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# Effects of reading-writing-application and learning together techniques on 6th grade students' academic achievements on the subject of "Matter and Temperature"

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The aim of this study was to determine the effects of Reading-Writing-Application technique, Learning Together technique and according to teaching techniques suggested by course books developed based on Science and Technology teaching program and approved by Ministry of Education on students' academic achievements on the subject of "matter and temperature" and attainment level of students regarding the experiments. Sample of the study comprised a total of 92 6th grade students from three different classes of a primary school. As data collection tools; Academic Achievement Test (AAT) and Experimental Achievement Test (EAT) were used. The study was conducted in three different groups, each representing a different learning method. These groups were; the Reading-Writing-Application Group (RWAG), Learning Together Group (LTG) and the Control Teaching Group (CTG). For data analyzes; descriptive statistics, one-way analyzes of variance (ANOVA), paired group t-test and effect sizes were used. Conclusively, it was determined that effects of Reading-Writing-Application technique and Learning Together technique on students' academic achievements and attainment level of students regarding the experiments were much higher compared to according to teaching techniques suggested by course books developed based on Science and Technology teaching program and approved by Ministry of Education. It was further determined that the amount of increase in the achievement level created by cooperative groups (RWAG and LTG) were much higher in comparison to increase in attainment level of students regarding the experiments.

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## Introduction

Learning and teaching activities have a significant role in terms of providing students with sustainable knowledge. For students to be able to learn more efficiently, high level of mental processing skills needs to be given to students. This meaning; instead of rote-learning, students must learn comprehendingly and their skills which would enable them to create solutions to new challenges must be developed. The main purpose of science lesson is not to make the students memorize the science concepts but to develop their reasoning skills by teaching them to learn and hence to raise exploring and questioning individuals. In accordance with the above given purpose, therefore, science lessons in schools need to be instrumental. It is therefore rather important in science teaching to give the students the necessary skills to reach information by themselves instead of conveying them the currently available (Atar, 2011; Black, 2005; Karaçöp, 2010; Kim, Yoon, Whang, Tversky & Morrison, 2007; So & Ching, 2011; Turgut, Gurbuz & Turgut, 2012; Whang, Chang & Li, 2007; Wu & Shah, 2004; Yang, Andre & Greenbowe 2003). Student centered techniques such as; cooperative learning, project-based learning, question-based learning and problem-based learning were identified as instrumental learning methods by many researchers. Among these methods, cooperative learning method has been becoming more prominent in recent studies. In line with the cooperative learning concept, students are divided into versatile heterogenic groups and provide each other with opportunities of guidance, self development and strengthening knowledge (Black, 2005). Responsibilities given to cooperative group members, such as members' asking questions to each other and carrying out the related activities jointly etc, plays a role in increasing the achievements of students (Whang, Chang & Li, 2007). In order to realize positive learning during the process of cooperative learning activities, many techniques and methods were developed to help teachers contribute to the achievement of students. Among these; Learning Together, Team-Play-Tournament, Student Teams Achievement Divisions, Combined Cooperative Reading and Composition, Jigsaw, Group Research and Team Supported Individualism were extensively used. Cooperative learning groups usually consist of two to six students and these groups are heterogenic in terms of students' academic achievements (Doymus, 2008). Group work is divided among group members. Scores given in these activities reflect both group and individual achievement (Colosi & Zales, 1998; Doymus, 2008; Hines, 2008; Woodfield & Kennie, 2008). Reading-Writing-Application technique where cooperative learning process is supported by reading and writing activities are consist of three major parts. First part of this technique is the reading phase. In this phase, the main purpose of posters or reading texts provided for the students is to increase the amount of time they use for reasoning. Visually rich reading texts which are suitable to the level of students and the curriculum are proved to be quite useful in catalyzing the reasoning of students and enabling to express the knowledge they received (Schoonen, Gelderen, Stoel & Glopper, 2010; White & Gustone, 1989).

