PRE SERVICE TEACHERS' USAGE OF DYNAMIC MATHEMATICS SOFTWARE

Mehmet BULUT
Faculty of Gazi Education
Gazi University
Turkey
mbulut@gazi.edu.tr

Neslihan BULUT
Faculty of Gazi Education
Gazi University
Turkey
mrsbulut@gmail.com

ABSTRACT
Aim of this study is about mathematics education and dynamic mathematics software. Dynamic mathematics software provides new opportunities for using both computer algebra system and dynamic geometry software. GeoGebra selected as dynamic mathematics software in this research. In this study, it is investigated that what is the usage of pre service mathematics teachers for teaching and learning mathematics concepts. Qualitative research methodologies were used in this study. First participants learned basic commands about GeoGebra. During lessons pre service teachers of mathematics used dynamic worksheets. Data were collected by participants' works and opinions on dynamic mathematics software. According to responses of participants, pre service teachers want to use dynamic mathematics software for teaching mathematical concepts. Their works on GeoGebra showed that participants want to offer interactive dynamic mathematics worksheets on internet to the students for mathematical concepts.
Keywords: dynamic mathematics software, mathematics teaching, mathematics learning

INTRODUCTION
Understanding the factors about teachers' use of technology for teaching and instructional purposes is important (Teo, 2009). Teachers' usage of computer depends on their knowledge and experience about technology. Teachers integrate technology for teaching in different ways such as presentation purposes or allowing students to use a full range of technology resources (Teo, 2009). According to content of teacher education programs, pre service teachers can be able to use technology for educational purposes. Şahin and Toy (2009), reported that student-centered teaching methodology, expertise in computer use, and a high level of technology integration in teaching expressed more pre service teachers' positive attitudes toward using computer applications for instructional purposes.

On the other hand, pre service teachers of mathematics need to improve technological skills in order to use Information and Communication Technologies (ICT) in classrooms. Programs for teacher preparation in Turkey have computer courses. Pre service teachers are able to learn basic commands and usage about operating systems, word processing, presentation preparation, and internet. However, pre service teachers must know how to use ICT for teaching and learning.

Also, mathematics curriculum emphasize on using dynamic geometry systems (DGS) for teaching geometry concepts (MoNE, 2006). For this reason, teachers should learn use DGS in mathematics classrooms. According to curriculum reform in Turkey, students' role and teachers' role has changed (Bulut, 2007). Mathematics teachers must know usage of DGS for preparing lesson activities with it. So, some courses about using DGS offered to pre service teachers of mathematics in Gazi University. During these lessons, they can learn both how to use DGS and how to develop dynamic worksheets with DGS.

Computer Algebra Systems (CAS) improves students' conceptual understanding and problem solving abilities (Aksoy et al 2007, Bulut et al 2007). Dynamic mathematics software offers opportunities for using both computer algebra system and dynamic geometry software (Hohenwarter et al, 2009; Hohenwarter & Lavicza, 2009). Pre service teachers of mathematics need applications of dynamic mathematics software, while learning and teaching mathematical concepts (Jones, K, 2009).

In this study, it is investigated that what is the usage of pre-service mathematics teachers for teaching and learning mathematics concepts. Because of facilities of GeoGebra, it was selected as dynamic mathematics software in this research.

GeoGebra is an interactive geometry software which offers algebraic possibilities like entering equations directly (Hohenwarter, 2003). It is a useful software for students and teachers. The program encourages students to experiment the mathematical ideas. For example, by its dragging tool users can explore the relationship between the circle's graph and its equation. Students may also manipulate the equation directly from the algebra window and see the changed circle in the geometry window.

The basic objects in GeoGebra are points, vectors, segments, polygons, straight lines, all conic sections and functions in x. With GeoGebra dynamic constructions can be done like in any other dynamic geometry system. These constructions may be altered dynamically by dragging free objects. Also, it is possible to enter coordinates of points or vectors, equations of lines, conic sections or functions and numbers or angles directly (Hohenwarter, 2002).

