Developing Vietnamese pre-service high school mathematics teachers' skills of using Geogebra

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ABSTRACT: In this article, I describe how third-year pre–service high school mathematics teachers developed their skills of using Geogerba software in a compulsory course entitled "Mathematical Software" in a teacher training program of the Faculty of Mathematics and Informatics at Hanoi National University of Education, Vietnam.

KEYWORDS: Geogebra, skills, pre-service high school mathematics teachers

1. Introduction

In recent years, there have been numerous articles which discuss Geogebra software in teacher training programs ([AM10], [Ant11], [Blu09]) and prospective teachers' usage of Dynamic Geometry Software including Geogebra in their studies and future careers ([Bul11], [HL12]).

At the Faculty of Mathematics and Informatics, Hanoi National University of Education, third-year prospective high school mathematics teachers attend a 2-credit compulsory course called "Mathematical Software" with 30 fifty-minute teaching periods. The main aim of the course is to teach pre-service high school mathematics teachers how to use several software such as Dynamic Geometry Software, Algebra Computer System, Latex, etc. so that they can use their knowledge and skills about the software in their studies and future jobs.

In this course, future teachers spend around 12 fifty-minute teaching periods in learning to use Geogebra. All of the lessons took place in a fifty-computer room of the Faculty of Mathematics and Informatics at Hanoi National University of Education. Computers are available for students to use.

I often instruct pre-service mathematics teachers to use Geogebra software according to following steps:

Step 1 (Introduction to Geogebra):

In this step, prospective mathematics teachers are introduced to Geogebra software and its main functions.

Step 2 (Installation of Geogebra, Geogebra commands and tools):

Future mathematics teachers are instructed to download and install the software, to use from straightforward to complicated Geogebra tools and commands, etc. They

interact with computers to learn and practice using the tools and commands of Geogebra

Step 3 (Working with basic tasks):

Pre-service mathematics teachers use their initial knowledge and skills of Geogebra commands and tools to implement basic tasks.

Step 4 (Working with challenging tasks):

Complicated and challenging tasks, which require more advanced Geogebra knowledge and skills are gradually given to mathematics teachers in training.

Step 5 (Working with several projects):

Prospective mathematics teachers work with several projects in groups.

Around 150 third-year prospective high school mathematics teachers, who were divided into 5 classes, took part in the "Mathematical Software" course in the second term of the academic year 2013-2014 (from January, 2014 to May, 2014) at the Faculty of Mathematics and Informatics.

In the following, I give an example to illustrate how a group of 30 future teachers among 150 teacher students mentioned above developed their skills of using Geogebra through dealing with a challenging task for them in Step 4 above.

2. Developing of students' skill of using Geogebra

In the following part, I describe how the teacher students' skills of using Geogebra were developed while they were working with a challenging task. After having assigned the task, each student tackled it individually with a computer. Next, I organised a whole-class discussion. Finally, I made some conclusion related to the task.

The below task was assigned to the teachers in training:

Let *xOy* be a fixed acute angle and *m* be a constant length measure. Let *A* and *B* be points on ray *Ox* and *Oy*, respectively such that $OA + OB = m$. Suppose that *N* is the midpoint of segment *AB*. Use Geogebra software to draw the figure and find the locus of *N*.

I used the three following steps in order to instruct the pre-service mathematics teachers to use Geogebra software to complete the task:

Step 4.1 (Individual working):

Each prospective teacher worked individually with a computer. While they were using Geogebra to deal with the task, I observed their performances and took note how they coped with the task.

While I was observing the pre-service mathematics teachers' working with the problem, I found that:

- A few future teachers had good solutions;

- Most of them could carry out the task, although their solutions were either incomplete or imperfect;

- Some of them could not complete the task because they were not able to locate points A and B on ray Ox and Oy, respectively such that $OA + OB = m$.

Step 4.2 (Whole-class discusion):

I asked the pre-service teachers to explain how they carried out the task. Several students put their hands up. I asked a male pre-service teacher to explain his solution.

