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The Effect of Inquiry-Based Collaborative Learning and Inquiry-Based Online Collaborative Learning on Success and Permanent Learning of Students

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ABSTRACT This study aims to specify the effect of inquiry-based collaborative learning and inquiry-based online collaborative learning methods on students' success and permanent learning. In this quantitative study, a pre-test post-test non-equalized control group model of quasi-experimental design has been used. The study's sample comprises 64 students, 32 in the experimental and 32 in the control group, determined by the stratified sampling method. The research has taken place in four stages. Firstly, an achievement test for chemical bonds subject has been applied as a pre-test to both experimental and control groups. The researchers have developed the test; it consists of 33 questions. Secondly, chemical bonds have been taught to control groups with inquiry-based collaborative learning methods and experimental groups with inquiry-based online collaborative learning methods. The achievement test has been applied to both groups as a post-test in the third stage. The same test has been applied as a retention test six weeks later. In the analysis of tests, dependent and independent samples t-test have been used in p=.05 significance level. The research results show that the inquiry-based online collaborative learning method is more effective on students' success and permanent learning than other methods.

Keywords Inquiry-based learning, Online Learning, Collaborative Learning, Inquiry-based collaborative learning, Inquiry-based online collaborative learning, permanent learning, chemical bonds

1. INTRODUCTION

Inquiry-based learning, one of the main science education methods, aims to solve a problem they encounter by doing the necessary research (Wood, 2013). Therefore, inquiry-based learning contributes to students developing and using higher-order thinking skills such as search, query, criticism, correlate, and analysis (Bybee, 2000; Perry & Richardson, 2001; Hofstein & Lunetta, 2004; Duban, 2008). Besides, it is reported in the literature that inquiry-based learning makes a significant contribution to students' academic success and higher-order cognitive features such as scientific process skills and self-efficacy (Wilder & Shuttleworth, 2005, Duban, 2008; Seyhan, 2008; Akben, 2011; Ulu, 2011; Kocagül, 2013). Besides intending to have students solve a daily-life problem by doing research (Jorgenson, Cleveland & Vanosdall, 2004; Wilder & Shuttleworth, 2005), inquiry-based learning allow students to learn collaboratively with their peers by engaging in learning activities with them, and it contributes to students to develop some features like listening to the others and being open to different opinions. In addition to these advantages, inquiry-based learning has some limitations, and there are some issues to regard while implementing it.

Class management is one of the issues that must be considered during the implementation of inquiry-based learning (Bayram, 2015). Teachers should manage the inquiry process well. If the management is not effective, the teacher may not have the expected return from the students. Moreover, if the teacher cannot prepare the questions that s/he will use during the Inquiry, this will cause the process to go on differently from the purpose (Campbell, Zhang & Neilson, 2011). Furthermore, implementing inquiry-based learning in crowded classrooms may lead the process to get out of control and hinder each student's participation in the process (Kocagül, 2013). Some dominant students may also prevent others

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from participating in the inquiry process, and as a result, they may display negative behavior against the course (Campbell, Zhang & Neilson, 2011). Therefore, the inquiry process should be planned and managed well. In planning and managing, the online learning method may be beneficial (Günbatar, 2014).

Online learning is referred to in the literature as e-learning, web-based learning, and distance learning. While online learning is named differently, all these concepts have a learning environment supported by a computer network infrastructure. During instructional activities in online learning, both student-student and student-teacher interaction may be seen (Çalışkan, 1999; Çalışkan, 2001). The online learning method extinguishes the physical environment's dependence during instructional activities and moves student-student and student-teacher interaction into online learning environments. Thus, computer and online environments become a part of educational-instructional activities (De Wever, Schellens, Valcke & Van Keer, 2006; Caspi & Blau, 2008). Wang (2008), cited in Akgün (2012) states, thanks to computer-assisted/online learning, students can learn new things and share their experiences by communicating with their teachers and peers online or offline. Online learning is widely used in science education as it makes searching the information more accessible and increases the chance for concrete experiences while learning. Despite many benefits, online learning also has some limitations.

Online learning is limited for the reliability of the assessment and evaluation process, and it cannot reveal some positive outcomes of face-to-face interaction. Also, establishing an effective student-teacher interaction in online learning takes longer than traditional learning, and students need to motivate themselves and study regularly (Kaya, 2002). Therefore, online learning may be used with collaborative learning, which increases face-to-face interaction to decrease its limitations and have a more effective educational-instructional process.

