The Effect of Dynamic Web Technologies on Student Academic Achievement in Problem-Based Collaborative Learning Environment*

Agâh Tuğrul KORUCU [1], Hasan ÇAKIR [2]

[1] Assist. Prof. Dr., Necmettin Erbakan University, Ahmet Kelesoglu Faculty of Education, Department of Computer Education and Instructional Technology, Konya-Turkey, akorucu@konya.edu.tr

[2] Assoc. Dr., Gazi University, Gazi Faculty of Education, Department of Computer Education and Instructional Technology, Ankara-Turkey, hasanc@gazi.edu.tr

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ABSTRACT

Some of the 21st century proficiencies expected from people are determined as collaborative working and problem solving. One way to gain these proficiencies is by using collaborative problem solving based on social constructivism theory. Collaborative problem solving is one of the methods allowing for social constructivism in the class. In education systems where constructivist education programs are common, dynamic Web technologies which support teachers and students in the teaching and learning processes have an important contribution to the IT integration process. In this study, the ''Semi-Experimental Design model with Pre- test-Post-test Control group'' was used. The research aimed at determining the effect of dynamic web technologies on academic achievement in the problem-based collaborative learning environment. In the research, the ''Academic Success Test'' was applied as pre test-post test as a data collecting tool. This research was conducted during the application period of 8 weeks in 2012-2013. The working group of the research was formed from 104 teacher candidates, 53 of whom were in second teaching (evening classes) and 51 of whom were in first teaching (day-time classes) in the 3rd class of the Education Faculty Computer and Teaching Technologies Teaching department of a state university located in a metropolitan city. The results suggest that students who learned with dynamic web technologies are more successful.

Keywords: *ICT Integration, Collaborative Learning, Technology-Supported Collaborative Learning, Dynamic Web Technologies and Interaction, Academic Achievement, Online Learning*

INTRODUCTION

Changes in information technologies are transforming education. In many countries, innovations in education and integration of educational technology are defined as necessary reforms (Demetriadisa et al., 2003; Lim & Hang, 2003; VanBraak, 2001). These technology developments demand individuals who can think analytically, can detect and resolve problems, who can relate existing situations in real life easily, have cooperative problem solving skills, are inquisitive and creative and maintain active participation (Akkan & Çakıroğlu, 2011; Baki & Çelik, 2005).

According to the EnGauge report (2003, p. 15), in the 21st century, as society changes, individual skills for dealing with life complexities are changing. In the early 1900s, a person with basic reading, writing and computation skills was considered as literate; in the 21st century, students need knowledge and proficiency in science, technology and culture (Pink, 2005). The common denominators of adequacy in the 21st century are defined as: critical thinking, creativity / innovation, information literacy, problem solving, decision making, adaptability; learning to learn, research and investigation, communication, entrepreneurship and self-orientation, productivity, time management, leadership and responsibility, cooperation and active participation, information technology operations and concepts, digital citizenship as well as digital and media literacy (EnGauge, 2003; Finegold & Notabartolo, 2010; Mishra & Kereluik, 2011; Otten & Ohana, 2009;).

The constructivist learning theory in which individuals digest and interpret information was introduced by the Ministry of Education in Turkey in 2005 (MEB, 2006). Constructivist learning is the construction of knowledge by learners participating in the process actively rather than passive knowledge transfer from teacher to learner. The constructivist learning process means not just transmitting knowledge but instead it implies knowledge construction (Duffy & Cunningham, 1996).

The constructivist approach as an educational process has two different perspectives; cognitive constructivism as pioneered by Piaget and Bruner and social constructivism pioneered by Vygotsky (Özden, 2003). According to Hickey and McCaslin (2001), social constructivism is defined as a development process taking place in the individual's cultural and social environment. In social constructivism, the individual and community complete each other. Therefore, in the constructivism process, the social aspects are very important. According to social constructivists, the basic knowledge process is based on social interaction with community members. In other words, information regarding the environment is bound to personal experience and it is created by mutual interaction or communication (Vygotsky, 1987). Thus, according to social constructivists, learning is an active process involving other individuals.