Second phase of the RWA is writing. It is very important for students to be involved in collective writing activities in terms of being able to better organize, comprehend and express what they learned. The main purpose in this phase is to make group members come up with a group product by collectively writing what they learned. It is experienced in such activities that many original ideas are come up with while students are trying express their personal views in a common sense (Dinan, 2005; Eshietedoho, 2010; Hohenshell & Hand, 2006). In the third phase of application of RWA, the purpose is the realization of learning through experiencing and creation of source dependency within the group. During the process of application, it must be ensured that appropriate circumstances are provided for tests and activities to be conducted in each lesson and group members personally conduct the activities. During the process, students' behaviors such as contribution to each other's opinions,

encouragements towards their friends, contributing to the group management and controlling the learning process must be monitored and their individual and group performances must be determined (Hand & Choi, 2010).

Another cooperative technique widely used in science teaching is Learning Together technique. This technique was developed by Kurt Lewin, Morton Deutsch and Johnsons (Eshietedoho, 2010). The most significant characteristics of this technique are the existence of a common group objective, sharing of ideas and material and cooperation. During the application of this technique, it must be ensured that students work together to bring out a common group product, share their ideas and material with each other and direct their questions to one another before posing them to their teachers. During the application of this technique which is the most common among cooperative learning approach, first of all; the objective of the study must be determined, groups must be created in accordance with this objective and the work must be carried out in a cooperative framework (Hines, 2008). In groups of 2 to 6 people, students share their opinions on subjects assigned to them and the worksheets. In this technique, students are usually given separate assignments in advance on the forthcoming subject by the researcher. After completing their assignments, students report the results of their assignments to other students in the group. In accordance with the objectives of the group subjects and assignments, members of the group jointly decide on how to move and what to do thereon. Subsequently, they put forth a common product (Nilsson & Driel, 2010). Teaching activity concludes by each group presenting their subject to the whole of the class (Jiao, Daros-Vaseles, Collins & Onwueabuzie, 2011). The aim of this study was to determine the effects of Reading-Writing-Application technique, Learning Together technique and according to teaching techniques suggested by course books developed based on Science and Technology teaching program and approved by Ministry of Education on students' academic achievements on the subject of "matter and temperature" and attainment level of students regarding the experiments.

## Methodology

### *Model*

Within the scope of primary school 6$^{th}$ grade science and technology lesson's "matter and temperature" subject, in this study, control group design of pretest – posttest was predicated to examine the results of three different teaching techniques and methods on students' academic achievements and attainment level of students regarding the experiments (McMillan & Schumacher, 2006).

### *Sample*

Working group of the study consist of 92 students of three classes of a primary school during the school year of 2010-2011. One of the classes was assigned as the Reading-Writing-Application Group (RWAG) (n=30), another one was assigned as the Learning Together Group (LTG) (n=32) and the last group was assigned as the Control Teaching Group (CTG) (n=30). The study was continued in all three groups for four weeks.

