Eurasian Journal of Educational Research, Issue 35, Spring 2009, 1-20

The Effects of Discovery Learning on Students' Success and Inquiry Learning Skills

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Suggested Citation:

Balım, A., G. (2009). The Effects of Discovery Learning on Students' Success and Inquiry Learning Skills. *Egitim Arastirmalari-Eurasian Journal of Educational Research*, 35, 1-20.

Abstract

Problem Statement: In this study, the unit "If It Weren't for The Pressure?" in the Science and Technology course at the Elementary 7th grade was tackled in two different ways. The first way is the discovery learning method along with the daily plans and activities. The second is the traditional teaching method. This study particularly aims at answering the question: "How does teaching science through the discovery learning approach affect students' academic achievement, perception of inquiry learning skills, and retention of knowledge?"

Purpose of Study: This study aims at identifying the effects of the discovery learning method upon the students' perceptions of inquiry learning skills, academic achievements, and retention of knowledge. This research also investigates whether there is a significant difference between the experimental and control groups in learning the subjects of the unit "If It Weren't for The Pressure?" from the point of cognitive and affective learning levels.

Findings and Results: A quasi-experimental research design with a pre-test and post-test control group was used in this study. Fifty-seven seventh graders participated in this study during the spring term of the 2006-2007 academic year.

The result of the study shows that there is a significant difference in favour of the experimental group over the control group regarding the average of academic achievement, scores of retention of learning, and perception of inquiry learning skills scores, both on cognitive and affective levels.

Conclusions and Recommendations: The conclusions of the study showed that there is a significant difference in favor of the experimental group over the control group in terms of academic achievement scores, perception of inquiry learning scores, and retention of learning scores in both cognitive and affective levels. Thus, it can be stated that the experimental group

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students, who scored high in the post-achievement test, have high perception of inquiry learning skills scores. Using the discovery learning method, which is one of the various teaching methods in which the students are active and are guided by the teacher, is considered to increase students' success and inquiry learning skills more than the traditional teaching methods.
Keywords: Discovery learning method, perception of inquiry learning skills, science education, curriculum.

Teaching students with the notion of discovering, critical thinking, questioning, and problem solving skills is one of the main principles of science and technology teaching. Thus, science and technology teaching curriculum should accordingly be developed to educate science-literate students who are able to inquire and solve problems they face. Today, it is believed that methods in accordance with the constructivist approach in which the students learn more effectively by constructing their own knowledge, should be used. One of these methods is discovery learning.

The basis of science teaching is understanding that natural phenomena and the nature of science requires inquiring and discovering. Inquiry in science consists of experiments and inquiring natural phenomena by discovery learning (Bruner, 1996; Lee et al., 2004). Bruner points out that any individual has the will to learn and this will should be used in such activities that it should raise curiosity and direct students to studying and discovering knowledge. Bruner (1961) states that learning happens by discovery, which prioritizes reflection, thinking, experimenting, and exploring. People who use self discovery in learning turn out to be more self confident. Discovery is a way from the unknown to the known by the learners themselves (Bruner, 1966). The active participation of the learner in the learning process is called discovery learning (Bruner, 1968; Kara & Özgün-Koca, 2004; Kipnis, 2005). In discovery learning, students construct knowledge based on new information and data collected by them in an explorative learning environment (De Jong & Van Joolingen, 1998; Njoo, 1994).

Harlen (2004) states that inquiry learning in science develops the perception skills of students because it allows them to understand the natural phenomena and the world by using their cognitive and physical skills. It is suggested that this kind of learning shows students the nature of scientific studies and the ways learning is realized. Thus, it develops their discovery skills (National Research Council [NRC], 2004). Therefore, inquiry learning requires active participation of students in the learning process (Matson, 2006).

According to Matson (2006), inquiry and discovery based science teaching is the process of inquiring the nature and structure of the universe. Inquiry and discovery based learning requires students to take examples from daily life, to propose hypotheses, test them like scientists, and meanwhile, to gain advanced level cognitive skills (Matthews, 2002). Discovery learning is a method that encourages students to arrive at a conclusion based upon their own activities and observations. Inclusion of activities based on discovery learning in science teaching in Turkey is important for meaningful and lifelong learning. The activities in science teaching

raise the curiosity of students and drive them to inquire their priorities and perceive the natural phenomena from different aspects. Such activities help to correct the conceptual errors of students (Kaptan & Korkmaz, 2000).

Erdal and Öngel (1993), state that when learners take part in an inquiry, they get a complementary excitement and satisfaction by what they do, sense, and share, and what and how others do and sense during the discovery process. In this study, the subjects related to the unit "If It Weren't for The Pressure," and were taught through daily plans and activities that are consistent with the discovery learning method and the effects of the method upon the students' perceptions of inquiry learning skills and academic achievements.

Methods

Purpose of the Study

This study aims at identifying the effects of the discovery learning method upon the students' perception of inquiry learning skills, academic achievement, and retention of knowledge. Below are the research questions which this study also seeks answers to: The primary question of this study can be formulated as follows:

"Does discovery learning based science teaching have any effects on the students' academic achievement, perception of inquiry learning skills, and retention of knowledge?"