GeoGebra is multilingual both in its menus and also in its commands. For example, the English command "Area" becomes "Alan" in Turkish.

Preiner (2008) described the features of Geogebra tools as follow;

Toolbar: The toolbar consists of a set of toolboxes in which GeoGebra's dynamic geometry tools are organized. Tools can be activated and applied by using the mouse in a very intuitive way. Just like Move, New Point, Line through Two Points, Perpendicular Lines, Polygon, Circle, Ellipse, Angle tools it is possible to build the geometric constructions directly. In the right corner of the toolbar the Undo and Redo buttons can be found, which enable the user to undo mistakes step-by-step.

Graphics window: The graphics window is placed on the right hand side of the GeoGebra window. It contains a drawing pad on which the geometric representations of objects are displayed. The coordinate axes can be hidden and a coordinate grid can be displayed by the user. In the graphics window, existing objects can be modified by dragging them with the mouse, while new objects can be created using the dynamic geometry tools provided in the toolbar.

Algebra window: The algebra window is placed on the left hand side of the GeoGebra window. It contains the numeric and algebraic representations of objects which are organized into two groups: Free objects can be modified directly by the user and don't depend on any other objects. Dependent objects are the results of construction processes and depend on 'parent objects'. Although they can't be modified directly, changing their parent objects influences the dependent objects. Algebraic expressions can be changed directly in the algebra window. If not necessary, the algebra window can be hidden using the View menu.

Input field: The input field is placed at the bottom of the GeoGebra window. It permits the input of algebraic expressions directly by using the keyboard.

Menu bar: The menu bar is placed above the toolbar. It provides a wide range of menu items allowing the user to save, print, and export constructions, as well as to change default settings of the program, create custom tools, and customize the toolbar.

Spreadsheet window: The spreadsheet feature in GeoGebra has all the regular Excel-features. Apart from manipulating numbers and formulating you can also manipulate all GeoGebra-objects in the spreadsheet view.
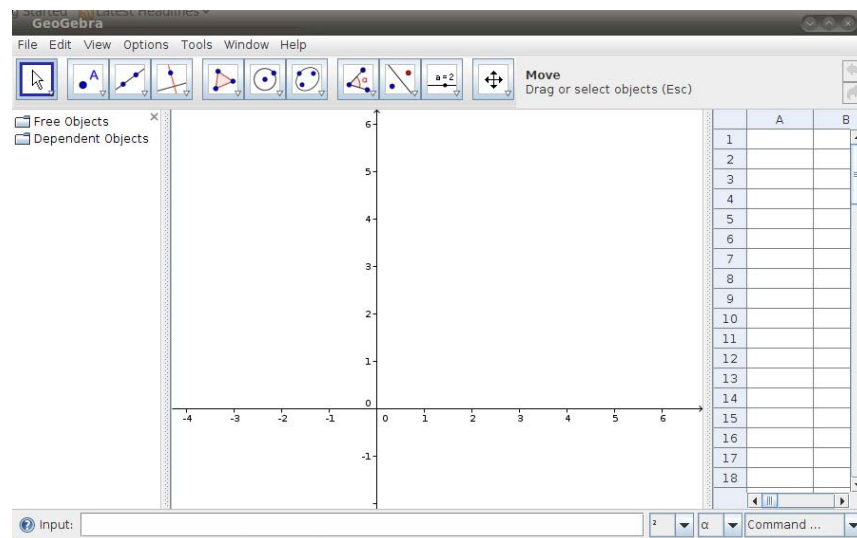

Figure 1. Geogebra Features

In Figure 1, left hand side shows the algebra window, middle side shows the graphic window and right hand side shows the spreadsheet window. The input window is located at the bottom of screen.

THE STUDY
Qualitative research methodologies were used in this study. First 47 second year student participants learned basic commands about GeoGebra. During lessons pre service teachers of mathematics used dynamic worksheets. Data were collected by participants' works and opinions on dynamic mathematics software. Interviews administered to randomly selected participants.