### *Data Collection Tools*

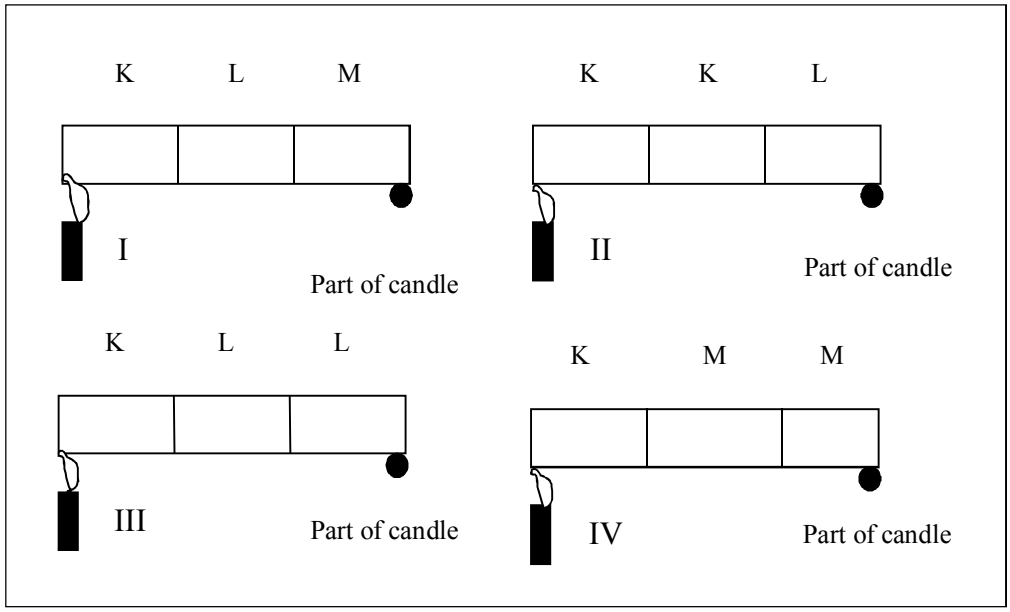
As data collection tools; Academic Achievement Test (AAT) for determining students' preliminary and latest information regarding "matter and temperature" subject and Experimental Achievement Test (EAT) for determining students' attainment levels regarding experiments conducted within the scope of the subject were used.

### *Academic Achievement Test (AAT)*

Academic Achievement Test was designed taking into consideration the "matter and temperature" subject in the study and to be able to measure student attainments by making use of primary school science and technology program and science and technology school books. AAT was designed as 25 question multiple choice test following the preparation of questions specifications table which was prepared according to subject distribution and questions and examined and corrected by 3 academics who are leading experts on the subject and 3 science and technology teachers (teaching at $6^{th}$ grade). After these adjustments, AAT was applied on 44 $7^{th}$ grade students from 3 different classes, who had studied the subject previously and hence, the reliability of the test measurements were established. 5 questions in the AAT which were found to be dysfunctional were removed from the test. Thus, the AAT was prepared as 20 question test and its reliability coefficient was determined as 0.71. AAT was applied to all three groups as both pretest - posttest to determine the change in the academic achievement level. An example of question taking place in the AAT is given below.

***AAT Sample Question***

The relation between K, L, M solids and their thermal conductivities are K>L>M




According to this, which of identical candles would melt and fall first when heated with same sized and identical K, L, M, mattered heaters?