In collaborative learning, students work in heterogeneous groups for a common purpose and are responsible for each other's success (Demirel, 2006). Contributing to students' socialization, developing their communication skills, and forming an in-group interaction are essential characteristics of collaborative learning (Demirel, 2006; Ünlüsoy, 2006). Besides, collaborative learning increases student motivation and develops their features such as discussion, debate, criticizing ideas, respecting others' ideas, tolerating and shared decision making by providing a social environment (Serrano & Pons 2007). Using collaborative learning leads to positive changes in students' characteristics like success and attitude (Yapıcı, Hevedanlı & Oral, 2009; Topsakal, 2010). Thanks to these traits, collaborative learning is widely used in science education and inquiry-based learning, and online learning (Bakanlığı, 2005; Meb, & Başkanlığı, 2006).

Apart from providing students many positive changes, using inquiry-based learning, collaborative learning, and online learning in science education helps students have concrete experiences. Because science education consists of abstract concepts, concretizing these abstract concepts are rather crucial in science education.

The chemical bond is one of the abstract subjects in science education. Chemical bonds are among the Chemistry course's fundamental subjects, and their great importance in learning many scientific concepts at the high school and university levels (Ritter, 2007). This subject consists of abstract concepts such as atom and subatomic particles like proton, neutron, and electron, which are difficult to observe in the classroom environment. Also, ionic bond, which is based on the exchange of electrons, and covalent bond, which occurs with the everyday use of electrons between the atoms that are prone to take an electron, are considered as a challenging subject to understand by both teachers and students (Şen & Yılmaz, 2013). While instructing this subject, abstract concepts like electron exchange and electron cooperation need to be concretized. Therefore, inquiry-based learning, collaborative learning, and online learning may be used while teaching chemical bonds to concretize the abstract concepts and increase students' success.

Recently, there is a tendency to use inquiry-based learning, collaborative learning, and online learning together in science education because of their limitations and advantages. That is seen in the relevant literature.

It is seen in the literature that the studies carried out with inquiry-based learning methods analyzed the variables like success, self-efficacy, attitude, and scientific process skills. Gül (2011) found that inquiry-based learning affects students' success positively. Gençtürk & Türkmen (2007), Ulu (2011), Sağlam (2012), Atar & Atar (2012), Yazgan (2013) and Sarı & Güven (2013) also had similar results. Likewise, Akben (2011) investigated the effect of inquiry-based learning on self-efficacy and concluded that inquiry-based learning had positive impacts on students' self-efficacy. Kocagül (2013) and Gezer (2014) found similar effects of inquiry-based learning on self-efficacy. Some studies examine the effect of inquiry-based learning on students' attitudes. Duban (2008) asserts that inquiry-based learning implemented in fifth grade positively affected their attitudes towards science courses. Yaşar & Duban (2009), Akben & Köseoğlu (2010), Akben (2011) and Yazgan (2013) report similar results. In addition to these, Ulu (2011), Akben (2011), Kocagül (2013), and Gezer (2014) investigated the effect of inquiry-based learning on scientific process skills, and they found positive results. Therefore, it is possible to say that inquiry-based learning contributes significantly to success, self-efficacy, attitude towards the course, and scientific process skills.

The studies carried out with online learning show that it increased students' success (Bodur, 2010; Coşkun, 2013;

Başarmak, 2013; Sarı, 2013), and made a positive contribution to their attitudes towards the course (Bodur, 2010; Coşkun, 2013; Yılmaz & Top, 2015). Moreover, some studies use online learning and Inquiry-based learning, and collaborative learning and examine learning effects. For instance, Günbatar (2014) used online learning and inquiry-based learning together in the study and found that online inquiry-based learning had a statistically significant effect on motivation and learning strategies. The studies in which online learning was used and collaborative learning reported that students' success increased (Korkmaz, 2013; Esgin & Saraç, 2015), and students had positive attitudes (Korkmaz, 2013).

