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Use of Cabri 2D software in drawing height, perpendicular bisector and diagonal

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Abstract

In this study, the effect of Cabri 2d software on drawings of height, perpendicular bisector in triangles and diagonal in polygons was explored. Case study method was used in the study. Diagnostic questions and computer assisted worksheets related to height, perpendicular bisector and diagonal concepts were developed as data collecting tools. Diagnostic questions were posed as pre- and post-implementations to total 25 students studying at 8th grade of an elementary school in Trabzon. Students' answers to questions were analyzed and presented in tables. As a result of the study, Cabri 2d software was found to positively contribute to students' better understanding of height, perpendicular bisector and diagonal concepts. Therefore, it's recommended to develop and use in the classes Cabri 2d assisted worksheets also for other subjects of geometry.

*Keywords:*Height; perpendicular bisector; diagonal; cabri 2d; computer assisted instruction

1. Introduction

All the technologies used in the realization of the processes of producing, processing, keeping, using, sharing and expanding knowledge can be defined as information technology (Baki, 2002). Use of technology in instructional settings provides richer learning opportunities for the students, arouses their interests and increases their motivation by putting student at the center (Şahin & Yıldırım, 1999). Parallel with the developments in technology, computers have been used in instructional settings with the aim of developing audio and visual materials such as animation and representations and as a result the term *Computer Assisted Instruction (CAI)* has emerged (Bintaş & Ebrulan, 2007). CAI is the method of utilizing computers in the instruction process with the purposes of enabling students to recognize their deficiencies and performances via interaction, keep control of their learning by receiving feedbacks and increasing their interest towards the subject with the help of graphics, audio, animation and shapes (Baki, 2002).

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Computers are used in mathematics education increasingly, as in many fields (Baki, Güven & Karataş, 2002). In every environment where a reform is involved, computer is addressed as the key element of educational programs and they should be effectively used for the achievement of these movements (Heid, 1997). The aim of using computer in mathematics instruction is to increase students' interest towards the subject and to help them understand the concepts visually easier where they had difficulty to imagine via traditional instruction. In other words, the aim of using computer in mathematics education is that computer helps students develop high level of cognitive skills and allow students to live experiences of a mathematician and construct their own mathematics (Baki, Güven & Karataş, 2002).

Softwares that provide opportunities to work with dynamic diagrams instead of static diagrams should be used to develop students' abilities to make operations on geometric concepts (Baki, Kösa & Karakuş, 2008). One of the most important softwares providing such opportunities is the dynamic geometry software, Cabri 2d. This software is among the dynamic geometry softwares used worldwide. Cabri 2d software is built on Euclidean geometry. In Cabri 2d, objects can be intuitively constructed by the user after being selected using the mouse (Dedeoğlu, 2007).

The unique properties of Cabri 2d give us an opportunity to explore mathematics dynamically (Baki, 2001). In traditional instruction, children may not usually find opportunities to predict, reason, think intuitively, engage, experiment, formulate and communicate individually with the teacher. On the contrary, Cabri 2d provides a great deal of these opportunities. This software enables students to learn at their own pace, and make abstract concepts shaped in their minds concrete (Gürbüz, 2008). Additionally, drawn shapes can be dragged by the dynamic geometry software, Cabri 2d (Hoyles & Noss, 1994). By the help of dragging shapes, student may discover some constant relations while changing some properties of the shape. This discovery allows the student to make a strong hypothesis. Then the student may support this hypothesis with many examples or reject it. From this point of view, Cabri 2d software, as a tool, empowers mathematical thoughts by changing mathematical objects on the screen (Karataş & Güven, 2008).

Since geometry is constructed on abstract structures, some difficulties may be encountered in perceiving and understanding some basic geometrical concepts such as triangles or polygons (Akuysal, 2007; Kemankaşlı & Gür, 2005; Ubuz, 1999). This may result in ending geometry instruction without attaining the intended goals. The difficulties related to drawing height (Blanco, 2001; Gutierrez & Jaime, 1999; Hızarcı, Ada & Elmas, 2006) and perpendicular bisector in triangles, diagonal in polygons (Baki & Bell, 1997) are some examples. In the subjects of triangles and polygons which form the basis of many geometry subjects, investigating the effect of the dynamic Cabri 2d software on difficulties faced by students is thought to shed light on the works of academicians and teachers. Therefore, the aim of this study is to investigate the effect of Cabri 2d assisted worksheets on drawings of height and perpendicular bisector in triangles and diagonal in polygons.