FINDINGS
According to responses of participants, pre service teachers want to use dynamic mathematics software for teaching mathematical concepts. There are some intercepts from interviews:

Pre service teacher of mathematics (PTM-1) stated that: *"...Mathematical proofs can be learned easily by using Geogebra. Students can discover relationships between mathematical concepts through different types of representations such as geometric, algebraic and graphical..."*

PTM-1 preferred to construct geometric figures and prove with dynamic worksheets as shown below:
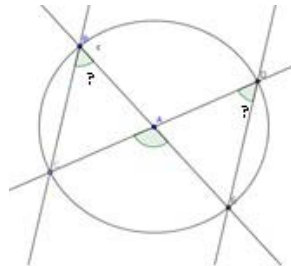

Figure 2. Investigation of relationship between angles in a circle by using GeoGebra

Their works on GeoGebra showed that participants want to offer dynamic mathematics workheets on internet to the students. Participants learned basic commands of GeoGebra during lessons. After that they prepared activities for mathematical concepts. Their dynamic worksheets on internet were interactive learning environment for learners. There some examples from preservice teachers' works:

PTM-2 was used other materials pictures such as Turkish patchwork for teaching geometric concepts in primary mathematics such as rotation, symmetry, translation and reflection. PTM-2 stated that: *"...I am looking everywhere by mathematical point of view. I can adopt real situations and images to Geogebra. In my opinion, geometry should be thought by using GeoGebra..."*
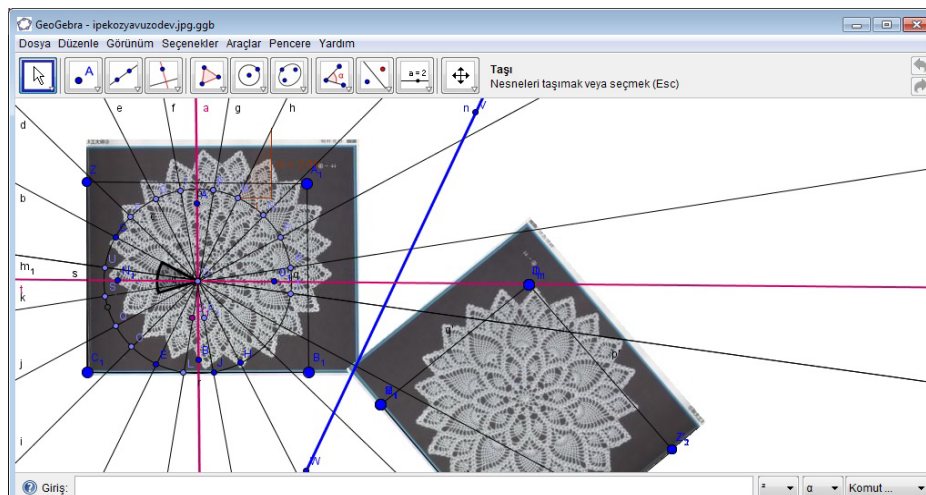

Figure 3: PTM-2's work about symmetry, rotation, translation and reflection

Some pre service teachers used GeoGebra for establishing real life examples with an international perspective from all over the world. For this reason PTM-3 was used a stadium picture from Riyad and PTM-4 was used Pisa tower. PTM-3 stated that:

