

THE EFFECT OF COOPERATIVE LEARNING METHOD ON THE ACADEMIC SUCCESS OF STUDENTS ON SCIENCE TEACHING LABORATORY LESSON

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Abstract

The aim of this research is to investigate the effect of Student Teams-Achievement Divisions (STAD) technique used within the cooperative learning method on the academic achievement of the university students during the laboratory lesson. In this research, experimental research design with pre-test and post-test control groups was used. The research was conducted with a work group of 52 students from the 3rd grade of Firat University, Department of Education, Field of Science and Technology Education in Elazığ, Turkey, during Fall Semester 2014-2015. The study was designed with one study and one control group. Academic Success Test (AST) was used for data collection during the study. The pre-test and post-test scores of experimental and control groups from AST were analyzed by using t-test. According to the results of the AST pre-test and post-test for research groups, significant difference between pre-test and post-test scores of control and experimental group students was observed.

Keywords: Science Teaching, Laboratory, Cooperative Learning, Student Teams-Achievement Divisions

1. Introduction

In the information era, it is highly important that individuals could acquire skills to produce and evaluate knowledge and to use knowledge in order to identify and solve problems. The creation of the information society is possible through multilateral individuals with various skills, not through one-track mind individuals (Oğuz, 2004).

The main purpose of today's education system is to train students who could keep up with the promptly changing conditions of the world, who are capable of thinking independently, who have a developed sense of responsibility and have the ability to use the acquired skills and knowledge throughout their life (Doymuş, Şimşek and Şimşek, 2005).

The individual comes across science and technology lessons in a planned and intentional manner, for the first time in primary school years. Science lesson is of high importance since the students grasp the notion to understand and interpret the natural world, to develop the ability to discern by establishing cause and effect relationship, to enjoy science and scientists, to take them as an example. Hence, it is necessary to reliably apply the learning methods used in science education and to utilize learning methods that provide a high level of outcome with instruction materials proven effective through research. To catch up with the information and technology era is possible through training qualified individuals who could adapt the age of their own. This requires the use of different teaching methods and techniques in science education (Demiral, 2007).

Science courses are instructed at all levels from primary to higher education. Via the instruction of these courses, training individuals with science literacy is intended. Science literate individuals are individuals who feel themselves responsible in solving social problems and who are capable of individual and collaborative work with the assistance of creative and analytical thinking, besides the understanding of basic science concepts (Ministry of National Education, MNE, 2013). Science courses stand out among the most compelling courses for students of all levels from primary, middle school or high school. Once the levels of students' comprehension of science concepts are scrutinized, it is observed that students are compelled at all levels of science education due to the abstract nature of science concepts, the difference in the meaning of concepts between scientific and everyday life and the lack of foreknowledge and visualization (Aktaş and Bilgin, 2014; Bilgin, Aktaş and Çetin, 2014; Özmen, 2011).

According to Aydede (2006), a number of problems are encountered in conventional instruction. Among these, problems such as impermanency of instructed knowledge, students' learning for the exam and forgetting quickly, non or partial apprehension of the information by the students, incapability to use the acquired knowledge and skills later in life are observed. Educators have commenced to study on developing more effective, efficient and attractive instruction methods in order to overcome these problems stemming from the conventional approach.

According to the student-centered education approach, the student discovers knowledge because he/she is active at the class, asks questions, seeks answers to questions, carries out analyses and syntheses, discusses with classmates, shares, cooperates, conducts experiments individually, establishes own sentences, aims to come to a conclusion, solves own problems individually. This approach provides self confidence of students. It improves achievement, incentive, motivation, memory and permanence of the knowledge in students. While these are taking place in active learning methods, the teacher is not in a passive state, on the contrary carries an immense responsibility of guidance.

The research conducted in recent years confirmed that active learning methods increased the achievement of individuals, developed a positive attitude towards the course and are effective in

making individuals gain characteristics such as research and inquiry, scientific and critical thinking, sharing, cooperation, being open to learning all the time, solving problems (Eyvazoğlu, 2008).