Certain teaching-learning methods are based on constructivist theory. One of these methods is problem-based learning (PBL) where students are directed to think, question and explore (Mayer, 1999; Wilkie & Burns, 2003). In perceiving knowledge methods of students who have higher level thinking skills specified as 21st century proficiencies and who participate in the learning process actively and evaluate knowledge, collaborate and solve problems, teaching how to use this information has great importance (Kaptan & Korkmaz, 2001; Kılınç, 2007). Analytical thinking and interpersonal communication skills which are 21st century skills are essential in order for students to apply the collaborative problem-solving method (Finegold & Notabartolo, 2010).

Jonassen and Kwon (2001) highlight the importance of problem solving skill which is one of the most basic skills needed by students. PBL as a learning-teaching method requires students' active participation (Khoo, 2003), in which teachers guide students (Maudsley, 1999), which give comprehension skills about the ability to transfer and adapt the knowledge and experience acquired by students to new situations and to reach the information to solve the problems they encounter in daily life and how to apply existing knowledge to solve problems (Chrispeels, 2004, in Balım, İnel, & Evrekli, 2007). Chickering and Gamson (1987) emphasize the importance of effective communication and interaction in instruction for increasing student achievement and commitment to studies. Effective communication and interaction -- defined as 21st century proficiencies -- are important for educational outcomes such as achievement, dealing with problems, attitudes, and problem solving skills.

Collaborative learning has a social constructivist philosophical background. It defines learning as constructing knowledge in a social environment. According to Vygotsky (1987), learning in social circumstances involves knowledge construction which supports interaction, inquiry and discussion, and provides enhanced learning with active participation. According to Slavin (1996) collaborative learning uses social interaction in constructing knowledge; it does not depend on ideas put forward by others previously but instead involves learning by interacting with each other as a group in order to solve problems. By interacting, individuals work together to maximize not only their own learning but also other group members' learning. Johnson, Johnson, and Smith (1991) define collaborative learning as a process requiring people working together on one task, sharing their knowledge and supporting each other in completing tasks. Johnson and Johnson (1990) emphasize that individuals working in a collaborative environment have higher academic achievement than those working individually.

Whether or not a student undergoing a planned educational process gains the demanded level of skills and accomplishments is determined by the student's academic achievement level. Student academic achievement is measured by the grades, scores or both grades and scores obtained through applying developed or existing measurement tools. Academic achievement involves demonstrating gains and accomplishments, achievement of the desired result, achieving the desired at an adequate level and also the level of determined skills or gained knowledge. According to many studies in the literature, the more students deal with school tasks and take part in learning activities, in other words, the more they engage academically, the higher their academic achievement level (Garfield, 1995; Kuh, Kinzie, Cruce, Shoup, & Gonyea, 2006; Oncu, 2007).

In collaborative learning, knowledge is formed as a result of sharing information and experiences with other students, the environment and the teacher. Student-environment-teacher interaction occurs in various forms. To illustrate, students can get information by reading (the environment), by discussing with friends or by guidance of teachers who have the knowledge and experience and by feedback teachers give; learning can occur as a result of these interactions (Çakır, Uluyol, & Karadeniz, 2007). Developing environments where new technologies are used is important for delivering 21st century proficiencies and supporting knowledge sharing. Hence, the teacher-student-environment interaction is extremely important. In these environments, interactions can occur synchronously (via dynamic web technologies) and asynchronously.

Dynamic web technologies allow dynamic content production and can be sorted into the following main headings: social network sites, open source video sharing sites, instant messaging programs, virtual museums and google earth, podcasts, wikis, blogs and RSS (Çoklar & Korucu, 2011; Horzum, 2010; Karaman, Yıldırım & Kaban, 2008).

Online computer assisted learning environment developed by dynamic web technologies provide enormous opportunities and facilities for enhancing student-student, student-teacher and teacher-environment interaction and acquiring 21st century skills such as collaborative work, effective communication, and collaborative problem solving (Newman, Webb, & Cochrane, 1995). Collaborative learning environments developed by web technologies facilitate collaborative work by giving students opportunities for sharing information, promoting their knowledge and participating actively, developing creativity and providing joint construction of knowledge (Aydın, 2009; Cress & Kimmerle, 2008; Ekinci, 2005).

Vygotsky (1987) emphasized that learning occurs as a result of interaction between individuals and their social environment with media presence; and interaction has a large impact on learning. In acquiring these competencies, social constructivism gains great importance. Cooperative problem solving method is important because it is one way of providing social constructivism with students in the classroom. The basic philosophy of dynamic web technologies also supports this theory. Students can be involved in the knowledge formation and sharing process using dynamic web technology (DWT) applications. In this context, DWTs are important in contributing to developing constructivist learning environments and these teaching-learning technology applications enhance collaborative learning. Slavin (1996) also stated that collaborative learning method in learning environments developed by web-based technologies support students' complex thinking skills.

