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Which one is better? Jigsaw II versus Jigsaw IV on the Subject of the Building Blocks of Matter and Atom

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Abstract

In this study, the effect of using Jigsaw II and Jigsaw IV techniques on the subject of “Atoms-The Basic Unit of Matter” in science course of 6th grade on academic achievement was examined. Pre-test post-test control group research was used in the study. Study population is all secondary schools in Turgutlu district of Manisa province and the sample group was determined from “Samiye Nuri Sevil Secondary School” among 20 secondary schools in Turgutlu district through cluster sampling method. The experiment and control groups of the research were constituted from two branches based on the results of pre-test and there are 48 persons in total of which 24 are in experiment and 24 are in control group. In the study, the subject of “Atoms- the Basic Unit of Matter” was taught to the experiment group by using Jigsaw IV technique and it was taught to the control group by using Jigsaw II technique. In this research, Science achievement test consisting of 12 multiple-choice items which were developed by the researcher was used. T-test was used for the analysis of data obtained as a result of achievement test. In paired samples t-test (dependent group) conducted for achievement pre-tests and post-tests of the control and experiment group a significant difference was found, while no significant difference in terms of statistics in favor of the experiment group was found in independent samples t-test (independent group) conducted for post-tests of the control and experiment groups. At the end of the research, although the effect of Jigsaw II and Jigsaw IV techniques on the achievement in Science course was found to be positive on students learning, no statistical differences were found in these two techniques.

Key words: Cooperative learning, Jigsaw II technique, Jigsaw IV technique.

Introduction

In today's information age, the primary goal in our education system should be gaining the skills to the students to reach knowledge rather than transferring. This is possible with high-level thinking process skills. In other words, it requires meaningful learning, rather than memorizing, and problem solving and scientific process skills. Science course is the leading course to gain such abilities (Buzludağ, 2010; Kaptan and Korkmaz, 2001). Science can be defined as to examine the observed nature and natural phenomena in a systematic manner and efforts to estimate the unobserved phenomena. As it is understood from this definition, science is the product of the efforts of humankind to understand the nature (and oneself) (Ayna 2009; Turgut et al., 1997). Science was born due to the desire of humans to explain the natural phenomena. Science education began with the observations of the ancient people and to transfer their knowledge and observations to others (Gürdal et al., 1998).

Primary education has a special place and importance in our education system because primary education is an education phase preparing students for life, informing them on natural and social environment and providing guidance (Gürdal and Yavru, 1998). Science has a significant place due to this characteristic of the primary school. Along with latest developments in education, one of the methods and techniques which are primarily used in science education is cooperative learning method. According to Açıkgöz (2008), cooperative learning method can be simply described as the learning process that students study in small groups and help each other (etc. Doğru, 2012). In this context, cooperative learning method is a group study. However, constitution and implementation of cooperative learning groups differ from group studies (Bozdoğan et al., 2006, p.26). A group study only becomes a cooperative learning when the students in the group make effort to bring the learning of them and other students in the group to the top level. In order to perform cooperative learning, the students in a group should help each other by interaction and should produce a joint study rather than working on a particular part of the work independently. Thus, “educational activity, in which the students participate personally, helps them to understand the subject better and not to forget it easily” (Küçükahmet, 1997, p.59). “Students in the

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class in which cooperative learning environment is obtained, study within positive cooperation; each member has a particular and explicit role; joint study process is important and the group members analyze and discuss their work” (Lee et al., 1997, p.3). “Achievement of the group depends on the performance of the group members. For this reason, individuals have to help each other in order to achieve their individual goals” (Slavin, 1980, p.21; Lejik and Wyvill, 1996, p.270). “Group of members aware of the requirement of the group achievement in order to achieve their individual goals helps other members. More importantly group members encourage each other” (Johnson and Johnson, 1989, p.7). In cooperative learning approach, each student takes on several duties.