2. Method

Case study method was used in this study. Case studies enable in depth investigation of a single or a number of cases, phenomena or events with a limited sampling (Çepni, 2007). During this process, the setting, individual or processes are investigated holistically and the roles and relations draw the main focus (Yıldırım & Şimşek, 2005).

2.1. Participants

The sample consists of total 25 8th grade students studying in an elementary school in Trabzon during 2008-2009 school year. The students in the sample volunteered for the study. Approximately 50% of the pupils were girls (13 boys, 12 girls, average age 15 years).

2.2. Data collection tools

The data in this study were collected using diagnostic questions developed related to height, perpendicular bisector and diagonal drawings and the worksheets were prepared considering these concepts. The diagnostic questions and worksheets developed are shown to two mathematics teachers and two researchers working in the field of mathematics education. Teachers and academicians confirmed that the questions in the diagnostic materials and worksheets may appropriately serve the aim of the study. This demonstrates the content validity of the questions. Moreover, by referencing to teachers' views and the 8th grade mathematics curriculum of National Ministry of Education, it was attempted to fit the questions to the levels of 8th grade students.

Three diagnostic materials consisting of two questions related to drawings of height, perpendicular bisector and diagonals were prepared. Moreover three computer assisted worksheets were developed consisting of nine questions about height and perpendicular bisector and six questions about drawing diagonal. Before the actual implementation of materials, a pilot study was conducted in which possible deficiencies related to the worksheets were sought. In this way, detailed information on how to use the materials were obtained.

2.3. The implementation of data collection tools

The study lasted for five weeks. The implementation process was carried out in the computer lab for four hours. A pre-implementation was made with diagnostic questions approximately two weeks before computer assisted instruction and it was applied as a post-implementation two weeks after the computer assisted instruction. First, the students were given worksheets related to height and center of orthogonality, then perpendicular bisector and center of perpendicular bisector and finally concave and convex polygons. Solution of the questions on each worksheet continued for an hour. Students worked as peers and answered the questions on the worksheets in the computer environment. The teacher walked among the groups and guided in-group discussions and monitored proceedings. After the worksheets were completed, a class discussion was made with students on their newly learnt knowledge and their difficulties.

2.4. Data analysis

Students' answers to questions about drawing height, perpendicular bisector and finding height and center of orthogonality before and after using Cabri 2d were classified as "**Blank**", "**Wrong**", "**Correct**" and the obtained data were presented in tables. Furthermore, success percentages for these questions were calculated and added to the tables. Similarly, the numbers of diagonals for quadrilateral, pentagon and hexagon drawn correctly by the students before and after using Cabri 2d were given in tables.

3. Results

The findings from the questions related to drawings of height, perpendicular bisector and diagonal are given in this section.

3.1. Findings related to height and center of orthogonality

The students' answers to 1st question related to drawing height and success percentages are shown in Table 1.

Table 1. Answers to the question related to drawing height and success percentages

Drawing Height	Before Cabri 2d			After Cabri 2d			Success Percentage Before Cabri 2d (%)	Success Percentage After Cabri 2d (%)
	Blank	Wrong	Correct	Blank	Wrong	Correct		
Acute Triangle	0	2	23	0	0	25	92	100
Right Triangle	1	22	2	1	8	16	8	64
Obtuse Triangle	0	11	14	0	6	19	56	76

The students' answers to 2nd question related to finding center of orthogonality and success percentages are shown in Table 2.

Table 2. Answers to the question related to finding center of orthogonality and success percentages

Finding Center of Orthogonality	Before Cabri 2d			After Cabri 2d			Success Percentage Before Cabri 2d (%)	Success Percentage After Cabri 2d (%)
	Blank	Wrong	Correct	Blank	Wrong	Correct		
Acute Triangle	0	6	19	0	0	25	76	100
Right Triangle	0	24	1	0	21	4	4	16
Obtuse Triangle	0	25	0	0	23	2	0	8

Some of the students who answered the question about drawing height or finding center or orthogonality incorrectly or could not answer these questions at all were found to correct some of their wrong or blank answers after computer assisted worksheets.

3.2. Findings related to perpendicular bisector and center of perpendicular bisector

The students' answers to 3rd question related to drawing perpendicular bisector and success percentages are shown in Table 3.