It is seen in the literature that collaborative learning had positive impacts on success (Bozkurt, Orhan, Keskin & Mazi, 2008; Gök & Sılay, 2008; Gök & Sılay, 2009; Yapıcı, Hevedanlı & Oral, 2009; Doğan, Uygur, Doymuş & Karaçöp, 2010; Özdilek, Erkol, Doğan, Doymuş & Karaçöp, 2010; Topsakal, 2010; Aksoy & Doymuş, 2011; Aktaş, 2013; Güngör & Özkan, 2013). It also makes a statistically significant contribution to the attitudes of students (Yapıcı, Hevedanlı & Oral, 2009; Topsakal, 2010; Güngör & Özkan, 2011). In addition to these, collaborative learning had positive effects on laboratory skills (Aksoy & Doymuş, 2011), retention (Özdilek, Erkol, Doğan, Doymuş, & Karaçöp, 2010), and problem-solving skills and motivation for success (Gök & Sılay, 2009). Some studies use collaborative learning with inquiry-based learning. They show that the sample group displayed a scientific approach to determining environmental consciousness (Gülin, 2010), and the reading comprehension skills of students developed (Yılmaz & Top, 2015).

Although there exist some studies about the effect of Inquiry-based learning (Gençtürk & Türkmen 2007; Ulu, 2011; Sağlam, 2012; Atar & Atar 2012; Yazgan, 2013; Sarı & Güven, 2013) and Inquiry-based collaborative learning (Gülin, 2010; Yılmaz & Top, 2015) on success, Inquiry-based online collaborative learning studies are limited (Chang, Sung & Lee 2003; Salovaara 2005; Abdelraheem & Asan 2006; Linn, Lee, Tinker, Husic, & Chiu, 2006; Kollar, Fischer, & Slotta, 2007; Mäkitalo-Siegl, Kohnle, & Fischer, 2011; Sun, Looi & Xie, 2014; Sinha, Rogat, Adams-Wiggins & Hmelo-Silver, 2015) in the literature. Also, these studies do not entirely reveal the effect of implementations on success and permanent learning. They do not aim to determine whether inquiry-based collaborative learning or inquiry-based online collaborative learning is more effective on success and permanent learning. This study will compare Inquiry-based collaborative learning and Inquiry-based online collaborative learning and reveal which one is more effective on success and permanent learning. Because the studies that use different methods and compare the effectiveness of those methods are rare in the literature, this study will substantially contribute to the literature. Moreover, the study is different from other studies carried out in similar subjects as it implements the three frequently used methods in science education. This study also presents an example for the following studies by designing and implementing Inquiry-based online collaborative learning. Moreover, this study will guide the researchers who will use new learning methods in science education together. The fact that the studies that jointly investigate the effects on success and permanent learning are rare shows that this study will significantly contribute to the literature.

In this context, the problem of this study is "What are the effects of inquiry-based collaborative learning and inquiry-based online collaborative learning, which was implemented in Chemical Bonds subject of Structure and Features of Matter Unit in 7th grade, on students' success and retention of learning?" The subproblems are: (a) Is there a significant difference between the success of students who used inquiry-based collaborative learning and inquiry-based online collaborative learning? (b) Is there a significant difference between the retention of students who used Inquiry-based collaborative learning and inquiry-based online collaborative learning? This study's general aim is to determine the effect of Inquiry Inquiry-based collaborative learning and inquiry-based online collaborative learning on students' success and retention of learning in Chemical Bonds subject of Structure and Features of Matter Unit in 7th grade.

2. METHOD

The study aims to determine the effect of Inquiry-based collaborative learning and Inquiry-based online collaborative learning on students' success and permanent learning. This study employs a quantitative research approach, and because dependent and independent variables have been used, the experimental method has been thought to be appropriate for the study. Using a systematic method, experimental research is carried out to see how an individual intervention effectively solves a particular problem under controlled conditions (Özmen, 2014, Creswell, 2012). Therefore, this is an experimental study because an intervention has been performed to see the effect of Inquiry-based collaborative learning and Inquiry-based online collaborative learning on students' success. Besides, a quasi-experimental design has been used because the study has been carried out in an educational setting, and it is impossible to define the groups randomly at schools. Quasi-experimental designs are subordinate to true experimental designs in terms of scientific value, and they can be preferred by paying attention to their limitations when true experimental designs are impossible to use (Büyüköztürk, 2011; Creswell, 2012). Because the study aims to determine the students' level before the intervention and the change in their success after the intervention process, a pre-test post-test non-equalized control group model of quasi-experimental design has been used.