There are 8 sub-techniques commonly used in cooperative learning method so far. One of them is jigsaw technique. This method was developed by E. Aranson (1978). These procedures are followed in Jigsaw technique. First of all, students are divided into 3-7 person jigsaw groups and the subject is divided into segments. Then, the students are divided into individual groups and constitute the expert groups with other students who assigned to the same segment. Students in expert groups work by helping each other to develop strategies to learn and teach their segments to other group members. Such expert groups return to their jigsaw groups after they complete their studies and become ready for the segment. They give lecture to the group members on what they have learned about their segment. Following the presentation of the chapter or the subject by the group members in this way, the whole class is given an individual quiz on relevant material. The results of the quiz are evaluated individually (Yılayaz, 2012; Açıkgöz, 1992). After Aronson, educational researchers studying on Jigsaw technique made new arrangements and developments in Jigsaw technique starting from the flexible applications of this technique. In Table 1 below, Jigsaw techniques developed by several researchers are compared:

Table1.Comparison of jigsaw techniques*

Step	Jigsaw II	Jigsaw III	Jigsaw IV
1.			Introduction
2.	Experts sheet assigned to expert groups	Same as Jigsaw II	Same as Jigsaw II
3.	Group answers expert questions prior to returning to home teams	Same as Jigsaw II	Same as Jigsaw II
4.			Quiz on material in the expert groups checking for accuracy
5.	Students return to home teams sharing their information with team mates	Same as Jigsaw II	Same as Jigsaw II
6.			Quiz on material shared checking for accuracy groups
7.		Review process whole group by Jeopardy, or Quiz Bowl etc.	Same as Jigsaw III
8.	individual assignment and grade	Same as Jigsaw II	Same as Jigsaw II
9.			Re-teach any material missed on assessment as needed.

* Adapted from Holliday (2002, p. 4).

When Table 1 is examined; It is seen that Jigsaw II and Jigsaw IV techniques diverse in 1st, 4th, 6th, 7th and 9th steps. Accordingly;

In first step; the first difference is seen in Jigsaw IV. In this technique, as different from Jigsaw II, the teachers conducts activities such as movie screening, discussion platform, brainstorming, problem solving, lecturing to all groups, and presentation of the lesson plan or using other methods for the introduction of the lecture regarding the chapter or material to be studied by the class (Holliday, 2000). This implementation is an activity conducted to catch the students’ attention on the chapter before the study when they are in their jigsaw groups.

In fourth step; unlike Jigsaw II, in Jigsaw IV, a test is applied in order to check whether the students studying in expert groups have learned the information in relevant chapters. Correct answers and the level of understanding are checked with this test application. With the assistance of the instructor and facilitation of the studies, agreement between the students in expert groups on the answers is provided. Then, students in expert groups return back their jigsaw groups (Holliday, 2002).

In sixth step; there is difference between Jigsaw applications. In this step, unlike Jigsaw II, a second test is applied in order to check whether the students in jigsaw groups learn the whole chapter or material in Jigsaw IV (Holliday, 2002.).

In seventh step; unlike Jigsaw II, in Jigsaw IV technique, several tests, activities and forms are used to reexamine the study processes of all groups. In this process, before passing to individual evaluations, the state of learning the course, chapter or relevant material is submitted for the examination of whole class. This examination period is very important in terms of forming a basis for students to study the relevant chapters for the second or third time (Holliday, 2000).

In ninth step; unlike Jigsaw II, in Jigsaw IV, the instructor completes the study by summarizing and teaching the unanswered questions or unlearned parts of the chapters as a result of evaluations. However, this practice is optional. In the case of students gain required behaviors, practices in this step are not necessary. The practices in this step are very important especially for students with low level of achievement before passing to the next chapter (Holliday, 2002).

The positive effect of using cooperative learning method -Jigsaw techniques on academic achievement is supported by several researches. As a result of the study titled “The Effect of Education with Cooperative Learning (Jigsaw Technique) on student achievement for the Chapter of ‘Reproduction Growth and Development in Living Beings’ of 6th Grade Science and Technology Course” and conducted by Buzludağ (2010), it was found that cooperative learning-Jigsaw technique positively affect the achievement in Science and Technology course. In the study carried out by Doğru (2012) named “The Effect of Jigsaw Technique on Self-efficacy, Anxiety and Memorability Levels of Students in Mathematics Education”, it is determined that Jigsaw technique has more beneficial effects on self-efficacy, anxiety and memorability levels when compared with the traditional education method. In another study titled “The Effects of Group Study with Cooperative Learning Methods on Achievements, Attitudes for the Course and Memorability of the Learned Subjects” and conducted by Oral (2000), it was found that cooperative learning (Jigsaw II) activities has more beneficial effects on achievement levels at the end of the course, memorability of the learned subjects and attitudes of the students for study period when compared with group studies. Slavin and Karveit (1979) revealed that cooperative learning (Jigsaw II) activities improve achievement compared to the traditional education method in their study in which they examine the academic achievements, affective behaviors like attitude, anxiety and self-respect of primary school students. Shafiuddin (2010) revealed that Jigsaw technique improves achievement more efficiently when compared with the traditional education method in his study with experimental design.

