THE EFFECTS of INTERACTIVE WHITEBOARDS on TEACHING TRANSFORMATIONAL GEOMETRY with DYNAMIC MATHEMATICS SOFTWARE

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The studies about the determining the effects of using Interactive whiteboard (IWB) have gained importance since the installation of IWB in almost every school by government funded project "FATİH" in Turkey. The purpose of this paper is to share some ideas about an experience of teaching transformational geometry with dynamic mathematics software on interactive whiteboards. The participants of this study were 16 tenth grade students of one of the public high school in Ankara. A test was developed to assess students' transformational geometry achievements, which included translation, reflection and rotation tasks. The effects of IWB are also investigated by qualitative and quantitative analysis.

Key words: Interactive whiteboard, dynamic computer software, geogebra, geometry, transformations.

INTRODUCTION

The qualifications asked for from people have changed in line with the needs of our era and thus individual profile aimed to be created has also changed. It is aimed not to raise individuals who do memorize the information word by word but to raise individuals who can reach at the information s/he needs and who can use this information and synthesize it. In order to raise individuals having the required qualifications, it is necessary for them to pass through good education process. Including new technologies in education and training institutions will provide easiness to address learning needs of the individuals. These qualified individuals can discover fundamental concepts and use knowledge which they need. To educate individuals with the desired qualifications, it is important to integrate the new developing technology to education. New technology like interactive whiteboards (IWB) can help individuals for discovering and using knowledge.

Recently, the uses of new technologies become widespread in teaching and learning environments (Tate, 2002). Thus, there is needed to many researches which are aimed to investigate the effects of the using these technologies in teaching and learning environments. Similarly, NCTM (2000) emphasizes the using new technologies in mathematics education, and it has reported that using new technologies in mathematics education can enhance the learning of students. Using technology in mathematics education can help students to focus on mathematical ideas, make sense of them and solve problems whose solution impossible without using technological

tools. It can also enhance students' learning by giving them chance to discover further level (Van de Walle, Karp & Bay-Williams, 2010).

One can make easy drawings, make measurements, and drag elements of a drawing while those elements maintain the dependency relations that exist based on the initial construction in the environment by using dynamic computer software (DCS) programs (Hollebrands, 2007). Dragging which is called "is real-time transformation" is one of the most defining features of DCS programs. There are several DCS programs, but it can be said that Geogebra is one of the most popular and widespread one. It is popular not only its' developing always in progress but also it is freeware software. Thus in this study geogebra was chosen as a DCS program.

The touch-sensitive board allows users to interact directly with applications without having to be physically at the computer which is projecting the image onto the board (Beeland, 2002, p.2). Using IWB's is increasing day by day in education because of benefits and innovations it brings to teaching and learning process. In Turkey, IWB is going to be delivered to four thousand schools, and it was given to several schools along with FATİH project. So it can be said that IWB will supersede the classical white board with this project.

Several researches were carried out to examine the effect of IWB in teaching and learning process (Beauchamp & Parkinson, 2005; Kennewell, 2001). It was found that IWB enhances students' motivation and interest towards learning. IWB also expands interaction between students, meets the wide range of student needs through the use of multimedia and varied presentation of ideas. By using IWB, students can answer easily such questions like 'Can you explain?' 'Why?' that asked students to clarify points in their mind and to help them to enhance their own learning (Glover & Miller, 2002). But full potentially use of IWB's in teaching and learning process depends on how teachers use it. In researches it was found that if teachers use the IWB's without considering the interactivity features of IWB, and use it just for writing and drawing like the classical board, the IWB use will make no difference in teaching and learning process (Glover & Miller, 2002). Teacher and researchers can benefit from this research on using the IWB's that will be installed to almost every school by government funded project "FATİH" in Turkey.