In addition, dynamic web technology applications are quickly replacing traditional web technology in all spheres of life. This is mainly because DWT applications provide high interaction between web applications and users, high interaction between users, support for cooperative activities and easy access and sharing of information in accurate and reliable ways on the Internet. Minoche and Roberts (2008) state that the educational support from DWT applications involves sharing and transferring the student produced content that students can improve either by themselves or with team mates through co-operation freely and easily in the Internet environment. Therefore, DWTs are very powerful tools for regulating, distributing and presenting information and creating online collaborative environments. The constructivist approach has shortcomings in existing learning strategies to create technology supported collaborative problem-based learning environments. Teachers and students in educational systems where constructivist educational programs are aligned with problem-based collaborative working environments supported by DWT think that integrating DWT offers many advantages.

Hence, the purpose of this study is to examine the effect of dynamic web technologies on pre-service teachers' academic achievement in a problem-based collaborative learning environment.

In this context, the research question and sub-research questions guiding this research are as follows:

Is there a significant difference between "Course Achievement Scores" of students who use problem-based collaborative learning environments developed with dynamic web-based technologies support and the ones who do not use them?

a. Is there a significant difference between "Pre-Test – Post-Test Course Achievement Scores" of students who use problem-based collaborative learning environment developed with dynamic web-based technologies?

b. Is there a significant difference between "Pre-Test – Post-Test Course Achievement Scores" of students who do not use problem-based collaborative learning environment developed with dynamic web-based technologies?

c. Is there a significant difference between "Post-Test Course Achievement Scores" of students who use problem-based collaborative learning environment developed with dynamic web-based technologies support and the ones who do not use it?

METHOD

Quantitative research approach is used to answer the research questions. "Pre-test – post-test with Control Group Semi-Experimental Design Model" is determined as the quantitative research approach. This research method is used as a semi-experimental design with pre-test post-test control group. In such studies research is applied through testing the subjects both before and after research application related to the dependent variable. Research participants are divided into the experimental and control groups (Karasar, 1999). In addition, pre-test – post-test control group semi-experimental design rather than neutral assigning, two of available groups are tried to be paired on specific variables. There are two groups formed by random assignment; one is used as the experimental group, the other group is used as a control group. Both groups are measured in the same way before and after the experiment (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz, & Demirel, 2012). Academic achievement pre-test scores and academic achievement scores which are composed of quantitative data of experimental and control group students are used. In order to determine the academic achievement scores "Academic achievement test post-test score (50%) + Project score (45%) + Attendance score (5%)" are calculated.

Student teachers in primary education and student teachers in secondary education in the referred department are randomly assigned as the experimental group, and control group respectively. While the application course of experimental group is processed by problem-based collaborative learning environment developed in the scope of research supported by dynamic web technologies, face-to-face problem-based collaborative learning approach is used for the control group course. The independent variables of this research are problem-based collaborative approach supported with face-to-face communication and problem-based collaborative learning approach supported with dynamic web technologies and face-to-face communication. The dependent variable is academic achievement.

The experimental design used in this research is illustrated in Table 1.

Table 1. Pre-Test – Post-Test Control Group Semi Experimental Design Table Related To Research Model

Assign	Group	Pretest	Method	Posttest
M	G_D	O_1	$X_{iö}$	O_2
M	G_K	O_1	$X_{YYÖ}$	O_2

GD = Experimental Group
GK = Control Group
M = Paired Sample (Group randomly assigned)
$X_{iö}$ = Dynamic web technologies supported problem-based collaborative learning environment
$X_{YYÖ}$ = Face to face learning environment
O_1 = Experimental and control group academic achievement pre test application
O_2 = Experimental and control group academic achievement post test application

Research Group

The research group selected for this study is composed of N = 104 pre-service ICT teachers from two groups who are primary education teachers (experimental group) (N = 51) and secondary education teachers (control group) (n = 53) studying in the 3rd stage of the Computer Education and Instructional Technology Department in the Faculty of Education. The Computer and Instructional Technology Department was chosen because this department guides other branches in using technology in education. The demographic characteristics, general average academic achievement scores and the findings related to pre-application motivation scale analysis of the research group and technological facilities presented for research group students are given in this section. The distribution table related to gender variable of experimental and control groups is shown in Table 2.