Today, when the fundamental aim of science teaching is examined, it is possible to observe that the objective is not to train individuals who know everything, but to train those who are capable of reaching the relevant information to solve a problem encountered, solving problems through the analysis and synthesis of the attained information, and producing information. The special attributes of the field of science teaching caused the requirement for various teaching and learning methods due to several reasons, such as involvement of different disciplines in science teaching, instruction with different purposes to students with different levels, abilities and motivation (Alkan and Kurt, 2007).

According to Cooper and Mueck (1990), the group learning method is important for every student. Groups are made according to the students with different abilities, needs, learning styles and students continue to work within these groups. In the group, each student's positive interaction with other students and the mutual sharing of equipment, knowledge and skills is ensured. Besides, group members should contribute the group work on the subject, while being responsible for a particular aspect of the subject. One of the group learning methods is the "Cooperative Learning" method (Şimşek et al., 2005).

The main objective of today's education system is to train students who are capable of adapting the rapidly changing conditions of the world, thinking independently, and who have a developed sense of responsibility and the ability to use the acquired skills and knowledge throughout their life (Doymuş, Şimşek and Şimşek, 2005). In today's educational approach, active methods and techniques are used. One of the most effective of contemporary methods is the model of cooperative learning.

The most important advantages of cooperative learning model, which has its basic philosophy as learning together, are that the students, while performing the instructional tasks, benefit from helping each other to learn along with the uppermost advantage from positive effects of social interaction (Güvenç and Açıkgöz, 2007) and development of collaboration, problem solving and social skills (Doymuş, Şimşek and Bayrakçeken, 2004).

This study is intended to evaluate the effect of cooperative learning method, which is one of the active learning methods in science and technology teaching, on the academic achievement of the students.

2. Aim of the Study

The aim of the study is to investigate whether there is significant difference in student achievement between the laboratory activities based on cooperative learning and laboratory activities based on conventional teaching in Science Teaching Laboratory course.

3. Research Questions

1. Is there a significant difference between the pre-test scores of groups that work with the cooperative learning method and conventional teaching method?
2. Is there a significant difference between the pre-test and post-test success scores of the group that works with the conventional teaching method?
3. Is there a significant difference between the pre-test and post-test success scores of the group that works with the cooperative learning method?
4. Is there a significant difference between the post-test scores of groups that work with the cooperative learning method and conventional teaching method?

4. Methodology

4.1. Study Model

In this study, experimental research design with pre-test and post-test control groups was used. In this model the groups are formed through random assignment. Measurements are conducted on groups before and after the experiment. Presence of pre-test in the model provides the establishment of similarity levels for the groups before the experiment and helps the correction of post-test results accordingly. Yet, the significant difference between the pre-experimental measurements makes it hard to interpret the comparisons (Karasar, 2011).

4.2. Study Group

The study group participated in this research are 52 teacher candidates, attending the Science Teaching Laboratory course in the 3rd year at Firat Universtiy, Department of Education, Field of Science and Technology Education in Elazığ, Turkey, during Fall Semester 2014-2015.

4.3. Data Collection Tools

In this study, a 35 question academic success test was prepared and applied as pre-test and post-test in order to collect data.

4.3.1. Academic Success Test (AST)

An academic success test composed of 35 questions, which are based on the Science Teaching Laboratory course's topics as inertia, force of fiction, pressure and buoyancy of fluids, image on plain mirror, light refraction, series and parallel resistance, conductors and non conductors and magnetic field, with five multiple choice answers are prepared to measure the student success for this study. The content and face validity of the questions and their acceptability within principles of assessment and evaluation was controlled through expert opinion. In the academic success test prepared under the guidance of expert opinion consisted of 50 questions. The pre-application of the test was conducted on 90 students who attend the 4th year in Firat University, Faculty of Education, Department of Primary Education, Field of Science Teaching, in order to check the item difficulty and distinctiveness indices for each item. 15 items with low distinctiveness indices than .20 were eliminated from the content of the test. Hence, statistical processes were conducted on the success

test that is composed of 35 items. The difficulties for items in the content of the test vary between .17 and .62. This means that the test included both easy and difficult items. Alpha coefficient of the measurement tool was calculated with a value of .92 as a result of the application of Kuder–Richardson Formula 20 (KR-20) on the 35 remaining questions of the test. According to this result, the success test could be considered quite a reliable measurement tool.

This academic success test prepared was administered as pre-test and post-test to experiment and control groups.