IWB has three modalities of learning: visual, auditory and tactile (Beeland, 2002). Stimulating the one or more sense organ can provide effective learning and also by this way, students make sense of concepts and ideas. On the basis of Becta's (2003) analysis, the main research findings for general benefits of IWB has been summarized

- Versatility, with applications for all ages across the curriculum
- Increases teaching time by allowing teachers to present web-based and other resources more efficiently.

- More opportunities for interaction and discussion in the classroom especially compared to other ICT.
- Increases enjoyment of lessons for both students and teachers through more varied and dynamic use of resources, with associated gains in motivation.

IWB are effective educational tools, which provide dynamic learning environment for students. These dynamic learning environments can help students develop positive attitude towards learning. IWB's have been being used in some countries (e.g. England, USA; Canada; Brazil, Portugal). Thus there are many researches about the effectiveness of IWB (Beeland, 2002; Glover & Miller, 2002; Beauchamp & Parkinson, 2005). However, there is little research in Turkey. Therefore, we aimed to investigate the effects of using IWB in mathematics classrooms.

The purpose of this study was to determine the effect of the use of the IWB as an instructional tool on student academic achievement. In particular, the following research question was investigated:

Does the use of an IWB as an instructional tool affect students' academic achievement in transformational geometry?

METHODOLOGY

The participants of this study were 16 tenth grade students of one of the public high schools in Ankara in the second semester of 2011-2012. Data were collected through eleven open ended questions about transformational geometry. This study involved a one group pre-test post-test experimental design and a comparison group that was taught traditionally was chosen (Creswell, 2002). The treatment was implemented to the experimental group and after the treatment a comparison group was chosen. Post-test was implemented to both comparison and experimental groups. During teaching process, dynamic mathematics software GeoGebra is used via IWB. In the teaching process constructive, collaborative and interactive learning strategies were used. The test used for assessing students' academic achievement was developed by consulting with experts. The test involved 11 open ended questions. The test was used as either pre-test or post-test. The duration between pre-test and post-test was four weeks. Data gathered through participants' written responses. Quantitative data is analysed with non-parametric statistics Mann-Whitney U and qualitative data were cleaned, coded and analysed. Students' responses in the pre-test and post-test were grouped, summarized and analysed using a content-based analysis approach to gather qualitative data. Students' responses were coded in three categories: "Completely wrong", "Completely true" and "partially true". The qualitative result was consistent with the quantitative results. Percentages of each response the students gave were computed. Frequencies and percentages were displayed in tables.

RESULTS

In this section it is shown the results of comparison of post-test between experimental and control group and the comparison between pre-test and post-test of experimental group. Also some qualitative results of students' responses have shown. Four of eleven questions' analysis is shown because of limitation of the pages. Results were analyzed according to learning objectives about transformational geometry.

Groups	N	Mean rank	Sum of Ranks	U	p
Control group	16	9.50	152.00	16.000	.000
Experimental group	16	23.50	376.00		

*p<.05

Tablo 1 The results of comparing groups of post-test academic achievement test scores with Mann-Whitney U Test

It is seen in Table 1 that average rank of post-test scores of the students in the experimental group is 376.00, while the average rank of score for the control group is 152.00. According to Mann Whitney U Test which was conducted to experimental and control groups students' post test scores, it is observed that there is a statistically significant difference between the academic achievement test scores of the students in favor of the experimental group (U=16.000; p=.000<.05). According to this result, it can be said that students who are taught by using IWB understands better in comparison to the students not taught with the IWB.

Post-test-pre-test	N	Mean Rank	Sum of Ranks	z	p
Negative Ranks	0[a]	.00	.00	-3.519*	.000
Positive Ranks	16[b]	8.50	136.00		
Ties	0[c]				

*Based on negative ranks

Tablo 2 the result of comparing pre-test and post-test with Wilcoxon test

A Wilcoxon test was conducted to evaluate whether students showed greater success. The results indicated a significant difference, z=-3.519. p<.01. The mean of the ranks in favor of pre-test was .00, while the mean of the ranks in favor of the post test was 136.00.

