers and students can use the software for teaching and learning all topics of mathematics in schools. 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).

3. GeoGebra has a large community with users and developers from different countries around the world (Tatar, 2013). Thanks to it, it is easy for teachers and students to exchange ideas each other.

3. Course "GeoGebra"

Goal: To help participants using GeoGebra to support their teaching mathematics in an effective way. Focus of the course is to apply GeoGebra to teaching plane geometry to Grade 10 students –Vietnam.

Objectives: After finishing the training course, the learner will be able:

- To identify the functions of tools of GeoGebra
- To construct figures having "dynamic" property by GeoGebra
- To design lectures such that secondary school students have opportunities to learn mathematics

concepts and theorems with GeoGebra in an active way.

- To guide secondary school students to solve mathematics problems with the assistance of GeoGebra.
-

Teaching method and teaching materials

- Co-teaching by Assoc. Prof. Nguyen Phu Loc and MSc. Le Viet Minh Triet
- Learners working in group of three, giving report and discussing in classroom (see Fig. 1)
- Computer: Laptop
- Dynamic software: GeoGebra – version 4.4.
- Teaching – learning materials:
  1. Phelps, S. An Introduction to GeoGebra, GeoGebra Institiute of Ohio, Madeira High School, University of Cincinnati, (www.math.utah.edu/~emina/.../Intro_to_Geogebra.pdf)
  2. An Introduction to GeoGebra-Version 4.4 (http://www.geogebra.org/book/intro-en.pdf)

Fig. 1: Learning activities of participants (working together in group, giving report and discussing)

4. The contents of the course

The course of GeoGebra consisted of contents as follows (see Table 1):

Table 1: The contents of the "GeoGebra" course (45 periods)

	Content	Time
Lesson 1	- A survey of participants' experiences on dynamic mathematics software - General introduction to ICT and role of ICT in mathematics education - Dynamic software and application to learning and teaching mathematics - Introduction to GeoGebra - Examination of tools in GeoGebra	4 periods (1period=50 minutes)
Lesson 2	- Drawing of a point, line and segment , midpoint of segment, - Showing the intersection of two objects - Drawing of a perpendicular line, parallel line, perpendicular bisector and angle bisector - Drawing of altitude of a triangle, - Drawing of a polygon and a regular polygon - Exercises	4 periods
Lesson 3	- Construction of a slider - Drawing of a circle and connecting the slider to radius of a circle -Construction of an angle and connecting the slider to an angle -Reflecting object about line and point -Exercises	4 periods
Lesson 4	-Drawing of a ellipse and connecting the slider to to its coefficients -Construction of the parabola by connecting each slider to its coefficients -Exercises	4 periods
Lesson 5	-The areas of a triangle, a polygon -Drawing of a tangent line to a curve from a point. Exercises	4 periods
Lesson 6	Algebra, Calculus, Spreadsheet of GeoGebra	4 periods
Lesson 7	Working in Groups: design a lecture to teach a mathematics concept assisted by GeoGebra	4 periods
Lesson 8	Presentation of Groups: teaching a concept assisted by GeoGebra & discussing.	4 periods
Lesson 9	Working in Groups: design a lecture to teach a mathematics theorem assisted by GeoGebra	4 periods
Lesson 10	Presentation of Groups: teaching a theorem assisted	4

	by GeoGebra & discussing.	
Lesson 11	Working in Group: Solving a problem assisted by GeoGebra & presentations	4 periods
Survey	A survey of participants' opinions on GeoGeobra	1 period

5. Participants

Participants were 27 secondary school teachers of mathematics who are pursuing master program of mathematics education in Can Tho University. They have learned some of dynamic software while working at secondary schools in Mekong Delta - Vietnam (see Table 2).

Table 2: A number of participants using dynamic mathematics software (n=27)

	How often to use (Frequency)				
	Never	**Rarely**	**Sometime**	**Often**	**Very often**
Geometer's Sketchpad	0	0	12	8	2
Cabri II Plus	5	0	8	3	0
Geoplan	9	1	0	1	1
GeoGebra	8	0	2	2	0

Comment: Table 2 showed that Geometer's Sketchpad have been more popular than the others. We think that there are two main reasons for the fact: (1) for over ten years ago, Geometer's Sketchpad were taught to all teachers of secondary schools by experts of the Ministry of Education and Training of Vietnam; (2) the software Geometer's Sketchpad is easy to use and helpful. To the other software, the teachers learned them by themselves or through short – term training courses.

6. Comparison of participants' opinions on dynamic software before and after attending the training course

In order to know what the participants think about the GeoGebra, and to determine the effectiveness of the training course. We conducted the survey of the participants both before and after attending the training course. The results were presented as follows:

Question 1: Was it easy for you to use the dynamic software?
Answer: see Table 3

Table 3: A number of participants' answers to the question 1 (n=27)

	Very difficult	Difficult	Relatively easy	Easy	Very easy
BEFORE ATTENDING THE TRAINING COURSE (Frequency)					
Geometer's Sketchpad	0	5	10	7	0
Cabri II Plus	0	3	4	5	0
Geoplan	2	3	0	2	0
GeoGebra	1	2	2	2	0
AFTER ATTENDING THE TRAINING COURSE (Frequency)					
GeoGebra	**0**	**0**	**3**	**19**	**5**

Comment: Under the guidance of lectures, participants had opportunities to operate GeoGebra. So that, 100% of participants agreed that GeoGebra was trouble – free to use and was easier to operate than the others.