"…GeoGebra enables using real-life examples for teaching and learning mathematical concepts. During preparation of worksheets I investigate interesting buildings from different cultures and countries. Their common point is usage of mathematics in life…"
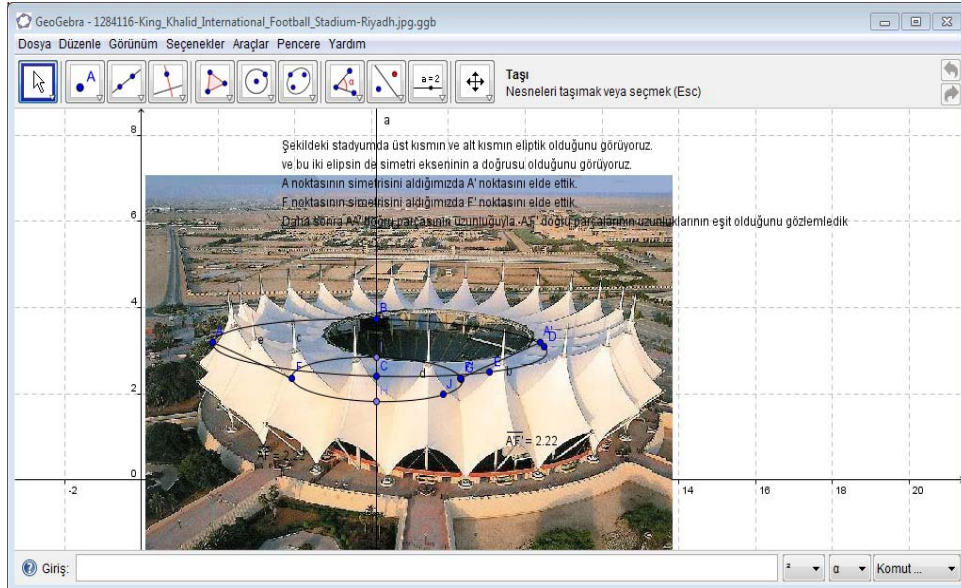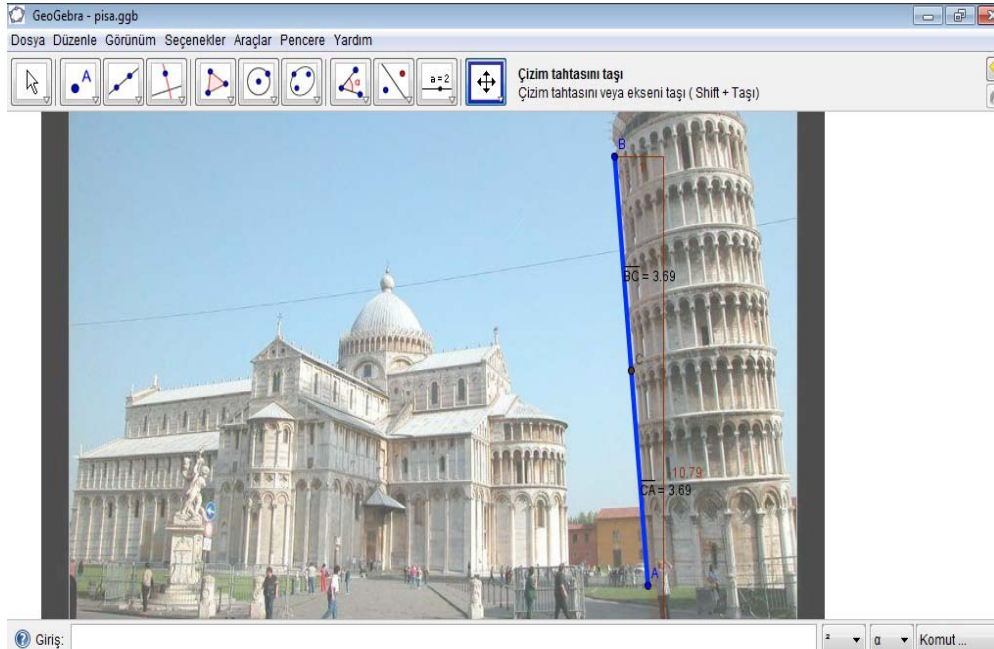

Figure 4. PTM-3's real- life example from Riyad

Figure-5. PTM-4's real life example from Pisa tower.