First learning objective is doing translations, rotations and their composition on two-dimensional figures using coordinates. Second learning objective is doing reflection, glide reflection on plane.

Question 1	Pre-Test	Pre-test (%)	Post-Test	Post-Test (%)
Correct Ans.	2	8.33	17	70.83
Wrong Ans.	21	87.5	6	25
Partially Correct Ans.	1	4.167	1	4.167
Total	24		24	

Table 3: The Change of the Students' Performances Related to Question 1b

While 8.33% of students give correct answers to Question 1, 87.5% of them gave wrong answers and 4.167% of student made some mistakes but the answers were not completely wrong. After implementing the teaching process with IWB the rate of students that gave correct answers increased to 70.83%, and the rate of wrong answers decreased to twenty five percent in the post-test. On the other hand partially correct answers remained same. The most common mistake done by the students in question 1 is rotating around wrong point. In Question 1, students were expected to rotate the shape around origin. But most of the students rotate the shape around the corner A of the triangle. After implementing the teaching process with IWB some students corrected their answers as shown below.

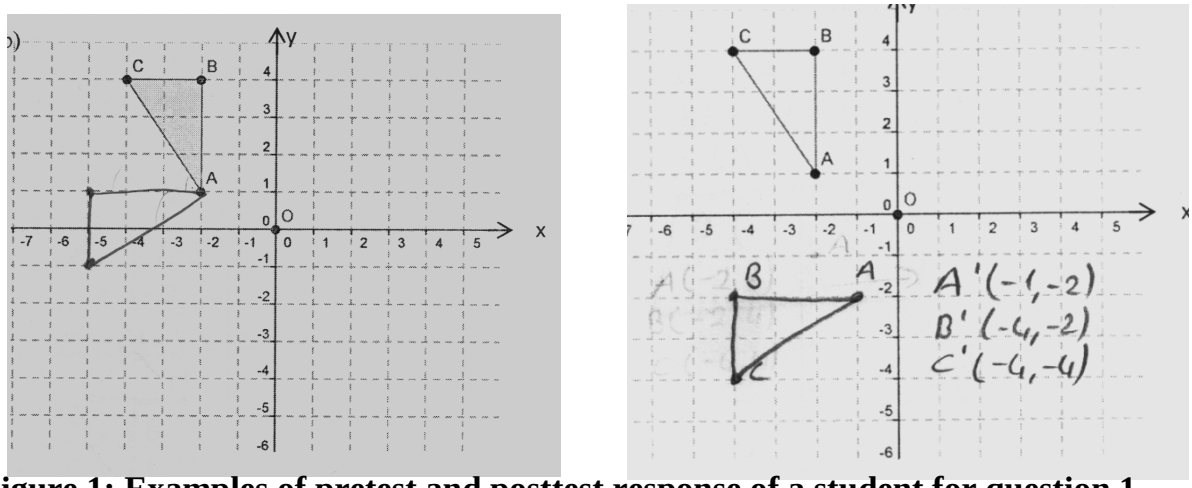


Figure 1: Examples of pretest and posttest response of a student for question 1

Question 2	Pre-Test	Pre-test (%)	Post-Test	Post-Test (%)
Correct Ans.	3	12.5	22	91.67
Wrong Ans.	18	75	2	8.33
Partially Correct Ans.	3	12.5	0	0
Total	24		24	

Table 4: The Change of the Students' Performances Related to Question 2

Question 2 in pre-test was answered correctly by 12.5% of students and it was answered wrong by 75% of students. After implementing the teaching process with IWB, the rate of correct answers of Question 2 increased to 91.67% of students and the rate of wrong answers decreased to 8.33% in post-test. İn pre-test most of the students could translate the shape in question 2 but they couldn't rotate the shape correctly around the origin. After the teaching process most of them not only translated but also rotated the shape correctly. As it can be seen below some of the students could find the rotated coordinates by formula but couldn't draw the shape and some of the students could find the correct answer by processing on the shape not with formula.