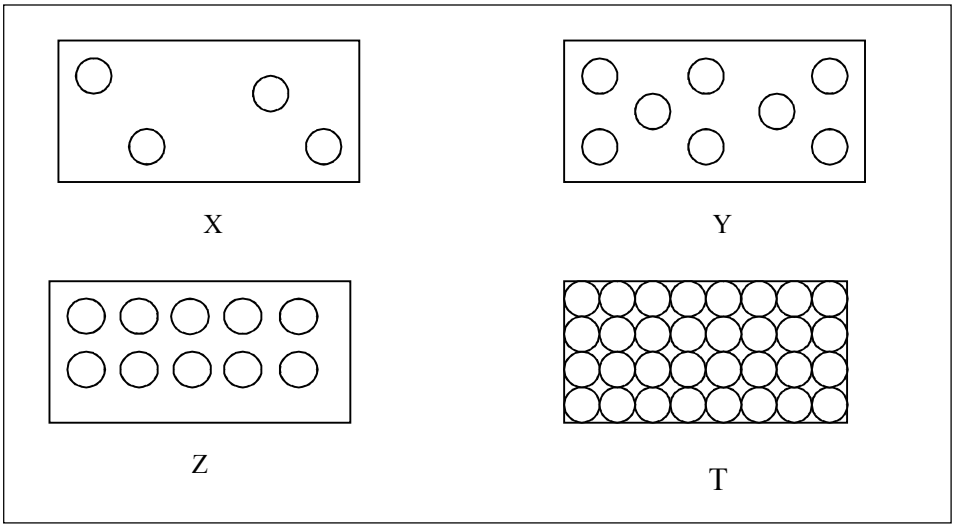
A) I
B) II
C) III
D) IV

### *Experimental Achievement Test (EAT)*

EAT was prepared comprehensively to address students' attainments towards cognitive target areas such as application, analyzes and synthesis by taking into account the targeted attainment level of students regarding the experiments conducted on "matter and temperature" subject, test results aimed to be achieved and technical knowledge and skills. EAT was prepared to answer 25 multiple choice questions on 4 tests (Dissipation of Heat on Wire, Direction of Dissipation, Means of Heat Conduction, Heat Exchange of Matters). Questions specifications table was prepared according to subject distribution and questions and examined and corrected by 3 academics who are leading experts on the subject and 3

science and technology teachers (teaching at 6th grade). After necessary corrections, the reliability of EAT was tested by being applied to 44 7th grade students from 3 different classes, who had studied the subject previously. 5 questions in the EAT which were found to be dysfunctional were removed from the test. Thus, the EAT was prepared as 20 question test and its reliability coefficient was determined as 0.68. EAT was applied to all three groups as posttest right after the study to measure the attainment level of students regarding the experiments. Since there could be no possibility of student attainments before the tests were conducted, EAT was not applied as pretest. A sample question regarding the EAT applied to students is given below.

***Sample EAT Question***




Which of the X, Y, Z and T matters given above is the best heat conductor?

A) X
B) Y
C) Z
D) T

***Application***

In this section, information on teaching process of students who participated in the study is present. Lessons in each of three groups were carried out by the same teacher.

***Teaching by Cooperative Reading-Writing-Application technique***

Students in Reading-Writing-Application Group (RWAG) were divided into 6 cooperative groups of 5 students, according to their average pretest results of Academic Achievement Test (AAT). This technique comprises three phases.

In reading phase which is the first, each group were disseminated 4 subject posters (Atom and Molecule, Means of Heat Conduction, Collusion is Exchange of Motion and Behavior of Matters Exchanging Heat) which contained visual and written information on the subject to be addressed in the concerned week.

It was made certain that posters were suitable to the level of the students and to the curriculum and contained relevant information on the tests to be conducted. Upon collectively reading the posters, second phase of writing was initiated. In the writing phase, groups were asked to write a summary of the subject and the relevant figures.

In the third phase of efficiency and test application, students established their test apparatus and conducted their tests in groups. The study was concluded in four weeks where the same technique was applied each week.

In order to determine the level of increase in students' attainments at the end of the study, AAT posttest and to determine the attainment level of students regarding the experiments conducted during addressing the subject, EAT posttest were used.

***Teaching by Learning Together technique***

Taking into account the Academic Achievement Test (AAT) pretest average scores, students in Learning Together Group (LTG) were divided into 6 cooperative groups, two of which consisted of 6 and the remaining of 5 persons. Before the initiation of the study, an information meeting in the class was carried out to determine how the Learning Together technique was going to be applied, which steps were involved, how the evaluation would be and what was expected from participants. In the class where the Learning Together was going to take place, subject of the each week was divided between each group member and thus it was made certain that students attended the lessons sufficiently prepared. Each group member presented other group members end opened to discussion their assigned subject, relevant tests carried out, reports prepared on the subject. It was of special attention during this phase that group interaction was high and reports were presented efficiently. After completing the presenting of reports, a group was selected by lot and asked to present to the class the subject and experiments related subjects. Other groups were encouraged to pose questions to the presenting group and identified deficiencies were evaluated. Afterwards, another group selected by lot was asked to re-present to the class the same subject, taking into consideration this time the deficiencies and shortcomings identified and expressed previously. In order to determine the level of increase in students' attainments at the end of the study, AAT posttest and to determine the attainment level of students regarding the experiments conducted during addressing the subject, EAT posttest were used.