In this study, an answer was sought for the question “Is there any effect of Cooperative learning method-Jigsaw II and Jigsaw IV techniques on the education of ‘Atoms- the basic unit of matter’ subject of primary school 6th grade Science and Technology course?”. Three questions were determined for the solution and answers were sought. These questions are: “Is there any significant difference between pre-test and post-test scores of the experiment group?”, “Is there any significant difference between pre-test and post-test scores of the control group?” and “Is there any significant difference between post-test scores of the experiment and control groups?”

Method

Research Model

In the research, pre-test – post-test control group research design was applied. One of two equivalent branches was designated as experiment group and control group randomly and, pre-test and post-test measurements were carried out on both groups and shown in the Table 2 as follows.

Table 2. Pre-test post-test experiment design with control group

Group	Pre-test	Experimental Process	Post-test
G1	T1	Cooperative Learning Method (Jigsaw IV)	T2
G2	T2	Cooperative Learning Method (Jigsaw II)	T2

G1: The experimental control group to which Jigsaw IV method is applied

G2: The experimental control group to which Jigsaw II method is applied

T1 and T2: Achievement tests on “Atoms- the basic units of matter”

Population and Sampling

Study population is all secondary schools in Turgutlu district of Manisa province and the sample group was determined from “Samiye Nuri Sevil Secondary School” among 20 secondary schools in Turgutlu district through cluster sample selection. Pre-test was conducted on all branches of 6th grade in order to determine the

experiment and control groups of the research. The experiment groups (24) and control groups (24) which are constituted from two equivalent branches according to pre-test results of the students are composed of 48 students. The t-test was used to determine whether there is a significant difference between the groups. Results of the analysis are given in the Table 3.

Table 3. The average pre-test scores for group accreditation, results of the t-test

Group	N	\bar{X}	Ss	t	P
Experiment	24	5,45	2,39	-1,142	0.259
Control	24	6,20	2,14		

$p > 0.05$

According to Table 3, mean and standard deviation scores of the experiment group were determined as 5.45 and 2.39 respectively in the achievement pre-test conducted before intervention. The mean and standard deviation scores were determined as 6.20 and 2.14 respectively. No statistically significant difference ($p > 0.05$) was observed in the independent-samples t-test conducted for achievement pre-tests of the control and experiment group. According to this result, the pre-test success of the experiment group is within the same standard deviation range as the pre-test success of the control group. This indicates that both the experiment and control groups are equivalent.

Data Collection Instruments

In the research, the following assessment instrument was used to determine achievements of the students on “Atoms- the basic units of matter” which is a 6th grade science course.

Achievement Test of Science Course: The achievement test used in the research was prepared by the researcher. In order to develop this test, all acquisitions on the subject of “Atoms- the basic units of matter”, 6th grade were determined based on primary science education program (MoNE, 2010), some of the questions were selected from among the assessment questions of the textbooks used in the schools currently and the questions within the open education lecture notes, whereas some of the questions were prepared by the researcher so that there will be a question on each acquisition. The 17-questions test was checked by experts (from university) and 5 questions were excluded. Pilot execution of the test was performed on the 7th grade students in the school where the research is conducted (because the students have already learned the subject) and reliability of the test was measured. So, reliability of the test was found 0.66. Then the test was conducted as pre-test and post-test.

Application

Two equivalent branches (6A= experiment, 6D=control) were selected with respect to the results of pre-test. The lesson was provided to the experiment group by means of the education program prepared in accordance with the Jigsaw IV technique of the cooperative learning method whereas in the control group Jigsaw II technique of the cooperative learning method was applied to teach subject. In both experiment and control groups, teaching activities were conducted by the researcher.