Below are the related research questions:

1. Is there a significant difference, in terms of academic achievement, between the experimental group, in which the discovery learning method was trialed, and the control group taught through traditional teaching methods?

2. Is there a significant difference between the experimental and control groups from the point of perception scale scores of inquiry learning skills of students?

3. Is there a significant difference between the scores of the experimental and control group students in the post-test scale of inquiry learning skills and the students' academic achievement?

4. Is there a significant difference between the total retention scores of the experimental and control groups?

5. What are the opinions of experimental group students about the preparation of concept maps and activities given to them?

Participants

In this study, a quasi-experimental design with a pre-test and post-test control and comparison groups was used. Fifty-seven seventh graders (30 boys and 27 girls) participated in this study from a public elementary school with a middle class economic profile in Izmir, the third largest city in Turkey. Twenty-eight of the students were in the experimental and 29 of them were in the control group. The studies continued for three

hours a week, during four weeks in the spring term of the 2006-2007 academic year. The study has shown that the academic achievement levels of students in science lessons in both groups were equal as given in table 3 (t=.149; p=.874>.05).

Instruments

The data in this study were collected by means of the Academic Achievement Test in Science, Perception Scale of Inquiry Learning Skills and Semi-Structured Interview Test. The Academic Achievement Test in Science Concerning the Unit "If It Weren't for the Pressure?": The Academic Achievement Test in Science consisted of multiple questions covering the subjects of the unit "If It Weren't for the Pressure?" in the 7th grade. In developing the achievement test, its validity and reliability were examined. In order to examine validity of the scale, content validity was carried out. The validity of the achievement test was confirmed in terms of its content validity. Content validity refers to the extent that the content of the items measure what is claimed to be measured (Anastasi, 1988); in this case content validity was ascertained by responses during the process of developing the instrument, from science education staff from the education faculty, and experienced science teachers from elementary school. To test the content validity of the achievement scale, the researcher selected 8 experts from the university and elementary school (six science education staff from faculty of education and two science teachers from the elementary school). The experts were asked to examine each item based on relevance, clarity, and simplicity. Then, all experts gathered in a meeting and compared their evaluations with each other. According to group evaluation, some items were discarded. The scale was reduced to 24 items in this process. Experts assessed the items of the test in accordance with the acquisitions and their cognitive areas and they were asked to rate the items as "suitable" or "unsuitable." Then, the Kappa value and agreement percentage was estimated. If agreement percentage is higher than .70, it means that there is an agreement. In addition, if the Kappa value is .0-.20, it means slight agreement: .20- .40 is fair agreement, .40-.60 is moderate agreement, .60-.80 is substantial agreement and higher than .80 means almost perfect agreement (Şencan, 2005). The analysis shows that the mean of Kappa value between experts is .49 and the significance values for all of them are .05. Besides this, the agreement percentage between experts is 0.81.

While developing the achievement test, the pilot experiment was carried out on the upper class students who had already learned the subjects of the unit "If It Weren't for The Pressure?" Initially the test was a 32-item test and it was given to 168 students in the 8th grade. After the pilot experiment, the KR-20 reliability coefficient was confirmed as 0.82.

After the item analysis, eight questions in the pilot experiment were removed as their distinguishing indexes were less than 0.30. The removed questions do not have any effect upon the test's validity of scope (Table, 2). The questions removed and their sections are as below: 4 questions from cognitive area's knowledge level, 2 questions from level of comprehension, 2 questions from the level of application. The test, which was developed after these changes, consisted of 10 knowledge, 8 comprehension and 6 practice questions. The removed questions do not have any effect upon the test's

validity of scope (Table, 1). Reliability is the consistency of a set of measurements or measuring instruments (Özgüven, 1998). The difficulty of the test varies from .322 to .628. The average difficulty of the test is .465. The highest score that can be obtained from the test is 24; the lowest is 0. Table 1 shows the difficulty levels of the test items, their correlations and discriminations. The final form of the test is a 24-item multiple questions test. The objective of using the Achievement Test is to examine the students' knowledge on the unit "If It Weren't for The Pressure?" by means of a pre-test and post-test and then find out the cognitive level differences, which may be caused by the method implemented, between the groups.

Table 1

The results of the academic achievement test related to the Unit of "If it weren't for the Pressure?"

Item No	Item Difficulties	Total-Item Correlation	Item Discrimination
2	.618	.4116	.705
3	.576	.2784	.524
5	.381	.3102	.546
6	.452	.2691	.447
8	.457	.3485	.445
9	.412	.3798	.559
11	.431	.3339	.522
12	.423	.2815	.432
13	.597	.3474	.542
15	.364	.2538	.387
17	.416	.3705	.472
18	.628	.3066	.458
19	.571	.4276	.643
20	.342	.3390	.382
21	.367	.2754	.341
22	.602	.4268	.642
23	.518	.3864	.525
24	.352	.2744	.422
25	.484	.3921	.536
26	.388	.2325	.317
27	.322	.3124	.465
29	.346	.3367	.482
30	.420	.3662	.524
32	.357	.4098	.512

Table 2

The last table of specifications for "If it weren't for the Pressure?"