***Teaching by Control Teaching techniques***

In the group of Control Teaching Group (CTG), lessons were carried out in according to teaching techniques suggested by course books developed based on Science and Technology teaching program and approved by Ministry of Education. Subject was generally addressed by questions-answers, simple lecturing, exemplify and verify laboratory models. According to their Academic Achievement Test (AAT) pretest average scores, students in the control group were divided into 6 sub-groups which consisted of 5 people. The study was concluded in four weeks with the same methods being applied in each. In order to determine the level of increase in students' attainments at the end of the study, AAT posttest and to determine the attainment level of students regarding the experiments conducted during addressing the subject, EAT posttest were used.

**Results and Discussion**

In this part of the study, findings obtained from examining the efficiency of cooperative Reading-Writing-Application technique, Learning Together technique and according to teaching techniques suggested by course books developed based on Science and Technology teaching program and approved by Ministry of Education in teaching lessons and lesson related tests. One way ANOVA was used in order to determine whether scores obtained from AAT and EAT used in the study revealed a significant difference or not.

### *Findings obtained from Academic Achievement Test (AAT) and comments*

AAT was applied to groups in the study both as pretest and posttest. According AAT pretest findings, groups' average scores were RWAG=58.50, LTG=63.13 and CTG=61.00 respectively. Whether groups' AAT pretest scores indicated a significant difference was determined by use of one way variance analyzes (ANOVA) and results of this analyzes is given in Table 1.

**Table 1:** AAT pretest ANOVA results of groups

| | Sum of Squares | Mean of Squares | sd | F | P |
|---|---|---|---|---|---|
| Inter group | 331.467 | 165.734 | 2 | .996 | .374 |
| In-group | 14815.000 | 166.461 | 89 | | |
| Sum | 15146.467 | | 91 | | |

According to data available in Table 1, it is revealed that a significantly meaningful difference between RWAG, LTG and CTG students' AAT pretest mean scores does not exist ($F_{2,89}$=.996; p>.05) and all groups' preliminary information level on the subject were above 55%. The high level of cognitive readiness of students has positive influence on their emotional attitudes towards the study they will participate and interpersonal social relations skills. According to the result of AAT posttest which was applied to all groups at the end of the study; the scores were RWAG=85.37, LTG=82.97 and CTG=72.33 respectively. Whether groups' AAT posttest scores indicated a significant difference was determined by use of one way variance analyzes (ANOVA) and results of this analyzes is given in Table 2.

**Table 2:** AAT posttest ANOVA results of groups

| | Sum of Squares | Mean of Squares | sd | F | P |
|---|---|---|---|---|---|
| Inter group | 2902.050 | 1451.025 | 2 | 10.694 | .001 |
| In-group | 12076.602 | 135.692 | 89 | | |
| Sum | 14978.652 | | 91 | | |

According to data available in Table 2, it is revealed that a significantly meaningful difference exist ($F_{2,89}$=10.694; p<.05) between RWAG, LTG and CTG students' AAT posttest mean scores. In order to find out to which groups' favor this difference exists, Games-Howell procedure among Post-Hoc (multiple comparisons) analyzes was conducted (Table 3).

**Table 3:** AAT posttest multiple comparisons table (Games-Howell)

| (I) GROUP | (J) GROUP | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| CTG | RWAG | -13.03(*) | 3.177 | .001 | -20.76 | -5.30 |
| | LTG | -10.64(*) | 3.420 | .009 | -18.90 | -2.37 |
| RWAG | CTG | 13.03(*) | 3.177 | .001 | 5.30 | 20.76 |
| | LTG | 2.40 | 2.245 | .538 | -3.01 | 7.80 |
| LTG | CTG | 10.64(*) | 3.420 | .009 | 2.37 | 18.90 |
| | RWAG | -2.40 | 2.245 | .538 | -7.80 | 3.01 |