Applications in the Experiment Group

The researcher informed the students in the experiment group that the subject of “Atoms- the basic unit of matter” will be taught by the Jigsaw IV technique of the cooperative learning method. Then information on the approach was provided. Heterogeneous groups of 6 students were created by the researcher by taking into consideration interest, ability and achievement levels of the students in the classroom before the intervention. The classroom was organized to allow the group work to be performed. Before the intervention, the science achievement test was implemented as a pre-test in order to assess prior knowledge of the students in the experiment and control groups. After the students understood the studies to be performed, the intervention was initiated and the Jigsaw IV technique of the cooperative learning method was implemented. The students in groups completed their studies. The researcher provided guidance during the intervention and ensured the study to be performed in accordance with its purpose.

Applications in the Control Group

The subject of “Atoms- the basic unit of matter” was taught by means of the Jigsaw II technique of the cooperative learning method. The students were informed about the approach and heterogeneous groups of 6 students were created by the teacher. The science achievement test was also implemented as a pre-test in the

control group. At the end of the study, the science achievement test was implemented as post-test in both experiment and control groups. Such applications performed with control and experiment groups last for 2 weeks.

Analysis of Data

Comparisons were made on data from the Science Achievement Test on the subject of “Atoms- the basic units of matter” between experiment and control groups by means of SPSS software package. For pre-test and post-test comparisons of experiment and control groups, the independent samples t-test was used. The pair samples t-test was used for pre-test post-test comparison of the experiment group and pre-test post comparisons of the control group. Significance level was accepted as at least 0.05. The results of analysis were interpreted individually by tabulating.

Findings

The Table 4 includes the reliability coefficients for the Science Achievement Test performed in the control and experiment groups. Cronbach's alpha coefficient for reliability was found as 0.66. Such results obtained show that the reliability of the test is 66% and this result is reliable statistically.

Table 4. Reliability coefficient for science achievement test

Reliability Coeff.	N	R
Cronbach Alfa	24	0,66

Findings for the First Sub-Problem: The first sub-problem was “Is there any significant difference between pre-test and post-test scores of the experiment group?” Mean scores of pre-test and post-test and standard deviations of the experiment group were calculated. The t-test was used on dependent groups in the SPSS statistic software package in order to determine significance of the difference between averages of the pre-test and post-test scores in the experiment group. Results are shown in the Table 5.

Table 5. Result of the dependent group t-test performed for achievement pre-test and post-tests of the experiment group

Experiment Group	N	\bar{X}	Ss	t	P
Pre-test	24	5,45	2,39	-3,646	0.001
Post-test	24	7,12	2,36		

$p < 0.05$

According to Table 5, the mean score of the achievement pre-test of the experiment group and standard deviation was found as 5.45 and 2.39 respectively. The mean score of the post-test of the experiment group and standard deviation was found as 7.12 and 2.36 respectively. A statistically significance difference at level of 0.05 was found in the dependent group t-test carried out for achievement pre-test and post-test of the experiment group. This difference occurred in favor of the post-test. As it is understood from this result, implementation of the Jigsaw IV technique of the cooperative learning method enhanced the student achievement.

Findings for the Second Sub-Problem: The second sub-problem was “Is there any significant difference between pre-test and post-test scores of the control group?” Mean score of pre-test and post-test and standard deviations of the control group were calculated. The t-test was used on dependent groups in the SPSS statistic software package in order to determine significance of the difference between averages of the pre-test and post-test scores in the control group. Data are shown in the Table 6.

Table 6. Result of the dependent group t-test performed for achievement pre-test and post-tests of the control group

Control Group	N	\bar{X}	Ss	t	P
Pre-test	24	6,20	2,14	-3,095	0.005
Post-test	24	7,95	1,92		

$p < 0.05$

According to Table 6, the mean score of the achievement pre-test of the control group and its standard deviation was found as 6.20 and 2.14 respectively and, the mean score of the post-test of the control group and its standard deviation was found as 7.95 and 1.92 respectively. A statistically significance level of 0.05 was found in the dependent group t-test carried out for achievement pre-test and post-test of the control group. This difference occurred in favor of the post-test. As it is understood from this result, implementation of the Jigsaw II technique of the cooperative learning method enhanced the student achievement.