4.4. Application

Academic Success Test (AST) was applied to classes which are subject to the experiment as a pre-test, hence it was determined how much behavior students possess on the subject of this research. Before the application started the technique was introduced to students in detail and in both classes the courses were held by the researcher. Later, student teams-achievement divisions, which is one of the cooperative learning techniques, were applied to experiment group in teaching the topics subject to this study for six weeks, four hours per week. Activities composed of closed ended experiments were applied to the control group for the same time period, four hours a week. After the application both groups were subjected to the post-test in order to measure the behaviors gained by the students in experiment and control groups.

4.4.1. Application of Student Teams-Achievement Divisions Technique

The classes were held according to the student teams-achievement divisions (STAD) technique of cooperative learning method. The information on the application of the STAD technique was adopted from the books by Slavin (1994) and Açıkgöz (1992).

Teams: First, heterogeneous teams were formed in the class. In forming these heterogeneous teams, the academic achievement of the students (decided according to the report card grades and teacher opinions) and their gender were taken into consideration. Each team was formed by 4 students, with an attention to include students from high, mediocre and low achievement levels. Seating plan was rearranged in order to facilitate the interaction between the students. Each team was asked to find a team name. In determining the team names, students were led to decide collectively. Explanations were made in order to make the students comprehend how they will work as a team.

Presentation: The topics to be explained during the class hours were given by the instructor, examples were solved. After the topic is learnt, worksheets were distributed to the students and they were asked to conduct the laboratory activities as team work. By distributing two activity worksheets to each group, the distraction of the students and the inclination to work individually were prevented. With worksheets composed of open ended experiments the students were led to help each other and correct each other's mistakes. The instructor guided the students when necessary walking around in the classroom, while the experiments were being conducted. The

students were informed that they might seek assistance from the instructor in cases that none of the team members have no answer to a question.

Examination: At the end of each chapter, examinations were held individually. Individual exams were composed of a few questions based on the taught topic. Cooperation among students during the examinations were strictly prohibited. In addition, each team were asked to submit a report after the activities.

Individual Progress Scores: Group scores were obtained from each score that each student got from the individual exams. In determining the individual scores, the starting scores of the students were taken into consideration. If the students' exam grades are equal or larger than 10 points than the base grade the individual achievement score was 30, if larger than the base grade by 1 to 10 points the individual achievement score was 20, if less than the base grade by 1 to 10 points the individual achievement score was 10, and if less than the base grade by 10 points the individual achievement score was 5 points (Slavin, 1994). Team points are obtained by calculating the arithmetic mean of the students' individual progress scores.

Team Reward: By evaluating the team scores best scoring team is determined every week, and small rewards and achievement certificates were given to these groups.

4.5. Analysis of the Data

Data collected during the research were analyzed computationally by using statistical analysis techniques appropriate to the characteristics of the data. For the analysis of the data arithmetic mean (\bar{X}), standard deviation (Ss) values were taken into consideration. In addition, t-test was used for testing the scores of experiment and control groups. The significance of statistical results was examined at the significance level of $p < 0.05$.

5. Findings

The AST, which was applied as pre-test and post-test, was prepared to assess the participant students' level of knowledge on the related topics and obtained t-test results are presented in Table 1, Table 2, Table 3, and Table 4.

Table 1. T-Test Analysis of the Scores Obtained from the Data of the AST Pre-Test

Groups	N	\bar{X}	Ss	d	t	P
Experiment	28	31,35	6,66	50	1,014	,315
Control	24	29,62	5,45			

As presented in Table 1, there is no significant difference between the research participant control and experimental group students' pre-test success scores ($p > 0,05$). According to this result,

it is possible to assert that in forming the experiment and control groups there was no biased act and the groups are appropriate for the study.

Table 2. T-Test Analysis of the Scores Obtained from the Data of the AST Pre-Test and Post-Test for the Control Group

Control Group	N	\bar{x}	Ss	d	t	P
Pre-Test	24	29,62	5,45			
Post-Test	24	31,45	5,10	23	-1,920	,067

No statistically significant difference is observed (Table 2), when the control group's pre-test and post-test success scores are examined ($p > 0,05$).