Table 2. Experimental-Control And Both Groups Gender Variable Distribution Table

Gender	Experimental Group		Control Group		Experimental and Control Group	
	f	%	f	%	f	%
Male	24	47.1	28	52.8	52	50
Female	27	52.9	25	47.2	52	50
Total	51	100	53	100	104	100

In Table 2 the similarities related to the gender distribution of students in the experimental and control group are shown. It is observed that groups are similar to each other in the gender distribution of students in the experimental and control groups.

The comparison result (independent *t*-test) of academic achievement test results (pre-tests) applied before the application to the experimental and control group is given in Table 3.

Table 3. Intergroups (Experimental-Control) Academic Achievement Pre-Test Comparison (*t* - Test) Analysis Results

	Groups	N	$\overline{X}$	Ss	Sd	*t*	*p*
Pre test	Experimental group	51	29.13	5.07	102	1.115	.268*
	Control group	53	28.01	5.14			

*$p < 0.05$

Pre-tests applied prior to the research to the experiment and control group (experimental group pre-test mean $\overline{X}$ = 29.13; control group pre-test mean $\overline{X}$ = 28.01) show that the differences in mean are not significant due to .05 < *p* for the **p* < .05 significance level. As a result of these statistics tests, it is determined that, prior to intervention, both groups are equivalent (Table 3). Between groups (experiment - control group) pre-test comparison (*t* - test) analysis has also concluded that the groups are equivalent.

Pre-test results for the motivation scale analysis applied to the experiment and control group are given in Table 4.

Table 4. Experimental and Control Group Motivation Scale Responses Pre-Test Analysis Results

Groups	N	$\overline{X}$	Ss	Sd	*t*	*p*
Experimental Group (1)	51	389.41	50.51	102	1.082	.282
Control Group(2)	53	378.20	54.90			

**p* < 0.05

According to the motivation scale response analysis results (Table. 4) of the experimental and control groups, there is no significant difference between motivation levels of groups (experimental group motivation test mean $\overline{X}$ = 389.41; control group pre-test mean $\overline{X}$ = 378.20) at the beginning of the research by *p* < .282 for the **p* < .05 significance level. Experimental and control groups are determined to be equivalent to each other in terms of student motivation.

Table 5. Experimental and Control Group General Academic Mean *t*-Test Analysis Results

Groups	N	$\overline{X}$	Ss	Sd	*t*	*p*
Experimental Group (1)	51	2.92	0.35	102	0.946	.346
Control Group (2)	53	2.98	0.34			

**p* < 0.05

The comparison results of experimental and control groups in overall academic average are given in Table 5. It is determined that there is no significant difference in general academic achievement levels (experimental group general academic mean $\overline{X}$ = 2.92; control group general academic mean $\overline{X}$ = 2.98) of experimental and control groups because of *p* < .346 for **p* < .05 significance level. Experimental and control groups are determined to be equivalent to each other; in short, they are similar to each other in terms of general academic means.

According to the abovementioned analysis and information, it is determined that demographic characteristics, general academic means and motivation levels of the students in experimental and control groups are equivalent prior to the intervention; it is concluded that both groups are homogeneous and similar to each other.

There are 125 computers in total available for the experimental and control group students in 5 computer laboratories in the institution. Windows 7 is installed as the operating system and Office 2010 is installed as office programs on computers. A 106 screen LCD television and a projector are available in each laboratory. Some 85 of these computers have the i3 processor with 500 GB Harddisk, 4 GB RAM, 40 of them have i5 processor with 750 GB Harddisk and 4 GB RAM. All computers have Internet connection and download / upload speed is given as 10 Mbps. In addition, wireless network and 10 network access points with usable rj45 connectors are available in each laboratory enabling students to connect to the Internet and school's network with their own personal computers. There are two 60-people classrooms and one meeting room for students' extracurricular study.

The research group students have received computer software and hardware education through "Information Technology in Education I-II" and "Computer, Computer Hardware" courses. Moreover, they have taken information about dynamic web technology use and other Internet tools from the computer department instructors. Therefore, it is considered that research group students have adequate technological knowledge and experience with technological infrastructure about the environment which will be used in the application process and the dynamic web technologies available in the environment.