Table 1. *Main Geogebra commands and tools the first student used:*

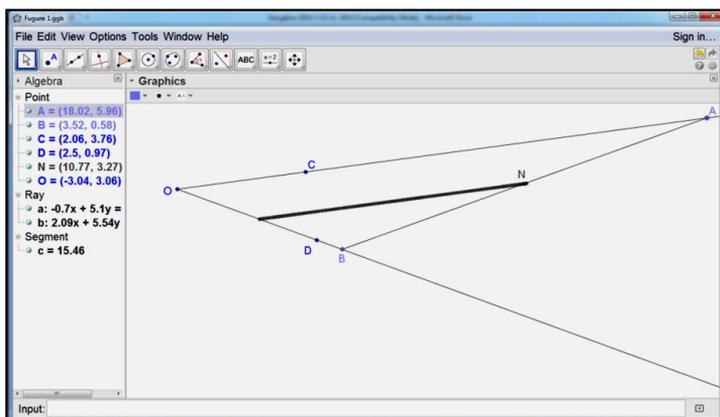|	
	Create point O on the Graphics View
	Create rays OC and OD
	Create point A on ray OC
	Create point B on ray OD
	Get midpoint N of segment AB
	Right-click on point N

Figure 1. *The mistaken solution*

He drew the figure like what he often draw figures with a pen and paper.

I asked the other prospective teachers to comment on his solution. Several students raised their hands. I asked a female student to present her solution.

The pointed pre-service teacher said: "In this figure, points A and B do not satisfy the condition $OA + OB = m$. Assume that m equals to 8. After creating point A on ray OC, I draw the circle with center O and radius $8 - OA$. This circle intersects ray OD at B. Consequently, I have $OA + OB = 8$."

Table 2. *Main Geogebra tools and commands the second student used:*

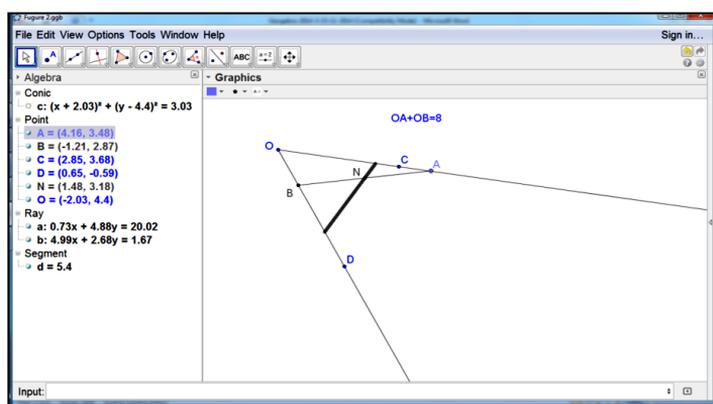|	
	Create point *O* on the Graphics View
	Create rays *OC* and *OD*
	Create point *A* on ray *OC*
	Draw the circle with center *O* and radius 8 - *OA*
	Create intersection point *B* of the circle and ray *OD*
	Get midpoint *N* of segment *AB*
	Right-click on point *N*

Figure 2. *The incomplete solution (OA + OB = 8)*

I asked the prospective teachers for their comments on the solution. Another female pre-service teacher said that "In this case, we have the length sum of segments *OA* and *OB* is 8. But we need the length sum of segments *OA* and *OB* is equal to *m*. To get this condition, I create segment *EF* such that its length measure is *m*."

Table 3. *Main Geogebra tools and commands the third students used:*

	Create point *O* on the Graphics View
	Create rays *OC* and *OD*
	Create segment *EF*
	Create point *A* on ray *OC*
	Draw the circle with center *O* and radius *EF* - *OA*

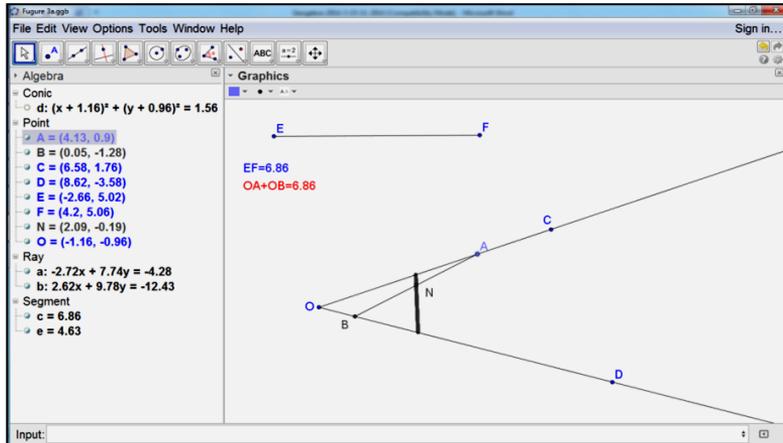|	
	Create intersection point *B* of the circle and ray *OD*
	Get midpoint *N* of segment *AB*
	Right-click on point *N*