Table 3. T-Test Analysis of the Scores Obtained from the Data of the AST Pre-Test and Post-Test for the Experiment Group

Experiment Group	N	\bar{x}	Ss	D	t	p
Pre-Test	28	31,35	6,66			
Post-Test	28	47,64	8,67	27	-8,892	,000

The findings for the experiment group, to which the cooperative learning method was applied, demonstrated that average scores have a statistically significant difference ($p < 0,05$). This finding suggests that student teams-achievement divisions (STAD) is an effective technique in the increase of students' academic achievement at the science teaching laboratory course.

Table 4. T-Test Analysis of the Scores Obtained from the Data of the AST Post-Test

Groups	N	\bar{x}	Ss	D	t	P
Experiment	28	47,46	9,01			
Control	24	31,45	5,10	50	7,699	,000

When the post-test scores applied after the application of the technique is examined, it is observed that there is statistically significant difference between the average scores ($X_{\text{experiment}} = 47,46$; $X_{\text{control}} = 31,45$) of the control group that works with conventional method and the experiment group that works with the cooperative learning method ($p < 0,05$). This significant difference militates in favor of the experiment group.

6. Results and Discussion

In the results of this study, which investigates the effect of student teams-achievement divisions technique on the academic achievement at the science teaching class, it is possible to observe that for the application conducted in 2014-2015, student teams-achievement divisions technique ensured academic achievement. According to the analysis results of the Academic Success Test (AST), which was administered to the group the courses were given through STAD and to the group the course was given through conventional teaching method as pre-test, both groups were at the same level before the application. When the pre-test and post-test AST results of both groups are compared, it is possible to observe that the groups presented differences after the application, although they presented similar results before the application. The achievement of the control group increased after the study is completed, yet the experiment group's achievement has significantly increased in comparison to the control group. In other words, statistically significant difference that militates in favor of the experiment group is observed between the control and experiment groups. While the conventional teaching method did not increase the academic achievement of the students effectively, student teams-achievement divisions technique was proven effective on the academic achievement of the students. The essential characteristics of the cooperative learning method is influential on increasing the academic achievement. Among these characteristics for the experiment group, the students coming to the class with preparation, collection of information on the experiments, coming to the class with different resources and benefiting from these resources during the class, studying together and being responsible from each other's learning, exchanging ideas and conducting discussions during the experiments could be mentioned. Student teams-achievement divisions technique is proven more successful, since it improves active learning, sense of responsibility and social skills and increases academic achievement in comparison to the conventional teaching methods. When the literature is reviewed it is observed that supporting research exists. In Gençosman's (2011) master thesis titled "The Effect of Student Teams-Achievement Divisions Technique Used in Science and Technology Teaching on the Self-Sufficiency, Exam Anxiety, Academic Achievement and Level of Remembrance" student teams-achievement divisions technique was regarded as a more effective method in comparison to the conventional teaching method, particularly on self-sufficiency, exam anxiety, academic achievement and level of remembrance. For instance, in the study conducted by Buzludağ and Yılayaz (2012) effects of cooperative learning on the academic achievement and permanence were investigated. Experiment group was applied the cooperative learning method; control group was applied the conventional teaching method. The results of the analysis demonstrated that cooperative learning method increased the student success more than the conventional teaching method. Moreover, Orunlu (2012) compared conventional teaching and cooperative learning methods in their study based on their effect on the student success. According to the findings of the study, between the success of the students of the cooperative learning technique employed to the experiment group and the plain lecture technique employed to the control group, there was significant difference in favor of the experiment group. Ocak et al. (2015), in his study titled "The Effect of Collusive Student Teams-Achievement Divisions (STAD) Technique on the Academic Achievement and Permanence in Social Sciences Course", determined student teams-achievement

divisions technique as a more effective method. These findings are parallel to the findings of this study.

7. Suggestions

Further research might contribute to the investigation whether the STAD technique is effective on laboratory teaching of different science and technology topics. It is possible to review instructor proficiencies with respect to the effects of STAD technique on learning. It is important to provide guidance to students in accessing resources easily and using them more efficiently to render cooperative learning techniques more effective. It is possible to conduct research to compare the STAD technique to other cooperative learning techniques and their efficacy on teaching could be scrutinized. It is possible to research the effects of cooperative learning techniques on the affective and social features.

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