**The mean difference is significant at the .05 level.**

According the data in Table 3 there is not a statistically significant difference between RWAG and LTG while there is such a difference between RWAG and CTG and LTG and CTG. Although there isn't any statistically significant difference between RWAG and LTG, RWAG

is relatively successful in terms of mean scores. That indicates that RWAG is more successful compared to both LTG and CTG while LTG is more successful compared to CTG. For determining the increased level of achievement of groups in the study, paired group t-test and effect size of group scores obtained from AAT pretest and posttest were examined. Results are presented in Table 4. In order to test the effect of each independent variable on each dependent variable, eta square (η2) values which indicate the size effect were calculated. Assessments of eta square values indicate; 0.10 low, 0.24 medium and 0.31 high effects (Cohen, 1988; Leech, Barrett & Morgan, 2005).

**Table 4:** Paired group t-test analyzes and effect size values of RWAG, LTG and CTG students' AAT pretest and posttest mean scores

| Groups | Pretest | | Posttest | | *t* | p | EB(η2) |
|---|---|---|---|---|---|---|---|
| | X | SS | X | SS | | | |
| RWAG | 58.50 | 12.94 | 85.37 | 7.19 | 9.93 | .01 | .78 |
| LTG | 63.13 | 15.12 | 82.97 | 10.31 | 6.30 | .01 | .60 |
| CTG | 61.00 | 9.95 | 72.33 | 15.85 | 3.53 | .01 | .39 |

**The mean difference is significant at the .05 level.**

According to available data in Table 4, it is evident that there is a statistically significant difference between AAT pretest and posttest mean scores of RWAG ($p<.05$; EB=0.78), LTG ($p<.05$; EB=0.60) and CTG ($p<.05$; EB=0.39) in paired group t-test. These results indicate that all three groups benefited from applied teaching techniques and methods. Among these techniques and methods, however, RWAG was the group which demonstrated the highest progress by 78% while LTG demonstrated lower progress by 60% and CTG the lowest by 39%.

### *Findings from Experimental Achievement Test (EAT) and comments*

Mean scores of EAT which was applied to all three groups in the study as posttest were; RWAG=86.00, LTG=85.31 and CTG=78.83 respectively. Whether scores obtained by groups from EAT exhibited a significant difference or not was examined by one way variance analyzes (ANOVA) and results are given in Table 5.

**Table 5:** Study Groups' EAT ANOVA results

| | Sum of Squares | Mean of Squares | sd | F | P |
|---|---|---|---|---|---|
| Inter group | 945.426 | 472.713 | 2 | 3.406 | .038 |
| In-group | 12351.042 | 138.776 | 89 | | |
| Sum | 13296.467 | | 91 | | |

**The mean difference is significant at the .05 level.**

It is evident according to data given Table 5 that there is a statistically significant difference ($F_{2,89}=3.406$; $p<.05$) between RWAG students', LTG students' and CTG students' EAT mean scores. In order to determine to which group's favor this difference is, Games-Howell procedure among Post-Hoc (multiple comparisons) analyzes was conducted (Table 6).

**Table 6:** EAT posttest multiple comparisons table (Games-Howell)

| (I) GROUP | (J) GROUP | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| CTG | RWAG | -7.17 | 3.296 | .088 | -15.20 | .86 |
| | LTG | -6.48 | 3.478 | .161 | -14.90 | 1.94 |
| RWAG | CTG | 7.17 | 3.296 | .088 | -.86 | 15.20 |
| | LTG | .69 | 2.147 | .945 | -4.48 | 5.85 |
| LTG | CTG | 6.48 | 3.478 | .161 | -1.94 | 14.90 |
| | RWAG | -.69 | 2.147 | .945 | -5.85 | 4.48 |

**The mean difference is significant at the .05 level.**

While a statistically significant difference does not exist between RWAG and LTG according to available data in Table 6, there is one such difference between RWAG and CTG and LTG and CTG. Although there is not a statistically significant difference between RWAG and LTG, it can be understood that RWAG is comparably successful. This indicates that RWAG is more successful compared to both LTG and CTG and that LTG is more successful compared to CTG.