Findings for the Third Sub-Problem: The third sub-problem was “Is there any significant difference between post-test scores of the experiment and control groups?” Mean score of total post-test scores of both the experiment and control groups and standard deviations were calculated. The t-test was used on independent groups in the SPSS statistic software package in order to determine significance of the difference between averages of the post-test scores of the groups. Data are shown in the Table 7.

Table 7. Results of the independent group t-test performed for achievement post-tests of the control and experiment group

Groups	N	\bar{X}	Ss	t	P
Experiment	24	7,12	2,36	-1,340	0.187
Control	24	7,95	1,92		

$p > 0.05$

According to Table 7, the mean score of the achievement post-test of the experiment group and its standard deviation was found as 7.12 and 2.36 respectively. The mean score of the post-test of the control group and its standard deviation was found as 7.95 and 1.92 respectively. A statistically significant difference at level of 0.05 was not obtained in the independent group t-test performed for the achievement post-tests of the control and experiment groups. Accordingly, post-test achievement of the experiment group is in the range of the same statistically significant standard deviation as post-test achievement of the control group. The Jigsaw IV technique and Jigsaw II technique of the cooperative learning methods have shown equally success on the science achievement post-test. This represents same impact of the Jigsaw IV and Jigsaw II techniques of the cooperative learning method on the student achievement.

Conclusion

In this study, it was aimed to show the effects of the Jigsaw IV and Jigsaw II techniques of the cooperative learning method on teaching of the subject “Atoms- the basic units of matter” in the Science Class of primary 6th Grade. The results showed that both these techniques increase the academic success of students. The results of the research, which was made by means of the Jigsaw techniques at different fields and different class levels, show parallelism with the results of this study (Buzludağ, 2010, Dođru, 2012, Oral, 2000, Slavin and Karveit, 1979, Shafiuddin, 2010). The cooperative learning method ensures active participation of the students to learning process. The students interact with class mates, thus efficiency in learning and students' interests in the course increase. Therefore, employment of the cooperative learning techniques in the Science subjects should be expanded at all levels of education in our country. The classrooms in the schools should be organized in compliance with cooperative method and provided with necessary facilities for this method.

The following suggestions were made by taking into account the findings form the research and the results obtained.

1. The research is restricted with the use of the Jigsaw technique (Jigsaw IV and Jigsaw II) of cooperative learning method. Otherwise, researches which compare other cooperative learning techniques or cooperative learning and other modern learning methods may be conducted.
2. This research is restricted with a Science course provided to 48 students from 6th grade for two course hours per week, a similar research may be conducted on larger groups at different class levels within different courses for a longer time.
3. Variables taken under the research are restricted with the achievement level. Besides, affective variables may be researched.
4. If the cooperative learning method and its techniques are introduced to pre/in-service teachers practically by in-service training activities, this may make such method and techniques applicable by teachers in other classes as such in the Science class.
5. The researchers or teachers who desire to use the Jigsaw IV and Jigsaw II technique should make some preparatory works by taking into account the students who are not familiar to such techniques and have no

information on the steps of such techniques before such techniques are implemented. Such works may include the introduction of the techniques to students, providing information on differences of this technique from other Jigsaw techniques, implementation steps of the techniques, assessment process, and time proposed for the technique.