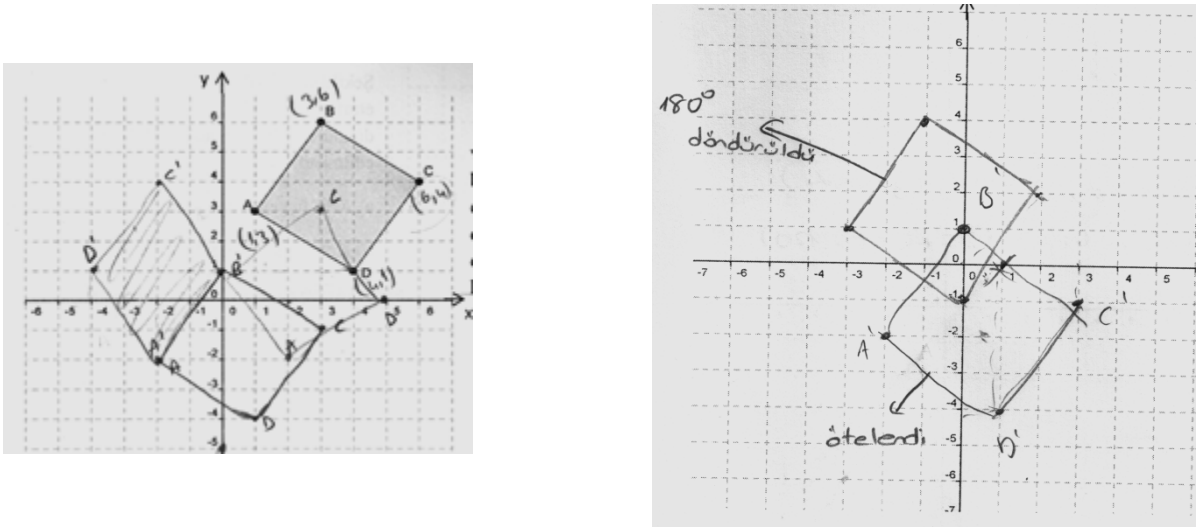
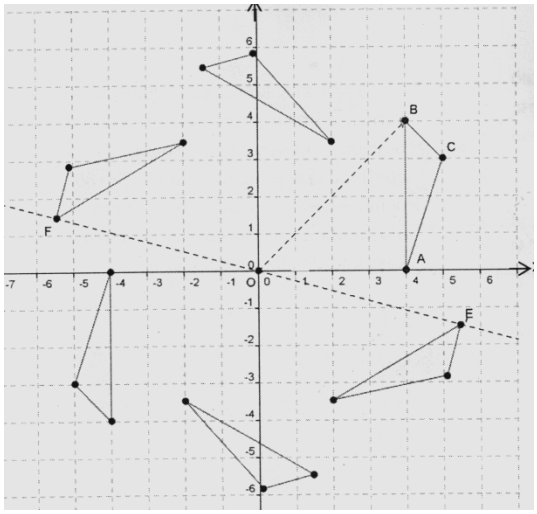


Figure 2: Examples of pretest and posttest response of a student for question 2

Question 3	Pre-Test	Pre-test (%)	Post-Test	Post-Test (%)
Correct Ans.	0	0	8	33.3
Wrong Ans.	24	100	2	8.33
Partially Correct Ans.	0	0	14	58.33
Total	24		24	

Table 5: The Change of the Students' Performances Related to Question 3

In pre-test all the students answered forth question wrong. After implementing the teaching process with IWB, the correct answer rate increased to 33.8% and the wrong answer rate decreased to 8.33% and the rate of the partially correct answers were 58.33%. Most of the students answered the question with similarly the same way. One is displayed below.