Application Process

For developing problem-based collaborative learning environment with dynamic web technologies, Nelson's (2009) collaborative problem solving method is determined as the teaching method. Web assisted online collaborative environment which will be used in the research is formed by dynamic web technologies. During the process of environment design where application will be conducted, experts' views were considered and the environment design was developed in accordance with these opinions. The determined content prepared by the experts was applied with the help of dynamic web technologies such as Google+ Circle, Google Chat, Google+ Documents, Mind 42 (for creating online concept maps), Google+, Blogger, Google Hangouts (for verbal, written and visual calls) Google+ Homepage (sharing the video records), Google Calendar, and Google+, Drive (Survey) for the experimental group.

For control group students instruction was applied in the face-to-face collaborative environment. In technology-assisted and face-to-face collaborative environments, the study is conducted in the 8-week period. Research group students save the analysis, information they shared, feedback, comments and evaluations about each other which they made in the process of solving real designed problems weekly. While the experimental group students save their work in weekly blogs which they use in dynamic web technologies and in Google Drive, control group students save theirs in project files created on desktop because they study in a face-to-face collaborative environment. In addition, the data collected from research group students were analyzed with the necessary statistical methods and content analysis method and the results are put forward at the end of the application.

How the academic achievement test was applied to the experimental and control group students in the application process and comparison of the application are shown in Fig.1.

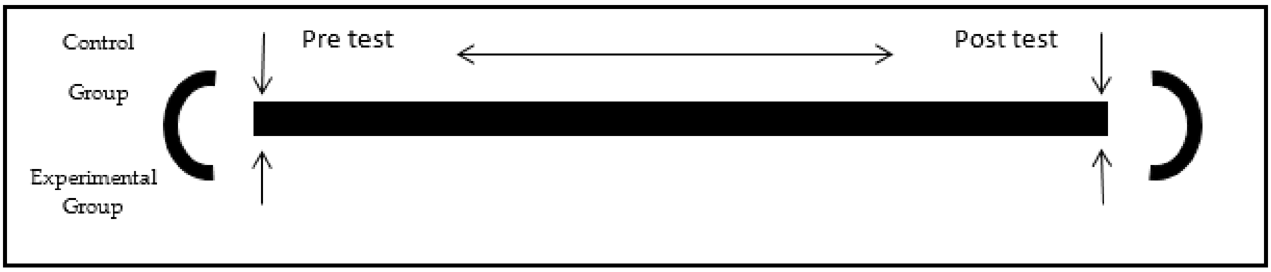

Fig. 1. The application and comparison of academic achievement score.

As shown in Figure 1, the academic achievement test was applied to experimental and control group students as both pre-test and post-test and the first research question is answered through the evaluation and comparison of the responses students gave as a result of these applications.

Data Collection Tools

At the beginning and end of the application process, the pre-test and post-test were performed using the "Academic Achievement Test" developed by the researcher; in determining the academic achievement score, the Academic Achievement test post test score (50%) + Project score (45%) + Attendance score (5%) total was calculated.

The researcher developed academic achievement test consists of 65 multiple choice questions. The test questions were prepared according to the steps in Bloom's Taxonomy as knowledge questions, comprehension questions and conceptual questions (analysis - synthesis questions). Each question has 4 alternatives and after forming an indicator chart consisting of lesson objectives before the application, these questions were created aiming at measuring research group students' achievements in accordance with each learning objective about each subject located in the indicator chart. The test was examined by 5 experts in the field and applied to the research group after revision according to experts' views. After the application, statistical analysis was made by scoring correct answers as 1 and wrong answers as 0; the Academic Achievement Test Item Discrimination Power and Academic Achievement Test Reliability Value were determined.

In the item analysis, reliability was determined by the Kuder-Richardson-20 (KR-20) technique. Each test item's compatibility with other items was determined by the KR-20 test. The determined reliability coefficient proximity to +1.00 indicates high reliability.

Table 6. Academic Achievement Test Reliability Value

	N	Kr-20 test value
Academic Achievement Test	65	.735

Internal consistency reliability test of the academic achievement test was calculated as **Kr-20 test-value = .735** from Table 6. According to this result, it can be said that the scale is highly reliable.