References

- Açıkgöz, K.Ü., (1992). *İşbirlikçi Öğrenme Kuram Araştırma Uygulama*. Malatya: Uğurel Matbaası.
- Açıkgöz, K.Ü. (1993). *İşbirliğine Dayalı Öğrenme Ve Geleneksel Öğretimin Üniversite Öğrencilerinin Akademik Başarısı, Hatırda Tutma Düzeyleri Ve Duyuşsal Özellikleri Üzerindeki Etkileri*, Ankara Üniversitesi Eğitim Bilimleri Fakültesi: I. Ulusal Eğitim Bilimleri Kongresi (25-28 Eylül 1990).Ankara: MEB yay. 187-201.
- Açıkgöz, K. Ü. (2008). *Aktif Öğrenme*, Biliş Yayınları, İstanbul, 2008.
- Akgün, Ş. (1995).*Fen Bilgisi Öğretimi*, Akgün Yayınları, Giresun.
- Ayna, C. (2009). *Fen ve Teknoloji Dersinde Birleştirme II (jigsaw II) Yönteminin Kullanılmasının ve Sosyo-ekonomik Düzeyin Öğrencilerin Akademik Başarı, Fen ve Teknoloji Dersine Yönelik Tutum ve Motivasyon Düzeylerine Etkisi*.taken from website <https://tez.yok.gov.tr/UlusalTezMerkezi/tezSorguSonucYeni.jsp>
- Bozdoğan A. E., Taşdemir A., Demirbaş M. (2006). Fen Bilgisi Öğretiminde İşbirlikli Öğrenme Yönteminin Öğrencilerin Bilimsel Süreç Becerilerini Geliştirmeye Yönelik Etkisi, *İnönü Üniversitesi Eğitim Fakültesi Dergisi*, 7(11), 23-36.
- Doğru, E. (2012). *Matematik Öğretiminde Kullanılan Ayrılp Birlesme Tekniğinin Öğrencilerin Özyeterlilik, Kaygı ve Kalıcılık Düzeylerine Etkisi*. taken from website <https://tez.yok.gov.tr/UlusalTezMerkezi/tezSorguSonucYeni.jsp>.
- Gürdal, A. ve Yavru, Ö., (1998). İlköğretim Okullarının 4.ve 5. Sınıflarında Laboratuvar Deneylerinin Öğrencilerin Mekanik Konusundaki Başarısına ve Kavramları Kazanmasına Etkisi, *M.Ü. Atatürk Eğitim Fak. Eğitim Bilimleri Dergisi*, 10, 327-328.
- Holliday D. C. (2002). Jigsaw IV: Using Student/Teacher Concerns To Improve Jigsaw III, (ERIC doküman no: ED465687). Taken from ERIC database.
- Kaptan, F. ve Korkmaz, H., (2001).*İlköğretimde Etkili Öğretme ve Öğrenme Öğretmen El Kitabı İlköğretimde Fen Bilgisi Öğretimi Modül 7*. Milli Eğitim Bakanlığı Yayınları, Ankara, 75s
- Küçükahmet L. (1997). *Eğitim Programları ve Öğretim*, Gazi Kitapevi, Ankara.
- Lee C, Ng M., Jacobs C. M.(1997). *Cooperative Learning in The Thinking Classroom: Research and Theoretical Perspectives*, (ERIC doküman no: ED408570). Taken from ERIC database.
- Oral B. (2000) “Sosyal Bilgiler Dersinde işbirlikli Öğrenme ile Küme Çalışması Yöntemlerinin Öğrencilerin Erişimleri, Derse Yönelik Tutumları ve Öğrenilenlerin Kalıcılığı Üzerindeki Etkileri”, *Ç.Ü. Eğitim Fakültesi Dergisi*, 2(19), 43-49.
- Shafiuddin M. (2010). Cooperative Learning Approach in Learning Mathematics” *International Journal of Educational Administration*, 2(4), 589-595
- Slavin R. E., Karveit N. L.(1979). *An Extended Cooperative Learning Experience in Elementary School*, (ERIC doküman no: ED183288). Taken from ERIC database.
- Slavin R. E. (1980).*Student Team Learning*, (ERIC doküman no: ED260023). ERIC database
- Turgut, Fuat., Baker, D., Cunningham, R, Piburn, M. Ve Roger Cunningham (1997); *İlköğretim Fen Öğretimi*, YÖK/DB Milli Eğitimi Geliştirme Projesi Hizmet Öncesi Öğretmen Eğitimi Yayınları, Ankara.
- Yılayaz, Ö. (2012). 6. Sınıf Fen ve Teknoloji Dersi" Canlılarda Üreme, Büyüme ve Gelişme" Ünitesinin İşbirlikli Öğrenmeyle (jigsaw tekniği) Öğretiminin Öğrenci Başarısına Etkisi.*Education Sciences*, 7(1), 109-117.