2.1. Population and Sample

The population of the study is comprised of 7th-grade students of 14 secondary schools in Yozgat. The sample has been chosen from the population by using a simple sampling method. In a simple sampling method, each individual or object in the population has an equal chance to be chosen. This method is accepted as moderate-good for the study's validity and reliability, and it is regarded as the simplest, the easiest, and the most reliable method (Akarsu, 2016). Firstly, a school has been randomly chosen from the population of the study. This school has four 7th grade classes and 128 students in them. One of these classes was randomly assigned as an experimental group and another as the control group. The study sample consists of 64 students, 32 in the experimental group and 32 in the control group. There are 20 females and 12 males in the control group and 17 males and 15 females in the experimental group.

2.2. Implementation Process

Implementation Process of Control Group: There are 20 female and 12 male students in the control group. They have been separated into seven heterogeneous collaborative groups in the study's preparation phase according to their science and technology grades by using a stratified sampling method. The students have been informed about the practices of collaborative learning and inquiry-based learning. While performing the practices during the research process, inquiry-based learning activities have been integrated with collaborative learning activities. Before the instructional process, the achievement test was implemented to the control group as the pre-test. Then, students have settled in the class with their groups. The learning environment of the control group was shown in Figure 1.

After having students involved in groups for collaborative learning, inquiry-based learning activities have been performed. The students have tried to solve six worksheets as a group appropriate for inquiry-based learning and are about the "Chemical Bonds" subject in the "Structure and Features of Matter" unit. In the first and second sheets called "salt of the meal" and "incombustible dress," ionic bonds are thought to students. In the other two sheets, "let's make a better one" and "find the antidote," covalent bonds are thought. The last two sheets, "solve the relationship" and "who is a friend to who," consist of students' activities to distinguish ionic and covalent bonds.

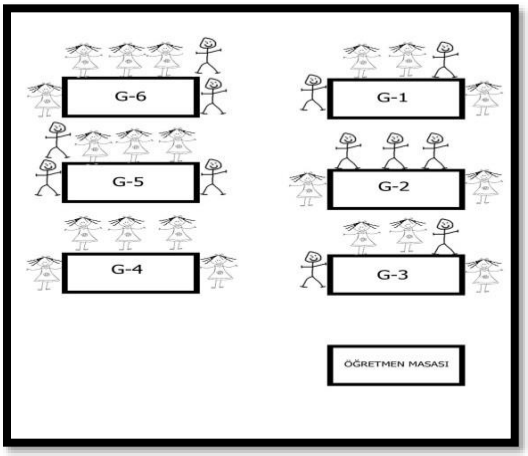

Figure 1 Learning environment of control group

Each of these worksheets has been given to students in different courses. They have studied them collaboratively with the researcher's facilitation for skills such as communication, interaction, and exchange of ideas between students. Group members have chosen ahead of the group, s/he has led the in-group work distribution during the study of sheets and ensured that each member had had the opportunity to speak. After taking the opinions of all the members, the group decision has been written on the worksheets. During the activities, one of the researchers has guided and helped students in problematic situations and provided the study to go on its standard procedure.

After solving the worksheets, the researcher has gathered them. This process has taken six weeks. After the instruction of chemical bonds, the achievement test has been implemented as a post-test to the control group. Six weeks after the post-test, the same test has been implemented as a retention test to see the method's effect on permanent learning.

Implementation Process of Control Group: There are 15 female and 17 male students in the experimental group. They have been separated into nine heterogeneous collaborative groups in the study's preparation phase using a stratified sampling method. Before group works, an online learning environment has been introduced to students, and students have practiced it. After eliminating the troubles, preliminary preparation has been completed. Moreover, study hours have been determined with group members before the implementation. As the implementation is online, a class design has not been formed. Therefore groups and group members have not been in the same environment. After having an agreement on every issue, the implementation process has begun.

Firstly, an achievement test has been applied to the experimental group as a pre-test before the implementation. Students have then signed into the moodle system in pre-determined hours with their usernames and passwords given by the researcher. Students have entered the course page of that day and accessed the private chat rooms for their moodle system group. All the group members have studied inquiry-based learning sheets together. For the control groups, experimental groups have also had six worksheets, and they studied one of them online and collaboratively each week. The researcher has guided and helped the groups in every phase of the implementation. Students have tried to solve the sheets by

discussing with group members and searching on the Internet. The Head of the groups has ensured that each member has participated in the study and had an opportunity to present his/her idea. The communication between group members during the implementation has been performed in chat rooms.