Figure 3. *The incomplete solution (OA + OB = EF)*

Then, the female student draged point *A* along ray *OC* to show the trace of point *N*. After observing the dragging, the other pre-service teachers visualized that point *B* did not exist when point *A* moved away from edge *O* (see Figure 4 below).
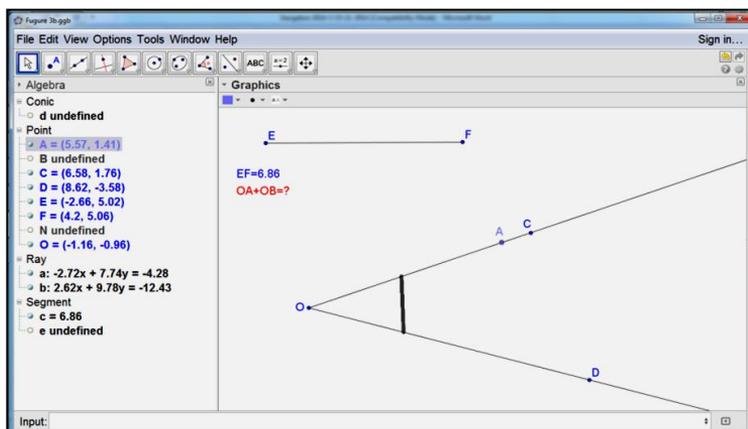
Figure 4. *The incomplete solution (OA + OB = EF, "B undefined"))*

One female pre-service explain her solution to this situation: "When $OA > EF$, we could not draw any circle with center O and radius $EF - OA$. Point A must lie on segment OG, where G is the point on ray OC such that $OG = EF$. So I will draw the cirlce with center O and radius EF. This circle intersects ray OC at point G. Then, I locate point A on segment OG." However, she was not able to locate point A on segment OG because segment OG had not existed in Geogebra environment.

Table 4. *Main tools and commands the fourth students utilized:*

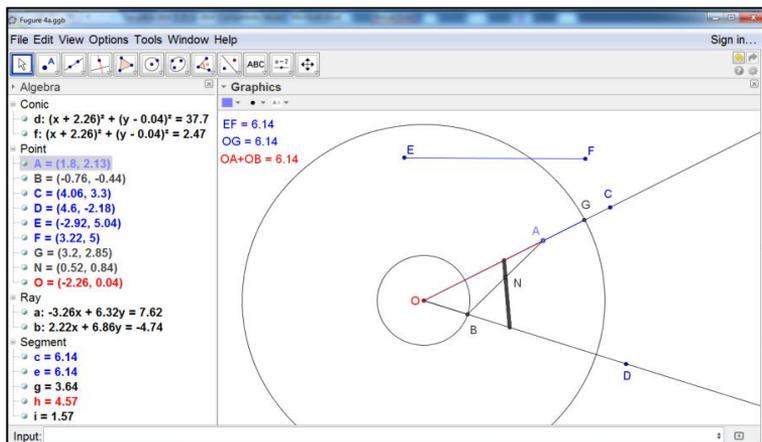|	
	Create point O on the Graphics View
	Create rays OC and OD
	Create segment EF
	Draw the circle with center O and radius EF
	Create intersection point G of the circle and ray OC
	Create segment OG
	Create point A on segment OG
	Draw the circle with center O and radius $EF - OA$
	Create intersection point B of the circle and ray OD
	Get midpoint N of segment AB
	Right-click on point N

Figure 5. *The complete solution ($OA + OB = EF$)*

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Another pre-service (the fifth pre-service teacher) gave a tip: "In fact segment *OG* does not exist in Geogebra environment. You can create segment *OG*". Taking this tip, the fourth pre-service had a completed solution.