Topics	Acquisitions about the unit	knowledge	understanding	application	Total questions	percentage
I apply force and create pressure	1.1 It determines the vertical force applied by the object and its area.	2, 5		18	3	**37,6**
	1.2 It defines the pressure and its unit.	9	3	21	3	
	1.3 It explains the role of the pressure on the sand or soft snow.	15	8, 11		3	
Apply pressure on a fluid and it will convey everywhere	2.1 It measures fluid pressure and clarifies its instruments.	12	6		2	**33,3**
	2.2 Pressure is conveyed by fluid.	19, 32		22	3	
	2.3 It explains the Pascal law and exemplifies it.		13	25, 26	3	
Water cannot float every object.	3.1 Any object, wholly or partly immersed in a fluid, is buoyed up by a force equal to the weight of the fluid displaced by the object .		17, 20		2	**29,1**
	3.2 It explains Archimedes' principle.	23, 24	30		3	
	3.3 It defines the floating conditions of the object immersed in a fluid.	29		27	2	
Total questions		**10**	**8**	**6**	**24**	
percentage		**41,7**	**33,3**	**25**		**100**

Perception Scale of Inquiry Learning Skills: This scale point is about the importance of inquiry learning skills in Science Teaching. The Perception Scale of Inquiry Learning Skills was developed by Taşkoyan (2007). The data analysis was made in SPSS program and it was initially a 44-item scale. The factor analysis was performed for the construct validity and the scale was collected in three sub-factors by taking the Eigen values (self-values) into consideration. The factors forming the scale were identified as "negative perception items," "positive perception items," and "perception items of inquiring the correctness." The reliability of factors concerning the scale were .73, .67, and .71. The last form of the scale consists of 22 perception items. The alpha reliability concerning the whole scale was identified as .84, and the Spearman-Brown test halfway coefficient of inner-consistency as .82.

Semi-Structured Interview Form: An interview form, concerning the activities practiced in the experimental group, was prepared for students. A semi-structured interview technique was used in this study. The researcher also asked for the opinions and suggestions of the academicians (n=3), research assistants (n=1), and teachers of Science (n=1). In order to provide the form's validity of scope, the necessary changes were made according to the suggestions and corrections of the experts. The main purpose of using the interview technique was not actually to test a hypothesis but to try to understand experiences of other people and how they give meaning to their experiences (Türnüklü, 2000).

Treatment

The dependent variables of the research are the students' academic achievements and perception of inquiry learning skills. The independent variable is the discovery learning method. The effects of the discovery learning method while studying the unit "If It Weren't for The Pressure?" were analyzed by using quasi-experimental design. The subjects were taught by discovery learning method in the experimental group and by the traditional method in the control group. In this sense, discovery learning method is an Intervention Program. The method and its content are explained below:

Two of the seventh-year classes, which were taught by the same teacher in the same school, were chosen as experiment group and control group. The research continued for four weeks, and pre-tests were administered during the first week. A week after this four-week experimental practice, the achievement test and perception scale of inquiry learning skills were administered as the post-test to both control and experiment group and then student interviews were held and the test of retention was administered 30 days after the post-test. With the help of the teacher, students were divided into heterogenic groups of four, based on their success levels. Only one group in the control group consisted of five students. Discovery learning activities concerning the unit "If It Weren't for The Pressure" were performed as group-work and all groups were made to practice the same activities at the same time. Below are some examples of activities done in the experiment group for the unit "If It Weren't for The Pressure," which are prepared for the three lesson hours:

The materials prepared were as follows: Six Open-Ended experiments and worksheets for students to study with their friends during the experiments or activities. One signboard included the subjects "I Apply Force and I Create Pressure," "Apply Pressure On The Liquid and It Will Be Transmitted Every Direction," and "Not Everything Can Float In Water." The students in the experiment group were encouraged to develop their own questions to find out what they would like to learn in the activities. Small group discussions were held to reach more than one conclusion out of one single activity. The whole class summarized the discussions and criticized the concepts discovered in the activities. The students were motivated to discuss and asked questions such as "Why do drawing pins and nails have sharp ends?," "Why can't we walk easily at the beach or on snow when we are on stilettos?", "Why is it easier to swim when we are in fins?" and so forth, thus the students kept discussing together until they found the

correct answers. The students also made various experiments and activities to define pressure and understand pressure units and the effects of pressure on our daily lives better. After the concept of "force" was reminded, the correlation of force with pressure was explained. The teacher explained that the implications of pressure were similar to those of force. Some students were given balloons to inflate, thus students learned that pressure has the capability to change the forms of objects. The role of pressure in blowing up the huge volumes of rocks while building roads or bridges was given as an example. The students were made to interconnect the concept of pressure with their daily lives. Then students were given an uncompleted map with concepts related to pressure, force, and surface related to the subject "I apply force and create pressure" and were asked to complete the map. The worksheets of each group were collected and reviewed through class discussions and the reviewed worksheets were returned to students and they were given feedback.

In the plans prepared for the control group within the research, traditional teaching methods were used. The course book was closely followed in the control group in which the teaching was carried out in a teacher-oriented direct teaching method. In the control group, the teacher wrote the concepts on the board and made explanations about the topic; the students listened to the teacher and rarely asked questions as passive participants.