Table 3. Answers to the question related to drawing perpendicular bisector and success percentages

Drawing Perpendicular Bisector	**Before Cabri 2d**			**After Cabri 2d**			**Success Percentage Before Cabri 2d (%)**	**Success Percentage After Cabri 2d (%)**
	Blank	**Wrong**	**Correct**	**Blank**	**Wrong**	**Correct**		
Acute Triangle	0	10	15	0	8	17	60	68
Right Triangle	0	6	19	0	2	23	76	92
Obtuse Triangle	1	22	2	0	17	8	8	32

The students' answers to 2nd question related to finding center of perpendicular bisector and success percentages are shown in Table 4.

Table 4. Answers to the question related to finding center of perpendicular bisector and success percentages

Finding Center of Perpendicular Bisector	**Before Cabri 2d**			**After Cabri 2d**			**Success Percentage Before Cabri 2d (%)**	**Success Percentage After Cabri 2d (%)**
	Blank	**Wrong**	**Correct**	**Blank**	**Wrong**	**Correct**		
Acute Triangle	0	23	2	0	21	4	8	16
Right Triangle	0	25	0	0	19	6	0	24
Obtuse Triangle	0	25	0	0	22	3	0	12

Some of the students who answered the question about finding perpendicular bisector and center of perpendicular bisector incorrectly or could not answer these questions at all were found to correct some of their wrong or blank answers after computer assisted worksheets.

3.3. Findings related to convex and concave polygons

The numbers of students who drew one or two diagonals for convex and concave quadrilaterals are given in Table 5.

Table 5. Numbers of students who could draw diagonals of convex and concave quadrilaterals

Drawing Diagonal	**Numbers of Diagonals Drawn Before Cabri 2d**		**Numbers of Diagonals Drawn After Cabri 2d**	
	1	**2**	**1**	**1**
Convex Quadrilateral	0	25	0	25
Concave Quadrilateral	25	0	2	23

The numbers of students who drew one, two, three, four or five diagonals for convex and concave pentagons are given in Table 6.

Table 6. Numbers of students who could draw diagonals of convex and concave pentagons

Drawing Diagonal	**Numbers of Diagonals Drawn Before Cabri 2d**					**Numbers of Diagonals Drawn After Cabri 2d**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Convex Pentagon	2	1	1	1	20	0	0	1	0	24
Concave Pentagon	1	4	3	17	0	0	0	7	16	2

The numbers of students who drew one, two, three, four, five, six, seven, eight or nine diagonals for convex and concave hexagons are given in Table 7.

Table 7. Numbers of students who could draw diagonals of convex and concave hexagons

Drawing Diagonal	Numbers of Diagonals Drawn Before Cabri 2d									Numbers of Diagonals Drawn After Cabri 2d								
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
Convex Hexagon	0	0	3	0	4	2	4	1	11	0	0	0	0	0	3	3	5	14
Concave Hexagon	1	0	9	2	2	1	10	0	0	0	0	0	0	4	2	5	5	9

Some of the students who answered the question about drawing convex and concave quadrilaterals, pentagons and hexagons incorrectly or could not answer these questions at all were found to correct some of their wrong or blank answers after computer assisted worksheets.

4. Conclusion and Recommedation

In this study, the effect of Cabri 2d software on drawings of height and perpendicular bisector in triangles and diagonal in polygons was explored. Following this aim, the results and the recommendations based on these results were presented as follows:

Cabri 2d software was found effective in drawings of height and perpendicular bisector, finding center of orthogonality and drawings of convex and concave quadrilateral, pentagon and hexagon. This result reveals that a computer assisted environment prepared by using Cabri 2d enabled the students in this study to make their knowledge more meaningful. In other words, Cabri 2d software was found to positively contribute to students' learning. Based on these results, the following recommendations were made:

Cabri 2d assisted practices may be extended to other subjects of geometry as shown in this paper. This will facilitate instruction of abstract subjects and concepts of mathematics. The activities prepared in this study may be supported by other instructional materials (animations, models and etc.) and used in classes. By this way, gained knowledge may be made more meaningful. Teachers who implement the activities play the key role in obtaining positive results from making mathematical concepts more meaningful by using computer assisted activities. Therefore, in-service training courses for teachers towards computer assisted instruction may be given by experts.

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