Next, I challenged the pre-service teachers by asking them to rename rays *OC* and *OD* to rays *Ox* and *Oy*, respectively according to the given problem. Some prospective teachers tried to rename point *C* to "*x*" or the name of ray *OC* to "*x*". However, they did not succeed and met a computer notice "*Invalid input*: *x*". All students in a class could not rename the rays to *Ox* and *Oy*. Then, I gave them a suggestion: "After having hidden some unnecessary objects and their names in the figure, you can use "*Text*" tool."
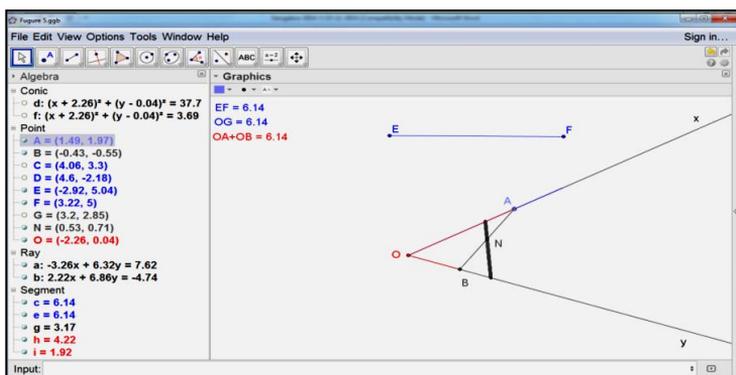

Figure 6. *The complete solution (OA + OB = EF)*

Then I asked several pre-service teachers who had different strategies for the given problem to explain their ideas and their strategies such as:

- Using "*Angle*" tool to draw angle *xOy* instead of drawing point *O*, rays *Ox* and *Oy*;
- Using "*Slider*" tool instead of creating the segment *EF* with *m*-length measure;
- Utilizing "*Compass*" tool instead of "*Circle with center and radius*" tool;
- Using "*Locus*" tool instead of "*Trace on*" tool.

Step 4.3 (Review):

In this step, the future teachers were asked to summarize key Geogebra tools and commands were used in completing the task and different strategies to deal with the task.

Finally, I gave the following tasks to the students as homework:
- Finding different strategies for the given problem;
- Finding a mathematical solution to the given problem;
- Using Geogebra to generalize the given problem.

3. Conclusion

Firstly, the pre-service high school teachers' skills of using Geogebra were developed considerably during the lessons of the "Mathematical Software" course. Secondly, the prospective teachers progressively built up knowledge of Geogebra, especially knowledge about "dynamic characteristics" while discussing with the lecturer and their peers and enteracting with the software. Futhermore, they had chances to find different strategies and solutions to the given problems. In addition, the students also utilized and applied their mathematical knowledge during the lessons. Finally, the future teachers' thinking such as critical thinking, creative thinking, functional thinking, etc. was gradually developed.

References

[AM10]   **M. Andresen, M. Misfeldt** – *Essentials of teacher training sessions with Geogebra*, The International Journal for Technology in Mathematics Education, vol. 17, no. 4, 2010.

[Ant11]   **V. Antohe** – *Geogebra in the context of the IT Surrounding Environment*, GGIJRO - Geogebra International Journal of Romania, vol. 1, no. 1. Available in:
http://ggijro.files.wordpress.com/2011/07/article-2.pdf

[Blu09]   **W. L. Blubaugh** – *A course for pre-service Mathematics Teachers that focuses on Mathematics and the Integration of Technology*, Mathematics and Computer Education, vol. 43, no. 1, 2009.

[Bul11]   **M. Bulut, N. Bulut** – *Pre service teachers' usage of Dynamic Mathematics Software*, The Turkish Online Journal of Educational Technology, vol. 10, issue 4, 2011.

[HL12]   **M. Hähkiöniemi, H. Leppäaho** – *Prospective Mathematics Teachers' Way of Guiding High School Students in Geogebra-Supported Inquiry Tasks*, The International Journal for Technology in Mathematics Education, vol. 19, no. 2, 2012.