Analysis of Data

In order to analyze the data obtained from control and experiment groups in this study, both groups were compared using the t-test, ANCOVA, and one-way ANOVA and then the data were organized into tables. The comparisons were made on an alpha significant level of 0,05. To determine whether there is a significant difference between the post-test academic achievement scores and post-test perception scale of inquiry learning skills scores of both groups, Pearson's Multiplication of Moments Correlation Coefficient was performed. After the semi-structured interview, the experiment was completed and six students from the control group (two low-, two middle-, and two high-success level students) were chosen. In teaching the unit "If It Weren't for The Pressure?", activities and open-ended experiments that are parallel to the discovery learning method were carried out with those students to determine the difference between the discovery learning method and concept-mapping technique which is based upon the constructivist approach, and find out the benefits of using the discovery learning method to learn scientific subjects and the opinions of students about learning subjects through this method. Students consented to their interview's being recorded by sound recorder devices.

Findings and Results

In this part of the study, the answers given by the experimental and control groups to the questions on the Academic Achievement Test in Science and Perception Scale of Inquiry Learning Skills and the data obtained from the interviews with the students were presented as tables including research questions. The first research question was; "Is there a significant difference, in terms of academic success, between the experimental group

(using discovery learning method) and the control group (using traditional method)?" The findings concerning the first research question were given in Tables 3 and 4. The average scores of the pre-achievement tests which were given to both groups in the beginning and the t-test analysis results are shown in Table 3.

Table 3

Comparison of Control and Experimental Groups' Pre-Test Achievement Scores

Group	*N*	*X*	*SD*	*t- value*	*P*	*Sig*
Experiment	28	7.07	2.58	0.149	0.874	p>.05
Control	29	7.09	2.54			

When the pre-test achievement average scores were analyzed, the experimental group's average score was 7.07; the control group's was 7.09. The analysis and average scores point out that statistically there is no significant difference between the groups. The average score comparisons of the post-test achievement tests which were given to both groups are shown in Table 4.

Table 4

Comparison of Control and Experimental Groups' Final-Achievement Test Scores

Group	*N*	*X*	*SD*	*t-value*	*P*	*Sig*
Experiment	28	14.84	3.18	9.476	0.000	p>.05
Control	29	9.95	2.37			

As shown in Table 4, the average score of the experimental group was 14.84 and control group was 9.95. In order to test whether the mathematical difference between the averages scores of both groups was also statistically significant, a t-test was performed and a significant difference was observed. According to this value, there is a significant difference between the control and experimental groups and the activities, which are prepared consistently with the discovery learning method, and have positive effects upon the success of students.

The second research question was; "Is there a significant score difference between the experimental group and control group from the point of perception scale of inquiry learning skills of students?" The findings concerning this research question are shown in Tables 5, 6, and 7. The results of the comparison of the scores of Perception Scale of Inquiry Learning Skills and the t-test are shown in Table 5.

Table 5

Comparison of Control and Experimental Groups' Scores of Pre-Test Perception Scale of Inquiry Learning Skills

Group	*N*	*X*	*SD*	*t-value*	*P*	*Sig*
Experiment	28	67.47	6.18	0.048	0.956	p>.05
Control	29	66.28	9.86			

As shown in Table 5, the pre-test Perception Scale of Inquiry Learning Skills average of the experimental group was 67.47 and control group's was 66.28. The table shows that there is no statistically significant difference between the experimental and control groups' scores in pre-test Perception Scale of Inquiry Learning Skills. After the application, the scores of Perception Scale of Inquiry Learning Skills were given again and the results from the comparison of those scores with the t-test are shown in Table 6.

Table 6

Comparison of Control and Experimental Groups' Scores of Post-test Perception Scale of Inquiry Learning Skills

Group	*N*	*X*	*SD*	*t-value*	*P*	*Sig*
Experiment	28	71.17	7.12	4.687	0.000	p>.05
Control	29	67.03	8.94			

As pointed out in Table 6, the average scores of Perception Scale of Inquiry Learning Skills of experimental group students was 71.17 after the application; the control group students' was 67.03. There is a significant positive difference for the experimental group in the scores of Perception Scale of Inquiry Learning Skills. The experimental group students displayed a more significant progress than the control

group students in the Perception Scale of Inquiry Learning Skills. In his research, Suters (2004) concludes that the discovery learning method has positive effects upon students' learning because it activates them, drives them to inquire, and affects them positively toward learning scientific concepts.

The pre-test and post-test average scores of Perception Scale of Inquiry Learning Skills of experiment group students and control group students were compared and the results are shown in Table 7.

Table 7

Comparison of Experimental Group and Control Group's Pre-Test and Post-test Scores of Perception Scale of Inquiry Learning Skills

Group	*Test*	*N*	*X*	*SD*	*t-value*	*P*	*Sig*
Experiment	Pre-Test	28	67.47	6.18	-4.335	0.000	p<.05
	Post-Test	28	71.17	7.12			
Control	Pre-Test	29	66.28	9.86	0.788	0.447	p>.05
	Post-Test	29	67.03	8.94			

It can be seen that there is a statistically significant difference between the post-test and pre-test scores of perception scale of inquiry learning skills in the experimental group. The average scores of Perception Scale of Inquiry Learning Skills have increased after the application in the experimental group. Although a similar increase has been observed in the control group also, this increase has not been found statistically significant enough. The third research question was; "Is there a significant difference between the scores of the experimental and control group students in the perception scale of post-test inquiry learning skills and their academic achievement?". The relation between the final-achievement test scores and final perception scale of inquiry learning skills scores in experimental and control groups are shown in Table 8.