The students have been informed about the practices of collaborative learning and inquiry-based learning. While performing the practices during the research process, inquiry-based learning activities have been integrated with collaborative learning activities. Before the instructional process, the achievement test was implemented to the control group as the pre-test. Then, students have settled in the class with their groups. After having students involved in groups for collaborative learning, inquiry-based learning activities have been performed. After taking all the members' opinions, the group decision has been written on the chat screen.

The group members' activities have been written on worksheets and given to the researcher by the groups' heads. During the implementation, heads of the groups have led the groups, and they have tried to prevent group members from doing different activities. They have allowed each member to state opinions and ensure the group work to go on in its standard procedure.

The researcher has been online during group works, visited chat rooms, promoted and encouraged students for group work, and motivated them for collaborative study. Online group works have been in four sessions and taken six-course hours. After the instructional process, the achievement test has been implemented as a post-test to the experimental group. Six weeks after the post-test, the same test has been implemented as a retention test to see the effect of inquiry-based online collaborative learning on permanent learning.

2.3. Data Collection Tool

The researchers have prepared the chemical bonds achievement test used in this study according to the procedures Metin (2016) stated for the achievement test development process.

In the first phase**,** the aim of the achievement test has been determined. In this study, the test has been used before the implementation, right after the completion of implementation, after passing a particular time to determine students' readiness, learning levels, and permanent learning.

In the second phase**,** the test's content has been designated. A table of specifications has been prepared by examining the chemical bonds subject's objectives in the 7th-grade science and technology curriculum. In the table of specifications, there have been a total of 40 questions for the achievement test; seven questions in remembering level, 12 questions in understanding level, 11 questions in applying level, and six questions in analysis level.

In the third phase**,** 40 multiple choice test items have been analyzed by experts for validity, reliability, comprehensibility, grammar, spelling errors, scientific convenience of the test, and test items for the level of the students. After the expert opinions, the final test has had 36 items.

In the fourth phase**,** the test has been implemented to 100 students for item analysis. In this process, true answers were coded as "1", false and unanswered items were coded as "0". The results have been ordered from the highest to lowest, and 27% of the highest scores were specified as a supergroup and 27% of the lowest ones as a subgroup. Following criterion have been used in item analysis: the items that have "0" or negative distinctiveness are excluded from the test; the item is considered as very well and does not need correction if its distinctiveness is 0.40 and higher; the item is considered as good and does not need correction between 0.40 and 0.30; the item can be used without correction or by correcting between 0.30 and 0.20, and the item should be prepared again or excluded if its distinctiveness is lower than 0.20. For item difficulty index; 0.00-0.20 is considered as very difficult, 0.21-0.40 as difficult, 0.41-0.60 as moderate difficult, 0.61-0.80 as easy, and 0.81-1.00 as very easy (Metin, 2016). After the item analysis, the 17th, 22nd, and 23rd items were excluded from the test as their difficulty and distinctiveness indexes were not acceptable.

In the last phase**,** the test's reliability was calculated using Kr20 reliability co-efficient, and this value was found to be 0.88. This result shows that the achievement test is reliable. After the validity and reliability processes, the final achievement test had 33 items.

2.4. Data Analysis

The data obtained using the achievement test as a pre-test, post-test, and retention tests have been analyzed using the SPSS program. Because the groups have been randomly assigned before the implementation and the data collection tool is an interval scale, a t-test has been used in data analysis. The Kolmogorov-Smirnov test was applied to determine whether the data had a normal distribution, and results showed that they presented a normal distribution ($p>0,05$). Levene test was used for testing the homogeneity of variances of experimental and control groups. Because the Levene test result was higher than 0.05, it was specified that both groups were equal. Independent samples t-test was used to compare the experimental and control groups pre-test, post-test, and retention test results. Paired samples t-test was used to analyze the pre-test post-test and post-test retention test average point differences of each group's test results. The level of significance was considered as $p=.05$. To comment on a test result, considering only the significance level is not sufficient. The result may be meaningful, but its effect may below. Effect size is

Table 1 Independent samples t-test results of experimental and control groups pre-test