In order to test reliability and validity of the "Project Evaluation Scale" prepared by the researcher to evaluate the project received at the end of the application process, randomly selected 5 projects assessed by the researcher were evaluated by one field expert independently. The consistency between the project assessment scores given by the researcher and field expert were analyzed by non parametric (because 5 projects are assessed) Kruskal-Wallis test and the results of this analysis are given in Table 7.

Table 7. Project Evaluation Scale Evaluation Scores Reliability and Validity Analysis Results

People	N	Ord. Num.	sd	X^2	p
Researcher	5	5.80	1	0.110	0.740
Field expert	5	5.20			

*$p < 0.05$

The results of analysis have shown that according to the Kruskal-Wallis test which determines consistency situation of project evaluation scale assessment scores, there is no significant difference. In accordance with * $p < .05$ level of significance X^2 (sd = 1, n = 10) = 0.110, $p < 0.740$ is found (Table 7). This finding suggest that the project evaluation scores given by the researcher and the scores given by the expert for the randomly selected projects are equivalent. Therefore, a reliable and valid assessment has been made in evaluating the project.

In the validity analysis carried out based on the lower-upper groups, to remove questions whose significance level is higher than p is suitable due to the significance level of $p < .05$. However, in view of five different field experts, as the questions that will be removed measure different objectives from the indicator chart, meet different goals and behaviors, and no other questions in the test measure these gains it was concluded that these questions should remain in the academic achievement test. Therefore, content validity of the academic achievement test is provided by expert opinion.

Achievement tests difficulty analysis results varies between 0 and 1. The 0 indicates that the test is very easy and 1 indicates that test is very difficult. The 0.5 result indicates that the test difficulty is at a normal level. The difficulty test of academic achievement test used as a pre-test and post-test in research is found as 0.464. This result has shown that difficulty level of the academic achievement test used in the research is at normal difficulty level.

Data Analysis

Demographics and the educational use levels of technology tools of the research group students are described by descriptive statistics such as frequency, percentage, arithmetic mean and standard deviation.

In the quantitative dimension of the research, the statistical software package SPSS (Statistical Packages for the Social Sciences) program version 19.0 was used to analyze the quantitative data collected after the experimental procedure. After the analysis of the data collected in SPSS 19.0 software, the effect on participant pre-service teachers' academic achievement of course, in which research is applied,

Independent sample *t*-test and Kruskal-Wallis tests are used for determining the differences between the experimental and control groups in data analysis after the experimental process. Moreover, Kruskal-Wallis test was used for determining the similarities or differences between gender distributions to the experimental and control groups.

Paired samples *t*-test was used to compare data collected from pre-test applied before the application and post-test after the application of students who go through experimental process. Independent samples *t*-test was used to test whether a significant difference existed between the two unbound sample means (Büyüköztürk, 2011). Kruskal-Wallis test was used to ensure the content validity of the project evaluation scale and to determine consistency of scores given by the researcher and experts to randomly selected 5 projects. In addition, validity, reliability and factor analysis were performed for all scales and tests in achievement tests in the research.

FINDINGS

The score table related to experimental and control students' responses of academic achievement test, the projects they prepare in the application process, the attendance scores and overall final academic achievement scores are given in Table 8.

Tablo 8. The Comparison of Experimental and Control Group Academic Achievement Scores

Score Types		Experimental Group			Control Group		
		N	$\overline{X}$	S	N	$\overline{X}$	S
Pre test score		51	29.13	5.08	53	28.01	5.15
Post test score		51	38.09	5.45	53	29.04	6.02
Projet score		51	85.29	11.02	53	87.17	11.50
Attendance score	0	18			19		
	100	33			34		
Final Academic Achievement Score		51	60.66	7.04	53	52.22	7.15

Is there a significant difference between "Pre-tests – post-test Course Achievement Scores" of the students who use problem-based collaborative learning environment developed with dynamic web technologies support? To answer this question;

The comparison of pre-test – post-test scores of experimental group (paired samples *t*-test) was done. The comparison of the results of pre-test and post-test which are performed to demonstrate experimental group students' academic development at the end of the application conducted are given in Table 9.