Table 8

The Relation between the Post-Achievement Test Scores and Post Perception Scale of Inquiry Learning Skills Scores in Experimental and Control Groups

Groups		*R*	*P*
Experiment	Post Achievement Test Scores	0.394	0.017
	Post Perception Scale of Inquiry Learning Skills Scores		
Control	Post Achievement Test Scores	0.201	
	Post Perception Scale of Inquiry Learning Skills Scores		0.225

Table 8 points out that in the experimental group, there is a moderate, meaningful, and positive difference between the post-achievement test scores and post-test perception scale of inquiry learning skills scores (r = 0.394; p<.05). According to this table, it can be stated that the students who had high scores in the final-achievement test had positive scores in Perception of Inquiry Learning Skills as well. According to Table 8, there is a low level positive relation between the post-test scores and post-test perception scale of inquiry learning scores of the control group students (r=0.202; p>.05). This can be explained by the fact that although the control group students have increased their post-test achievement scores, their Perception Scale of Inquiry Learning Skills scores have not changed at all.

The fourth research question was; "Is there a significant difference between the total retention scores of the experiment and control group?". Table 9 gives the results of the total retention scores in the experimental group, to whom the discovery learning method, and the control group, to whom the traditional method, was applied.

Table 9

Comparison of Experimental and Control Groups' Total Retention Scores and T-Test Scorers

Group	*N*	*Post Test x*	*Retention x*	*S*	*t-value*	*p*	*Sig*
Experiment	28	15.84	15.03	3.01	9.126	0.000	p<.05
Control	29	8.95	7.87	1.98			

As shown above, the experimental group's average score of retention was 15.03, whereas the control group's was 7.87. A significant difference was found according to the results of the t-test to determine if there was a statistically significant difference in the average scores of both groups. It can be said that the difference is more significant in the experimental group than the traditional group in enabling permanent success, and also the discovery learning method has affected students' learning positively.

The fifth research question was; "What are the opinions of experimental group students (to whom Discovery Learning based Science Teaching applied) on preparing concept maps and activities given to them?". In order to seek answers to this research question, 6 students were given a semi-structured interview. Students' answers, the frequencies, and percentages are given below:

1. The students' answers as to the question "Did you like the activities based on discovery learning method?" are given below: The students in the experimental group were asked if they liked the activities based on the discovery learning method while learning the unit "If It Weren't for The Pressure?" All the students interviewed liked the activities based on the discovery learning method very much. Of the students, 70% expressed that doing the activities related to the subject was fun (%40

of them said that they liked the activities and 30 % of them said that the activities were enjoyable, nice, and easy). The students also expressed that while they were doing the activities based on the discovery learning method, they learned many things as a result of doing research, found what they were looking for right away, organized the activities easily and used plenty of materials as they liked. 30% of the students said that activities based on discovery learning method were useful.

2. The students' answers as to the question "Would you like to learn the Science lessons based on discovery learning method from now on?" are given below: The students in the experimental group were asked if they would like to learn the Science lessons based on discovery learning method from then on. All the students in the experimental group expressed that they would. 60% of the students expressed that they found this method educational and 40% expressed that they found this method fun as the reason why they preferred the discovery learning method.

3. The students' answer codes, frequencies, and percentages for the question "How did you benefit from learning the subjects by the discovery learning method in Science lessons?" are given below: The students in the experimental group were asked how they benefited from learning the subjects by the discovery learning method in Science lessons. All the students interviewed in the experiment group expressed that the discovery learning method was beneficial in Science lessons. 57% of the students expressed that they learned the subject better and remembered more easily, 14,3% of the students expressed that they learned the subject by summarizing it. 14,3% of the students expressed that they could research and find out the images and information regarding the subject by means of the concept maps. 14,3% of the students also expressed that preparing concept maps was a thought provoking activity. Various answers and comments of experimental group students as to the question "How did you benefit from learning the subjects by the discovery learning method in Science lessons?" are given below:

Buse: "I like studying discover things. We summarize and learn, thus it is easier to learn and remember."

Fırat: "… we noted down what we found out in our studies and did research and we still remember some of the subjects. We have learned very well."

Hande: "My research skills have improved…"

Deniz: **"**We found the information and images from the internet and pasted them onto our homework."

Emin: "… I have understood better... I have learned pressure, force, and surface also from the computer…"

Aras: **"**Your knowledge grows as you prepare concept maps and it drives us to think more."

In the interviews, all of the students expressed that they found the discovery learning method beneficial for learning and liked the activities which are based on it; they added that they would love science lessons to be studied with this method.