Pre-test Results	Control Group		Experimental Group		t	p	Levene's test
	$\bar{x}$	SS	$\bar{x}$	SS			
Achievement Test	14.88	3.892	14.72	2.466	0.192	0.848	0.09

Table 2 Independent samples t-test results of experimental and control group's post-test

Post-test Results	Control Group		Experimental Group		t	p	Levene's test
	$\bar{x}$	SS	$\bar{x}$	SS			
Başarı Testi	20.38	7.691	22.59	6.116	1.277	0.206	0.059

Table 3 Paired samples t-test results of experimental and control group's pre-test and post-test

Groups	Tests	Achievement Test				
		$\bar{x}$	SS	t	p	d
Experimental Group	Pre-test	14.72	2.466	5.896	0.00	1.79
	Post-test	22,59	6.116			
Control Group	Pre-test	14.88	3.892	4.987	0.00	1.11
	Post-test	20.38	7.691			

Table 4 Paired samples t-test results of experimental and control group's post-test and retention test

Groups	Tests	Achievement Test				
		$\bar{x}$	SS	t	p	d
Experimental Group	Post-test	22.59	6.116	0.896	0.210	-
	Retention Test	22.13	4.696			
Control Group	Post-test	20.38	7.691	1.404	0.09	-
	Retention Test	19.91	7.818			

calculated in different ways in different tests, and Cohen's d was calculated in this study. Effect size is considered as; low between 0-0.2, moderate around 0.5, and high 0.,8, and above. The data obtained in this study have been interpreted by considering correlation, mean, standard deviation, p-value, and Cohen's d.

3. RESULT AND DISCUSSION

This study compares the effect of inquiry-based collaborative learning and inquiry-based online collaborative learning methods on students' success and permanent learning in chemical bonds subject. Therefore, pre-test, post-test, and retention test results between groups and the results of pre-test and post-test in-groups have been compared.

The independent samples t-test applied to pre-tests of experimental and control groups have been given in Table 1. According to the Levene test, Table 1 shows no difference between the pre-test variances of experimental and control groups. However, the control group's pre-test mean is higher than the experimental group's ($\bar{x}_{Control}$= 14.88; $\bar{x}_{Experimental}$ = 14.72). There is no statistically significant difference between pre-test means of experimental and control groups (t = 0.192; p> 0.05). Therefore, it is possible to say that both groups were equal before the implementation of Inquiry-based collaborative learning and inquiry-based online collaborative learning.

The independent samples t-test applied to post-tests of experimental and control groups was given in Table 2. According to the Levene test, Table 2 shows no difference between the post-test variances of experimental and control groups. However, the experimental group's post-test mean is higher than the control group's ($X_{Experimetal}$= 22.59; $X_{Control}$ = 20.38). There is no statistically significant difference between post-test means of experimental and control groups (t = 1.277; p> 0.05). Therefore, it is possible to say that the implementation of both Inquiry-based collaborative learning and Inquiry-based online collaborative learning has similar effects on students' success.

The paired samples t-test applied to pre-tests and post-tests of experimental and control groups has been given in Table 3. The table shows that post-test mean of experimental group ($\bar{x}_{Experimental}$= 22.59; SS = 6.116) is higher than its pre-test means ($\bar{x}_{Experimental}$= 14.72; SS = 2.466). It has been found that the experimental group has a significant increase in post-test ($t_{Experimental}$ = 5.896; p< 0.05), and the effect size ($d_{Experimental}$= 1.79) of this increase is at a high level. The table also shows post-test mean of control group ($\bar{x}_{Control}$= 20.38; SS = 7.691) is higher than its pre-test means ($\bar{x}_{Control}$= 14.88; SS = 3.892). It has been found that control group has a significant increase in post-test ($t_{Control}$ = 4.987; p< 0.05) and the effect size ($d_{Control}$= 1.11) of this increase is in high level. Therefore, both groups have shown a significant increase after the implementation; however, post-test means show that Inquiry based online collaborative learning has affected the students' success more than Inquiry-based collaborative learning.

The paired samples t-test applied to post-tests, and retention tests of experimental and control groups have been given in Table 4. Post-test mean of experimental group ($\bar{x}_{Experimental}$= 22.59; SS = 6.116) is higher than its retention test mean ($\bar{x}_{Experimental}$= 22.13; SS = 4.696). However, a significant difference has not been found ($t_{Experimental}$= 0.896; p>0.05) between post-test and retention test. The table also shows post-test mean of control group ($\bar{x}_{Control}$= 20.38; SS = 7.691) is higher than its retention test mean ($\bar{x}_{Control}$= 19.91; SS = 7.818). These results show that both experimental and control groups have decreased retention tests, but it is not significant in statistical terms.