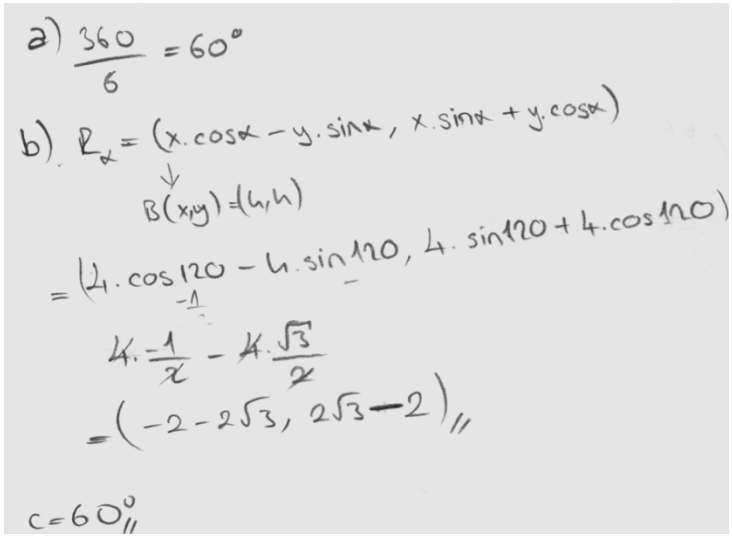


Figure 3: Examples of pretest and posttest response of a student for question 3

Question 4	Pre-Test	Pre-test (%)	Post-Test	Post-Test (%)
Correct Ans.	6	25	16	66.67
Wrong Ans.	18	75	1	4.167
Partially Correct Ans.	0	0	7	29.17
Total	24		24	

Table 6: The Change of the Students' Performances Related to Question 4

Question 4 in pre-test was answered correctly by 25% of students and it was answered wrong by 75% of students. After implementing the teaching process with IWB, the rate of correct answers of Question 8 increased to 66.67% of students and the rate of wrong answers decreased to 4.167% in post-test. İn pre-test most of the students couldn't reflect ΔABC to obtain ΔA"B"C" or couldn't do anything as seen in the Table 6. After the teaching process most of them do the reflection correctly. There is a correct answer below.