## Conclusion

This heading contains suggestions on the results of findings obtained by this study and on possible future studies relevant with the findings of the current one. In order to determine 6$^{th}$ grade science and technology lesson students' academic achievements on the subject of "matter and temperature" and attainment level of students regarding the experiments three different teaching techniques were compared. Based on the findings obtained from tests conducted before and after the study, the following conclusions were reached.

Findings from AAT pretest of study groups indicate that achievement levels of all groups are above 60%. There are no significant differences between all three groups according to AAT pretest mean scores (Table 1). High level of readiness of students in lessons and tests result in promoting the learning process, being active throughout lessons and tests, developing a sense of self responsibility towards self-learning and developing and using research tools and methods. It may be suggested that students' exhibit equal levels in AAT pretest mean scores due to taking the same lesson program in the previous period and possessing similar academic backgrounds. It was also discovered in other studies that students' preliminary information levels were similar (Aladejana & Aderigbe, 2007; Milner, 2008).

Based upon findings of study participating students' AAT posttest scores' statistical analyzes; it is revealed that there is a significant difference between whether the lesson is taught in Reading-Writing-Application technique, Learning Together Technique or according to teaching techniques suggested by course books developed based on Science and Technology teaching program and approved by Ministry of Education and the academic achievement levels of students in teaching the "matter and temperature" subject in science and technology lesson (Table 2-3). Furthermore, according to AAT posttest results, it is concluded that RWAG and LTG are more successful in the subject of "matter and temperature" compared to students receiving according to teaching techniques suggested by course books developed based on Science and Technology teaching program and approved by Ministry of Education. Although there is no statistically significant difference between RWAG and LTG, it is revealed that RWAG AAT posttest mean scores are higher compared to LTG. Reasons for

students in cooperative groups being more successful are predicted to be in-group positive dependency and development of source dependency. Additionally, teaching experiences in cooperative groups (RWAG and LTG) are instrumental in increasing cognitive academic levels of students. It may be suggested that this achievement in cooperative groups (RWAG and LTG) derives from rigidly following the principle of "for better or for worse". Results obtained in this study are in consistency with other studies conducted in the same field (Gatlin, 2009; Thurston et al., 2010).

While there is not a statistically significant difference between RWAG and LTG according to EAT posttest conducted at the end of the study, there is one such difference found between RWAG and CTG and LTG and CTG (Table 5-6). Even there is no statistically significant difference between RWAG and LTG, in terms of mean scores RWAG is found to be more successful. This indicates that RWAG is more successful compared to both LTG and CTG and that LTG is more successful compared to CTG. The reason for RWAG students being more successful compared to LTG and CTG students can be explained by the fact that cooperative techniques (Reading-Writing-Application technique and Learning Together technique) allow for a variety of applications during the process and an environment where students easily express their ideas, take active roles, share their thoughts with each other and encourage each other by mutual support. Results indicating that Reading-Writing-Application technique and Learning Together techniques are more effective in increasing academic achievements in comparison to according to teaching techniques suggested by course books developed based on Science and Technology teaching program and approved by Ministry of Education are in consistency with the results of other studies conducted in this field (Aksoy & Doymuş, 2011; Artut & Tarim, 2007; Pifarre & Kleine Staarman, 2011).

The fact that cooperative groups' (RWAG and LTG) EAT and AAT posttest mean scores are higher compared to Control Teaching Group's indicates that students who are educated with Reading-Writing-Application technique and Learning Together techniques are able to successfully increase their academic achievements and attainment level of students regarding the experiments collaterally. It was found in this study that cooperative groups' (RWAG and LTG) rate of increase in academic achievement is higher than the rate of increase in student attainments regarding tests (Table 2-3-5-6).

In line with the results of this study; it must be assumed that students are not familiar with the techniques used in cooperative groups (RWAG and LTG) and should therefore be familiarized to these techniques by training exercises. During these training exercises, activities introducing these techniques should be focused on and how application procedures and products will be evaluated should be explained.

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