Discussion

The experimental group to whom Science Teaching which is based upon the discovery learning method was applied had higher total average scores than the control group to whom traditional teaching methods were applied in studying the unit "If It Weren't for the Pressure?". These total average scores are comprised of post-test achievement test and retention scores. This difference between the average scores, which is significant on the level of 0,05, shows that the experimental group students are more successful than the control group. After the teaching process was completed, both groups made some kind of a progress in their success levels according to the results of the achievement test; however, the experimental group proved to be more successful.

When students are taught about pressure by traditional methods in Science lessons, they have difficulty comprehending the concepts regarding the subject and correlating them to their previous learning. This conclusion is supported by the fact that experimental group students gave more correct answers than the control group students on the academic achievement test. This result obtained from this study is also confirmed by other research studies in which the discovery learning method is compared with traditional teaching methods from the point of academic achievement (Hammer, 1997; Gijlers & Jong, 2005; Ünal & Ergin, 2006; Kipnis, 2007).

While there is no significant difference in the scores of Perception of Inquiry Learning Skills of experimental and control group students according to the pre-test results, there is a significant positive difference for the experimental group in the scores of final Inquiry Learning Skills. This significant difference here points out that the discovery learning method, which is based upon the constructivist approach, has a positive effect on the Perception of Inquiry Learning Skills. It has been found out that students who are taught Science lessons in a group-work along with activities and experiments have more positive Perception of Inquiry Learning Skills than those of the students who are taught Science lessons with traditional methods. This result supports the result obtained from Tatar and Kuru's research (2006), on the unit "Let's Get To Know and Protect Our Blue Planet, The Common Home For All Living Beings" with seventh-year students. Tatar and Kuru's research shows that Inquiry Based Learning improves student success much more than traditional methods. Keys and Bryan (2001) correlated the inquiry with the discovery and development of the scientific process skills and stated that the discovery method based on inquiry was effective for learners in correlating the various concepts.

When the correlation between the post-achievement test scores and the post-test Perception of Inquiry Learning Skills scores within the experiment and control groups is examined, it is concluded that a positive and significant correlation exists between the academic achievement of the experimental group and their Perception of Inquiry Learning Skills scores. Thus, it can be stated that the experimental group students, who scored well in the post-test achievement test, have high Perception of Inquiry Learning Skills scores as well. A positive correlation of a low level is observed between the post-test achievement test scores and the post-test Perception of Inquiry Learning Skills scores of the control group. Six students were interviewed

on the discovery learning method based Science teaching and activities done in the lessons. The results obtained from their opinions can be stated as follows:

1. When the students' answers as to the question "Did you like the activities based on discovery learning method?" were analyzed, it was found that all students liked doing the activities based upon discovery learning method very much. It can be said that students found the discovery learning method more enjoyable and beneficial because it allowed them to organize the activities and use different materials and techniques.

2. When the students' answers as to the question "Would you like to learn the Science lessons based on discovery learning method from now on?" were analyzed, it was found that all of the students said that they would. Most of the students added that they found the discovery learning method educational, and some of them said it was enjoyable.

3. When the students' answers as to the question "How did you benefit from learning the subjects by discovery learning method in Science lessons?" were analyzed, it was found that all of the students agreed the discovery learning method in Science lessons was beneficial. While most of the students expressed that they learned the subjects better and remembered more easily, a small number of students expressed that they learned the subjects by summarizing conducting research, and found images and information regarding the subjects with the help of concept maps.

Data from the interviews with students in the experimental group revealed that learners found discovery learning educational, entertaining, and useful. Positive feedback from the interviews seems to have resulted in a meaningful difference in the posttest scores of the students in the experiment and the control group, and that the discovery learning method had positive effects on student success. Furthermore, comparison of the perception of inquiry learning skills posttest scores of the students in the experimental and the control group revealed a significant difference between them. When the qualitative and quantitative data collected in the study were compared, the results indicated that the methods used had a positive effect on student success and the perception of inquiry learning skills.

It can also be stated that when compared with traditional teaching methods, using the activities that are based on teaching and inquiring through the discovery learning method in teaching the unit "If It Weren't For The Pressure?" to seventh-year elementary students enhances the students' success and perception of inquiry learning skills. In their study, Ünal and Engin (2006) have also reached the conclusion that activities structured through the discovery learning method along with the constructivist learning approach are more effective on the success of students in Science in the subject "Pressure of The Liquids and Gases". In science courses, it is considered that the activities, which are based on inquiry within the discovery learning method, can be used with the purpose of drawing the attention of the students and activating them to participate more in the classes, and it is also useful to organize In-Service Trainings and courses for the teachers to have them comprehend the importance of the activities based on this approach.

The discovery learning method necessitates the students' commenting on the concepts, information, and incidents by discussing and asking questions and reaching the information themselves, in other words, discovering and finding the solution through practice. That is why the students should participate in the class activities in groups and use the science labs more actively. Using the discovery learning method, which is one of the various teaching methods in which the students are active and the teacher guides them, is believed to increase the students' success and inquiry learning skills more than traditional teaching methods do.

References

Anastasi, A. (1988). *Psychological testing*. New York: Macmillan.

Bruner, J. S. (1961). The act of discovery. Harvard Educational Review, 31, 21–32.