Table 9. The Comparison of Pre-Test – Post-Test Scores of Experimental Group *t*-Test Analysis Results

	Test	**N**	$\overline{X}$	**Ss**	***SD***	***t***	***p***
Experimental Group	Pre test	51	29.13	5.07	50	-29.25	.000
	Post test	51	60.66	7.03			

$*p < 0.05$

A significant difference was found between the experimental group pre-test and post-test scores (pre-test mean $\overline{X}$ = 29.13; post-test mean $\overline{X}$ = 60.66) for statistically * p <.05 level of significance ($p < 0.05$). After 8-week application, it is determined that the academic achievements of the experimental group students were improved (Table 9). This finding resulting from the experimental group pre-test post-test comparison (*t* - test) analysis is supported by Parker and Thompson's (2012) research.

Is there a significant difference between "Pre-tests – post-test Course Achievement Scores" of the students who do not use problem-based collaborative learning environment developed with dynamic web technologies support? To answer this question, t**he comparison of pre-test – post-test scores of the control group (paired samples *t*-test) was carried out.**

The comparison of the results of pre-test and post-test which are performed to demonstrate control group students' academic development at the end of the application conducted are given in Table 10.

Table 10. Control Group Pre Test- Post Test Comparison (*t*-Test) Analysis Results

	Test	**N**	$\overline{X}$	**Ss**	***SD***	***t***	***p***
Control Group	Pre test	53	28.01	5.14	52	-25.01	.000
	Post test	53	52.22	7.15			

$*p < 0.05$

A significant difference is found between the control group pre-test and post-test scores (pre-test mean $\overline{X}$ = 28.01; post-test mean $\overline{X}$ = 52.22) for statistically * p <.05 level of significance ($p < 0.05$). After 8-week application, it is determined that there is a significant difference in the academic achievement of the control group students (Table 10). It is determined that control group students' academic achievements are improved. The findings which do not support this finding resulted from control group pre-test post-test comparison (*t* - test) analysis are reached. For example Polat and Tekin's (2012) research findings do not support this result.

Is there a significant difference between "post-test Achievement Scores" of the students who use problem-based collaborative learning environment developed with dynamic web technologies support and who do not? To answer this question, **Experimental-control groups post-tests comparison (independent samples *t*-test) was carried out.**

The results from the comparison of "course achievement scores" of students who use problem-based collaborative learning environment developed with dynamic web technologies support (experimental group) and students who do not use such support (control group) are given in Table 11.

Table 11. Intergroups (Experimental-Control Group) Post-Test Comparison (*t* - Test) Results

	Groups	N	$\overline{X}$	S	*SD*	*t*	*p*
Post test	Experimental Group	51	60.66	7.03	102	6.274	.000
	Control Group	53	52.22	7.15			

*$p < 0.05$

In the post-tests performed after the application to experimental and control groups *p* is significant due to .00 < .05 for significance level of $p < .05$. In The post tests (experimental group post-test mean $\overline{X}$ = 60.66; control group post-test mean $\overline{X}$ = 52.22), it is determined that the experimental group post-test scores are higher than the control group post-test scores (Table 11). This result indicates that the application is more significant in favor of the experimental group. In addition, in order to determine the effect size of the problem-based collaborative learning environment designed with dynamic web technologies on academic achievement the eta squared (η^2) value is examined. Effect size values are calculated as $\eta^2 = .53$. In this case, considering the effect size value ($\eta^2 = 0.53$), it can be said that problem-based collaborative learning environment designed with dynamic web technologies have a “large” effect size on academic achievement. The finding resulted from Intergroup (experimental - control group) post-test comparison (*t* - test) analysis is supported by Parker and Thompson’s (2012) research. The opposite findings which do not support this finding resulted from intergroup (experimental - control group) post-test comparison (*t* - test) analysis are reached. For example the Akyol and Ferda (2012) research findings are not parallel with this result; in other words they do not support this finding.

Many research studies (e.g., Alsancak, 2010; Alsancak & Altun, 2010; Chen, 2008; Chiou, 2011; Ferdig Dawson & Eric, 2008; Kwon, Hong, & Laffey, 2013; Razon, Mendenhall, Yesiltas, Johnson, & Tenenbaum, 2012; Tambouris et al., 2011) in literature which support the findings resulting from data collected at the end of the application process; “course achievement scores” of students who use problem-based collaborative learning environment developed with dynamic web technologies were higher than that of those who do not This difference between the experimental and control group students' “academic achievement scores” at the end of the research process emerges because the environment developed with DWT provides continuous interaction with lecturers and other colleagues in their group, classmates and developed environments independent of time and space limitations and active participation both in and out of the school constantly for experimental group students. The other important reasons are having more academic engagement to solve real design problems cooperatively and having higher active participation periods of students in problem-based collaborative environment developed with dynamic web technologies.