Question 2: What are your opinions on the interface of the following software to the user
Answer: see Table 4

Table 4: Participants' opinions on the interface of the following software to the user (n=27)

	Very unfriendly	Unfriendly	Relatively friendly	Friendly	Very friendly
BEFORE ATTENDING THE TRAINING COURSE (Frequency)					
Geometer's Sketchpad	0	1	10	11	0
Cabri II Plus	0	0	8	5	0
Geoplan	0	5	2	1	0
GeoGebra	0	1	4	4	0
AFTER ATTENDING THE TRAINING COURSE (Frequency)					
GeoGebra	**1**	**5**	**10**	**10**	**1**

Comment: About the interface of the software to the user, after finishing the course, the learners identified that friendly level of GeoGebra was equivalent to Geometer's Sketchpad, which they have been familiar with.

Question 3: What are your opinions on the utility of functional tools of the following software?
Answer: see Table 5

Table 5: Participants' opinions on the utility of functional tools of the dynamic software (n=27)

	Very unhelpful	Unhelpful	Relatively helpful	Helpful	Very helpful
BEFORE ATTENDING THE TRAINING COURSE (Frequency)					
Geometer's Sketchpad	0	1	9	11	1
Cabri II Plus	0	1	7	4	1
Geoplan	0	3	3	1	0
GeoGebra	0	0	4	3	1
AFTER ATTENDING THE TRAINING COURSE (Frequency)					
GeoGebra	**0**	**0**	**0**	**21**	**6**

Comment: Table 5 gave us a result that after finishing the training course, all of participants agreed that GeoGebra is more helpful than the others.

Question 4: For the following questions, what are your opinions?

Answer: Table 6 presented both questions raised and participants' answers.

Table 6: A number of participants answering to each item (n=27)

Questions for dynamic software		Strongly disagreed	Disagreed	Normal	Agreed	Strongly agreed
Helping effectively students to learn a concept by discovery	I (before attending the course)	0	0	3	16	2
	II(After attending course)	**0**	**0**	**3**	**20**	**4**
Helping effectively students to find out the solution to a problem	I	0	0	4	17	0
	II	**0**	**0**	**8**	**16**	**3**
Helping effectively students to learn a theorem by discovery	I	0	0	2	18	1
	II	**0**	**1**	**3**	**17**	**6**
Helping effectively students to verify a conjecture	I	0	0	4	16	1
	II	**0**	**2**	**3**	**16**	**6**
Helping effectively students to verify the solution to a problem	I	1	1	4	15	0
	II	**1**	**2**	**6**	**16**	**2**
Helping students to increase the effectiveness of their learning	I	0	0	4	15	2
	II	**0**	**2**	**6**	**18**	**1**
Helping teachers to save the time to give a lesson in classroom	I	1	1	6	9	3
	II	**0**	**0**	**12**	**10**	**5**
Helping teachers to be easier to implement their pedagogical ideas	I	0	0	1	17	3
	II	**0**	**0**	**3**	**19**	**5**

Helping teachers to increase the effectiveness of their teaching	I	0	0	3	16	2
	II	**0**	**2**	**4**	**15**	**6**

Comment: After accomplishing the training course, the participants were of the same opinion that the dynamic software GeoGebra assists teachers and students very well in teaching and learning mathematics in Vietnamese secondary schools.

6. An illustration: a case of finding out the solution of a problem

One group of participants suggested the following problem that with the assistance of GeoGebra, students can find out the strategy for solving.

Problem: In coordinate system Oxy, let (C) be a circle having the equation: $x^2+y^2+4x+4y+6 = 0$ and its center is I, and a straight line (Δ): $x+my-2m+3 = 0$. In case of (Δ) intersecting (C) in A and B, to determine the value of m such that the area of the triangle IAB obtains the greatest value.

Finding out strategy for solving with assistance of GeoGebra:
The teacher could lead his student to find out the strategy for solving the problem as follows:

- Step 1: Look for the position of A and B where the area of the triangle IAB (S) obtains the greatest value (S_{max}) by moving slider (m) to (Δ) runs and seeing spreadsheet. Thanks so, we can detect two cases of A and B where S is S_{max} (=1) (see Fig. 1 and Fig. 2).
- Step 2: Look for the relationship between IA and IB in case of S = 1: IA IA $\perp$ IB (see Figure 1 and 2)

- Step 3: Select a suitable formula to compute S: $S = \frac{1}{2} IA.IB \sin \hat{AIB}$.

$$\text{Because } \sin \hat{AIB} \le 1,\ S_{max} = \frac{1}{2} IA.IB \ \Leftrightarrow\ IA \perp IB. \qquad (1)$$

From (1), it is not difficult for students to discover how to solve the given problem (see Fig. 3).