Bruner, J. S. (1966). Some elements of discovery. In Shulman L. S., Keislar, E. R. (Ed.),

Learning by discovery: A critical appraisal. Chicago: Rand McNally, pp. 104-111.

Bruner, J. S. (1968). *Toward a theory of instruction.* New York: W.W. Norton and Company.

De Jong, T., & Van Joolingen, W. R. (1998). Discovery learning with computer simulations of conceptual domains. Review of Educational Research, 68, 179–201.

Gijlers, H., de Jong, T. (2005). The relation between prior knowledge and students' collaborative discovery learning processes. *Journal of Research in Science Teaching, 42*, 264-282.

Hammer, D. (1997). Discovery learning and discovery teaching. *Cognition and Instruction*, 15(4), 485-529.

Kaptan, F., & Korkmaz, H. (2000). Yapisalcilik (constructivism) kurami ve fen ögretimi, *Çagdas Egitim Dergisi, 265,* 22-27.

Kara, Y. & Ozgün-Koca, S. A. (2004). The application of discovery learning and meaningful learning approaches in mathematics classes: Two lesson plans on "the square of addition of two terms". *Ilkogretim Online, 3*(1), 2-10

Keys, C. W. & Bryan, L. A. (2001). Co-constructing inquiry-based science with teachers: Essential research for lasting reform. *Journal of Research in Science Teaching,* 38, 631-645

Kipnis, N. (2005). 'Chance in science: The discovery of electromagnetism by H.C. Oesrsted', *Science & Education,* 14, 1-28.

Kipnis, N. (2007). Discovery in science and in science education, *Science & Education,* 16, 883-920.

Lee, O., Hart, J. E., Cuevas, P. & Enders, C. (2004). Professional development in inquiry-based science for elementary teachers of diverse student groups, *Journal of Research in Science Teaching,* 41(10), 1021-1043.

Matson, J. O. (2006). Misconceptions about the nature of science, inquiry-based instruction, and constructivism: Creating confusion in the science classroom, *Electronic Journal of Literacy through Science,* 5(6), 1-10.

Matthews, M. R. (2002). Constructivism and science education: A further appraisal, *Journal of Science and Technology,* 11(2), 121-134.

National Research Council ([NRC], 2004). *National science education standards*, Washington, DC: National Academy Press.

Njoo, M. K. H. (1994). *Exploratory learning with a computer simulation: Learning processes and instructional support.* Eindhoven: Technische Universiteit Eindhoven.

Özgüven, İ. E. (1998). *Psikolojik Testler.* Ankara: Pdrem Yayınları.

Suters, A. L. (2004). *An exploratory study of the impact of an inquiry-based professional development course on the beliefs and instructional practices of urban in-service teachers.* The Annual Meeting of the National Association for Research in Science Teaching. The University of Tennessee, Knoxville

Şencan, H. (2005). *Sosyal ve davranışsal ölçümlerde güvenilirlik ve geçerlilik*. Ankara: Seçkin Yayıncılık.

Taşkoyan, N. S. (2007). Fen ve teknoloji ogretiminde sorgulayici ogrenme stratejilerinin ogrencilerin sorgulayici oğrenme becerileri, akademik başarilari ve tutumlari uzerindeki etkisi **(**Unpublished Mastering Thesis). Dokuz Eylul University, Institute of Educational Sciences, Izmir.

Tatar, N. & Kuru, M. (2006). The effect of inquiry-based learning approach in science education on academic achievement, *Hacettepe University Journal of Education,* 31, 147-158

Turnuklu, A. (2000). Egitimbilim araştirmalarinda etkin olarak kullanilabilecek nitel bir araştirma tekniği: Gorusme. *Kuram ve Uygulamada Egitim Yonetimi,* 6 (24), 543-559.

Tuzun, H. (2006). Egitsel bilgisayar oyunlari ve bir ornek: Quest Atlantis**.** *Hacettepe University Journal of Education,* 30, 220-229.

Unal, G. & Ergin, Ö. (2006). Bulus yoluyla fen ögretiminin ögrencilerin akademik başarilarina, ögrenme yaklaşimlarina ve tutumlarina etkisi, *Journal of Turkish Science Education,* 3(1), 36-52.

Buluş Yoluyla Öğrenmenin Öğrencilerin Başarıları ve Sorgulayıcı Öğrenme Becerileri Üzerindeki Etkisi

(Özet)

Problem Durumu: Bilim ve teknoloji alanında nitelikli bireyler yetiştirmeyi sağlamadaki en önemli araçlardan biri, doğru kullanılan farklı öğretim yöntem ve teknikleridir. Öğrencilerin keşfeden, eleştirel düşünen, sorgulayan ve problem çözme becerileri gelişmiş bireyler olarak yetişmeleri, Fen ve teknoloji öğretiminin temel ilkeleri arasında yer almaktadır. Bu nedenle Türkiye'de de Fen Öğretim Programı da karşılaştığı problemleri sorgulayan ve çözebilen, Fen okuryazarı bireyler yetiştirmeyi amaçlayan programlar olarak geliştirilmelidir. Günümüzde de bireylerin kendi bilgilerini kendilerinin oluşturarak daha iyi öğrendikleri yapılandırmacı öğrenme yaklaşımına uygun yöntemlerin kullanılması gerektiği düşünülmektedir. Bu yöntemlerden biri de buluş yoluyla öğrenmedir.