Experimental group students have spent more effort in the developed environment than the control group students in meeting the minimum requirements indicated in the weekly work plan for the application process; they allocate more active studying time to meet course requirements, and thus they engage more in active participation. Furthermore, student-teacher interactions in and out of the classroom, being in contact with developed medias academically have very important impact on student academic achievement. The communication built between student-teacher and environment and academic engagement students effort to build this communication in identified time contribute to increase in their academic achievements, their improved personal development, and developed skills defined as 21st century proficiencies (Anderson & Garrison, 1998; as cited in Cakir et al. 2007; Astin, 1993; Chickering & Gamson, 1987; Cuseo, 2009; Pascarella, Terenzi, & Hibel, 1978; Terenzi & Pascarella, 1980).

CONCLUSION AND DISCUSSION

In the scope of research; according to the results reached comparing "course achievement points (academic achievement points)",

1. According to the experimental group pre-test - post-test comparison analysis results; it is determined that experimental group students' academic achievement scores are increased as a result of the application.

2. According to the control group pre-test - post-test comparison analysis results; it is determined that control group students' academic achievement scores are increased as a result of the application.

3. According to the intergroup (experimental-control groups) post-test comparison analysis results, it is significant in favor of the experimental group students. According to this result, it is determined that post-test scores (course achievement scores) of the experimental group are higher than the control group's post-test scores (course achievement scores).

The results suggest that students who use problem based collaborative environment developed by dynamic web technologies have higher academic achievement than those who do not. In other words, students who experienced instruction based on cooperation developed with dynamic web technologies have higher academic achievement scores than those not exposed to DWT. The experimental process conducted in 8-week application led to a significant difference on "course achievement scores" (academic achievement) in favor of the experimental group.

To conclude, the difference between experimental and control group students' academic achievement scores at the end of the research process depends on the use of dynamic web technologies. The environment developed by dynamic web technologies provided without time and space limitations, enabled constant interaction between teacher-student and environment, more academic engagement in order to solve real designed problems and enhanced study with this technology support collaboratively. The fact that students who use problem based collaborative learning environment developed with dynamic web technologies support, have more active participation time than those who do not as mentioned indicates the difference between students "Academic Achievement Scores" at the end of the application process.

RECCOMMENDATIONS

Suggestions for application

In this research, it is presented that problem based collaborative learning environment supported with DWT has positive impact on academic achievement. The most important visions of CEIT are to increase student academic achievement, to involve students in this process, to have students gain the culture of collaborative work, the integration and implementation of technology in this process. In addition, doing technology-based collaborative work is very important for pre-service teachers; there are deficiencies in educating teachers in using technology in collaborative environments. Giving accurate feedback on time is appropriate because students construct knowledge continuously as they are working together and interact with the teacher-student-environment independent of time and space. Therefore, it is recommended to provide courses for teachers to use the technology. In addition, it is recommended to add a course about new collaborative technologies and how teachers should use them for CEIT departments.

Depending on the positive impact of DWT supported problem based collaborative learning environments on academic achievement, the use of instructional design based on collaborative learning should be encouraged. Therefore, The Ministry of Education is considered important that using DWT supported collaborative learning environments in in-service training teachers' courses because it will provide positive results such as increased academic achievement. It is recommended that technology supported learning environments with dynamic web technologies be developed for training and educating pre-service teachers.

Suggestions for researchers

Since DWT supported problem based collaborative learning environment provides constant interaction between teacher-student and environment and it improves personal development and academic achievement, dynamic web technologies supported problem based collaborative learning environments' impacts on different educational outcomes can be examined.

In this research, the finding that DWT supported problem based collaborative learning environment increases academic achievement is reached. It is considered as essential to examine technology supported collaborative learning impact on several variables which affect learning directly such as "attendance", "attitudes toward learning", "attitudes toward the course" or "perception status of the teaching environment" while investigating the causes of increased academic achievement. In order to expand this research, applying DWT supported problem based collaborative learning environment intended to solve real design problems in the same way again with a research group composed of pre-service IT teachers or pre-service teachers from other branches, and to compare these research findings with existing ones are seen as important.

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