PTM-4 stated that: *"…I can do problem posing by using real examples from touristic places. So I can interrelate my lesson with social studies or other disciplines. According to math curriculum, interdisciplinary approach should be used during teaching of math, so I think it is useful to develop activities by using GeoGebra…"*

GeoGebra offers web-publishing opportunities for mathematics education. Some of PTMs were used these tools for building interactive web pages. PTM-5 and PTM-6 created dynamic worksheet web-pages for teaching mathematics. PTM-5 stated that: *"...In nature, there are some examples of mathematical subjects like fractals and its If I publish these webpages to internet my students can enter whenever they want and they can discover by trying each time. This website was an interactive learning environment for learners of mathematics..."*
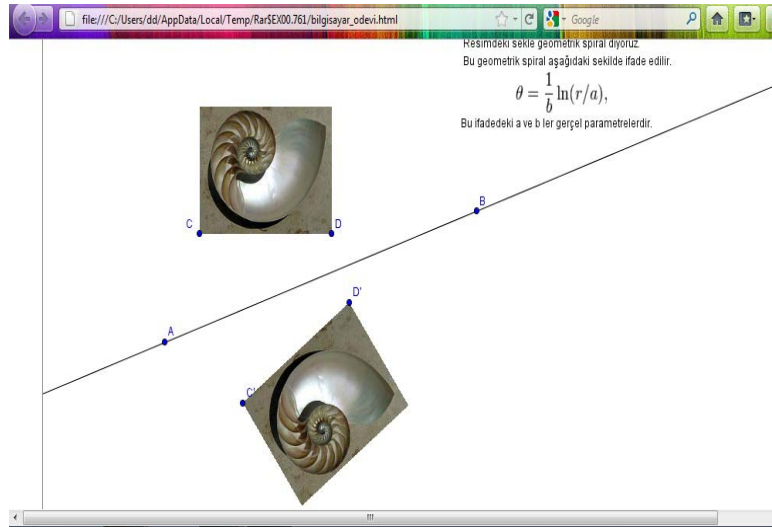

Figure 6. PTM-5's interactive dynamic worksheet extracted from GeoGebra as a website.

PTM-6 said that: "…most important part is discovering concepts both in Algebra and Geometry windows in GeoGebra…."
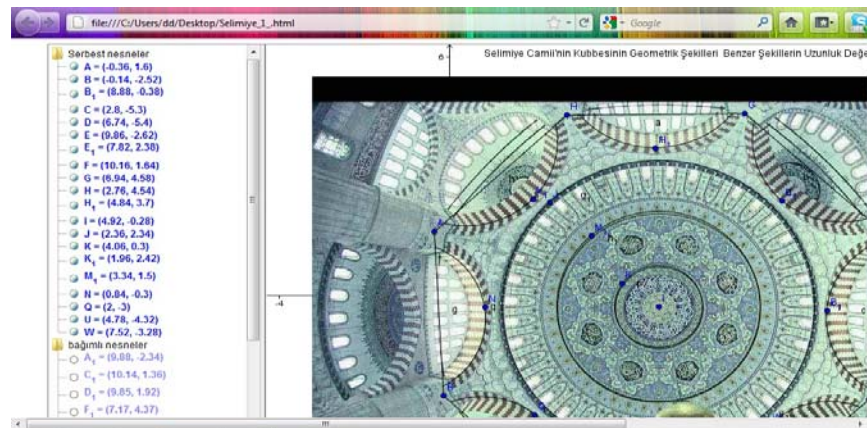

Figure 7. PTM-6's interactive dynamic worksheet extracted from GeoGebra as a website.

CONCLUSIONS
Most of the PTMs (%97) were using successfully basic computer facilities because of computer courses taken before. So they can easily use mouse and keyboard for entering commands input. Also PTMs know basic algebraic and geometric commands of Geogebra for constructing geometric figures. In addition they stated that they were able to design web pages with Geogebra applications for interactive dynamic worksheets.

On the other hand PTMs preferred to use integrate pictures to background of worksheets for connect geometry to real life examples. Also PTMS stated that they use Geogebra for writing exam questions, building web pages, calculating algebraic expressions. Findings revealed that, PTMs want to use technology with real examples in a discovery-based learning environment.

PTMs expressed that in Geogebra it is possible to have multiple representations of mathematical concepts such as geometric, algebraic, and spreadsheet. By this way, PTMs had the opportunity to construct their mathematical knowledge in different ways.

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