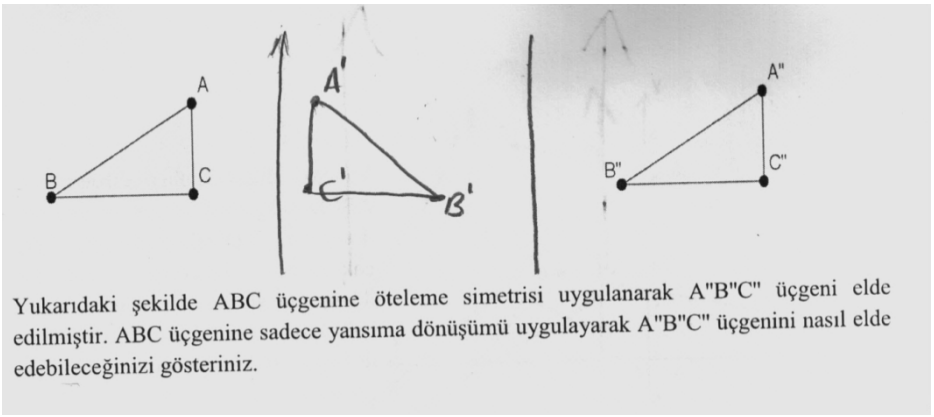


Figure 4: Examples of pretest and posttest response of a student for question 4

CONCLUSIONS

The purpose of this study was to provide a view of the impact that IWB has on academic achievement on transformational geometry. Understanding the concept of transformation is an important for students. Because patterns can be described with opportunities that geometric transformations provide. It also helps students make generalizations, and develop spatial competencies (Yanık, 2011). The results of this study indicate that interactive whiteboards can be used to increase student academic achievement during the learning process. Because IWB supports three modalities of learning: visual, auditory and tactile (Beeland, 2002). Thus, stimulating the one or more sense can provide effective learning and also by this way, students retain learning longer. Teaching and modelling transformational geometry via classical board is a difficult process therefore; students can understand transformational geometry better with the visual and unique features of IWB like drag and drop, manipulating images easily on the board. There is a statistically significance between the pre-test and post-test in favour of post-test in the experimental group. The post-test results were significantly higher in experimental group in comparison to control group. This result is consistent with the researches of Cheung, Slavin (2011); Thomson , Flacknoe (2000); Swan (2010); Zittle (2004); Dhindsha, Emran (2006); BECTA (2007); Oleksiw (2007). Also there was an increase in corrects answers between the pre-test and post-test in favour of the post-test. Moreover, in the post test students tried to respond the task with more visually than the pre-test. This study cannot exactly figure out how IWBs affect students' mathematics achievement so sustained studies should be done about the pedagogy of IWBs. For this purpose, further researches can be carried out on designing appropriate materials and developing adequate software to enhance the efficiency of IWB.

REFERENCES

Beauchamp, G., & Parkinson, J. (2005). Beyond the wow factor: Developing interactivity with the interactive whiteboard. *The School Science Review*, *86*(316), 97–103.

Becta (2003). *What research says about interactive whiteboards*. Coventry: Becta. Retrieved September 2, 2012, from http://smartboard-hat.wikispaces. com/file/view/wtrs_whiteboards.pdf

Beeland Jr., W.D. (2002). *Student Engagement, Visual Learning and Technology: Can Interactive Whiteboards Help?* Retrieved September 2, 2012, from http://chiron.valdosta.edu/are/Artmanscrpt/vol1no1/beeland_am.pdf

Dhindsa, H. S., & Emran, S. H. (2006). Use of the interactive whiteboard in constructivist teaching for higher student achievement. *Proceedings of the Second Annual Conference for the Middle East Teachers of Science, Mathematics, and Computing* (175-188). Abu Dhabi, UAE:METSMaC

Flecknoe, M., & Thompson, J. (2000). Raising attainment with an interactive whiteboard in Key Stage 2. *ME, 17*(3).

Glover, D., & Miller, D. (2002). The introduction of interactive whiteboards into schools in the United Kingdom: Leaders, led, and the management of pedagogic and technological change. *International Electronic Journal for Leadership in Learning, 6*(24).

Hollebrands, K. F. (2007). The Role of a Dynamic Software Program for Geometry in the Strategies High School Mathematics Students Employ. *Journal for Research in Mathematics Education 38*(2), 164-192.

Kennewell, S. (2001). Interactive Whiteboards– yet another solution looking for a problem to solve? *Information Technology in Teacher Education, 39,* 3–6.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.

Oleksiw T. (2007). Increasing Math Test Scores with the SMART Board interactive whiteboard. Retrieved from http://downloads01.smarttech.com/media/sitecore/en/pdf/research_library/k-12/the_effect_of_the_smart_board_interactive_whiteboard_on_raising_state_test_scores.pdf

Tate, L. (2002). Using the Interactive Whiteboard to Increase Student Retention, Attention, Participation, Interest and Success in a Required General Education College Course. Retrieved February 27, 2012, from http://www.smarterkids.org/research /pdf/tate.pdf.

Thomas M., Schmid C.E. (2010). Interactive Whiteboards for Education: Theory, Research and Practice. In K. Swan, A. Kratcoski, J. Schenker & M. Hooft *Interactive Whiteboards and Student Achievement* (pp.131-143.) Hershey, NY: Information Science Reference.

Van de Walle, J.A., Karp, K.S. & Bay-Williams, J.M. (2010). *Elementary and Middle School Mathematics Teaching Developmentally* (Seventh Edition). USA: Pearson Publications.

Yanık, H.B. (2011). Prospective middle school mathematics teachers'preconceptions of geometric translations, *Educational Studies in Mathematics,78,* 231–260.

Zittle, F. J. (2004). Enhancing native American mathematics learning: The use of Smartboard-generated virtual manipulatives for conceptual understanding. Retrieved from http://downloads01.smarttech.com/media/research/international_research/usa/ceerzittle.pdf