In recent years, there is a tendency to use several teaching methods to bring about more meaningful and permanent learning. Different methods are decided to be used together by considering their limitations and advantages. By eliminating the limitation of a method with another's superiority, more quality instructional activities are performed. This study aims to present the effects of inquiry-based learning, collaborative learning, and online learning on students' success and learning by using them together. In this context, this study aims to determine the effect of Inquiry-based collaborative learning and Inquiry-based online collaborative learning on students' success and retention of learning.

The findings show that the Inquiry-based collaborative learning group and Inquiry-based online collaborative learning group have homogeneous distribution. There is no significant difference between the pre-test results. This means both groups had similar features before the implementation process. According to pre-tests after the instruction of the chemical bonds subject, there has been a significant increase in both groups' post-test results. This shows that both inquiry-based collaborative learning and inquiry-based online collaborative learning methods effectively affect students' success. The literature supports these results. For instance, Gülin (2010) found that Inquiry based collaborative learning had positive effects on students' learning and awareness. Moreover, Schwarzve Gwekwerer, 2007; Sun & Looi (2013), and Sun, Looi & Xie (2014) presented in their studies that Inquiry based collaborative learning was effective on cognitive development of students and understanding the scientific concepts. Similarly, some studies show Inquiry-based online collaborative learning has positive effects on students' cognitive development, success, and learning (Chang, Sung & Lee, 2003; Salovaara, 2005; Abdelraheem & Asan, 2006; Linn, Lee, Tinker, Husic & Chiu, 2006; Sun, Looi & Xie, 2014; Sinha, Rogat, Adams-Wiggins & Hmelo-Silver, 2015).

Because both groups' post-test results are significantly higher than pre-test results, it is not clear which method is more effective. Effect sizes of groups have been analyzed, and it has been found that both methods have had a high-level effect on students. However, the effect size of Inquiry-based online collaborative learning is larger than Inquiry-based collaborative learning. Therefore, it is possible to say that Inquiry based online collaborative learning is more effective than inquiry-based collaborative learning on students' success. This result may be that in Inquiry-based online collaborative learning, students have extra opportunity to search on the Internet, discuss and get feedback from friends, and communicate more thanks to the online environment. In Inquiry-based collaborative learning, these opportunities are limited for students, resulting in a lower effect of instruction on students. Many studies (Moore & Kearsley, 1996; Jonassen & Kwon, 2001; Heckman & Annabi, 2005; Wang & Woo, 2007; Birişçi, 2013;) report that online play a more active role in providing a cognitive contribution to group works. It is also stated that student discussions designed in online environments enable developing common information with different individuals' participation (Olaniran, Savage & Sorenson, 1996; Marjanovic, 1999; McAlister, Ravenscroft & Scanlon, 2004; Watson, 2004; Balaji & Chakrabarti, 2010). Moreover, studies report that online learning environments help students; learn autonomously on the Internet or computer network, or by interacting with an instructor, extinguish the dependency on time and place concepts in reaching the information and learning, interact with their peers and instructors during instructional activities, have concrete learning experiences by providing them all the visual and audial environments that computer supplies (Çalışkan, 1999; Çalışkan, 2001; Salovaara 2005; Abdelraheem & Asan 2006; Gümüş, 2007; Yücel, 2013). It is a fact that the opportunities that online environments provide will positively affect students' learning. For this reason, Inquiry-based online collaborative learning will have more effect on students than Inquiry-based collaborative learning.

4. CONCLUSION

It has been found that both methods have had a high-level effect on students. However, the effect size of Inquiry-based online collaborative learning is larger than Inquiry-based collaborative learning. Therefore, it is possible to say that Inquiry based online collaborative learning is more effective than inquiry-based collaborative learning on students' success.

There has been a decrease in both groups' retention tests; however, this is not significantly different in statistical terms. Therefore, it is possible to say that both methods have similar effects on remembering knowledge. Yalın (2015) states that more permanent learning occurs when students become active, and they are provided multi learning environments and when more senses are addressed

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