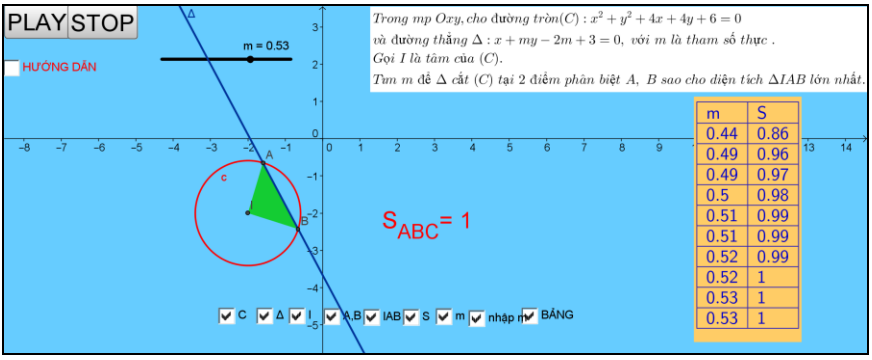

Fig. 1: In the first case of A and B for the greatest area of the triangle IAB: $IA \perp IB$

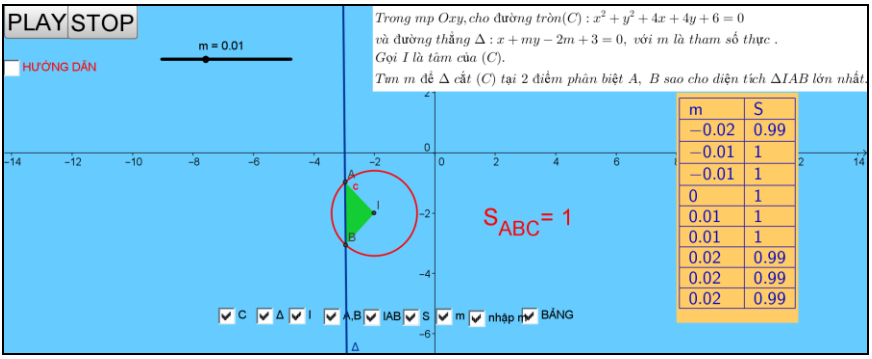

Fig. 2: In the second case of A and B for the greatest area of the triangle IAB: $IA \perp IB$

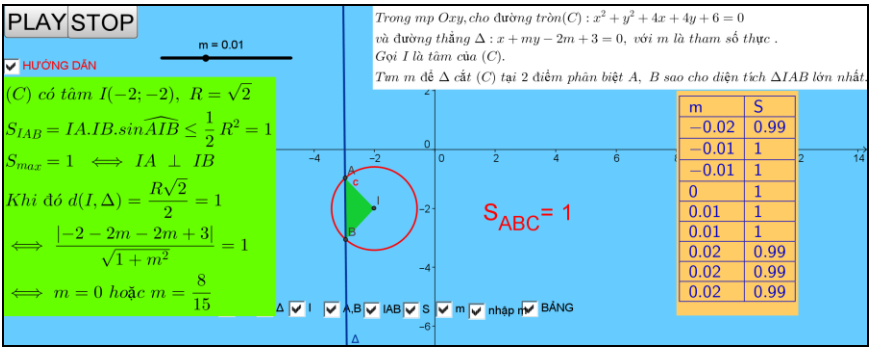

Fig. 3: The solution to the problem

Conclusion

The above results showed that after finishing the training course, GeoGebra became the dynamic software that learners preferred to the other software. The learner have highly evaluated GeoGebra because it integrates dynamic geometry, algebra, calculus, and statistics into a single easy-to-use package; so it is helpful and comfortable for students and mathematics teachers. From experiences that we obtained as above, at a present time, we still are continuing to study GeoGebra so that in coming years, we can offer mathematics teachers of different provinces in the Mekong Delta (Vietnam) training courses on GeoGebra in an effective way.

REFERENCES

_____. *"An Introduction to GeoGebra- version 4.4"*. http://www.geogebra.org/book/intro-en.pdf

Diković, L. 2009. "Applications GeoGebra into Teaching Some Topics of Mathematics at the College Level". *ComSIS* Vol. 6, No. 2, December 2009, UDC 004.738, DOI: 10.2298/csis0902191D.

Hohenwarter, M. & Preiner, J., 2007. Dynamic mathematics with GeoGebra. *Journal of Online Mathematics and its Applications*. ID 1448, Vol 7, March 2007.

Phelps, S. "*An Introduction to GeoGebra"*, GeoGebra Institiute of Ohio, Madeira High School, University of Cincinnati, www.math.utah.edu/~emina/.../Intro_to_Geogebra.pdf

Tatar, E. 2013. "The Effect of Dynamic Software on Prospective Mathematics Teachers' Perceptions Regarding Information and Communication Technology". *Australian Journal of Teacher Education,* Vol 38, 12, December 2013