Çalışmada, ilköğretim 7. sınıflardaki öğrencilerin Fen derslerinde "Ya Basınç Olmasaydı?" ünitesine ait konuların Buluş yoluyla öğrenme yöntemine dayalı fen öğretiminde günlük plan ve etkinliklerle, geleneksel öğretime göre öğrencilerin akademik başarılarına, sorgulayıcı öğrenme becerileri algılarına ve kalıcılığa etkisi belirlenmeye çalışılmıştır.

Araştırmanın Amacı: Buluş yoluyla öğrenme yöntemine dayalı etkileşimli bir öğrenme ortamı sağlayarak; Türkiye'deki Fen öğretim programına uygun ve yapılandırmacı yaklaşımı temel alan sorgulayıcı öğrenme becerilerini geliştirmeye yönelik olarak hazırlanmış, öğrencilerin pasif durumdan aktif duruma geçmelerini sağlayacak etkinliklerin öğrencilerin öğrenme düzeylerine etkisini araştırarak, geleneksel öğretim yöntemiyle ders sunulan grubun öğrenme düzeyiyle karşılaştırmaktır.

Araştırmanın Yöntemi: Araştırmada ön test-son test kontrol gruplu yarı deneysel desen kullanılmıştır. Bu araştırmanın problemi, "Buluş Yoluyla Öğrenme Yöntemine Dayalı Fen öğretiminin, öğrencilerin akademik başarıları, sorgulayıcı öğrenme becerileri algıları ve bilgilerin kalıcılığı üzerinde etkisi var mıdır?" şeklinde ifade edilebilir. Araştırma grubunu, Türkiye'nin büyük bir şehri olan İzmir ilindeki orta düzeyde bir gelir dağılımı olan resmi bir ilköğretim okulu'nda 7. sınıflarında okuyan 28'i deney, 29'u kontrol grubu olmak üzere toplam 57 (30 Erkek-27 Kız) öğrenciyle çalışılarak gerçekleştirilmiştir. Öğretim 2006-2007 öğretim yılının ikinci döneminde, dört haftalık bir sürede haftada üç ders saati olmak üzere toplam 12 ders saati olarak gerçekleştirilmiştir. Öğrencilere öğretimden önce ve sonra sorgulayıcı öğrenme becerileri algı ölçeği ile "Ya Basınç Olmasaydı" ünitesine ait Akademik başarı testi uygulanmıştır. Her

iki grupta da buluş yoluyla öğrenme yöntemi konusunda deneyimli aynı fen öğretmeni ile öğretim yapılmıştır.

Araştırmanın Bulguları: Deney ve kontrol gruplarındaki öğrencilerin uygulama öncesindeki akademik başarı düzeyleri ve sorgulayıcı öğrenme becerileri algıları, uygulamadan sonra artmıştır. Fakat, ön test akademik başarıları ve sorgulayıcı öğrenme becerileri algılarında anlamlı bir farklılık olmayan iki gruptan deney grubunun, kontrol grubuna göre son testte daha başarılı olduğu ve sorgulayıcı öğrenme becerileri algılarında bir artış gözlendiği belirlenmiştir. Deney grubu öğrencilerinin son test başarı puanları ile son test sorgulayıcı öğrenme becerileri algısı ölçeği puanları arasında orta düzeyde, pozitif ve anlamlı bir ilişki olduğu görülmektedir ($r=0,394$; $p<0,05$). Buna göre, son başarı testinden yüksek puan alan öğrencilerin sorgulayıcı öğrenme becerileri algılarının da olumlu olduğu söylenebilir. Kontrol grubu öğrencilerinin son test başarı puanları ile son test sorgulayıcı öğrenme becerileri algısı ölçeği puanları arasında düşük düzeyde, pozitif bir ilişki vardır ($r=0,201$; $p>0,05$). Bu durum, kontrol grubundaki öğrencilerin son test başarı puanları artmış olsa bile, sorgulayıcı öğrenme becerileri algısı ölçeği puanlarının fazla değişmemesi şeklinde açıklanabilir. Deney ve kontrol grubundaki başarıların kalıcılığını sağlamada, deney grubunda geleneksel gruba göre farkın anlamlı olduğu ve buluş yoluyla öğrenme yöntemiyle yapılan uygulamaların öğrenciler üzerinde olumlu değişiklikler yarattığı söylenebilir. Öğrencilerin tümü yapılan görüşmelerde buluş yoluyla öğrenme yöntemine dayalı uygulamaları sevdiklerini, bundan sonra yapılacak olan fen derslerinin bu yönteme dayalı olarak yapılmasını istediklerini ve derslerde bu yöntemin öğrenmeye faydası olduğunu ifade etmişlerdir.

Araştırmanın Sonuçları ve Önerileri: Deney ve kontrol gruplarının her ikisinde de başarı testi sonuçlarına göre öğretim sonrasında başarı düzeylerinde bir yükselme saptanmıştır. Fakat başarı düzeyindeki bu artış, deney grubunda daha fazladır. Deney ve kontrol gruplarındaki öğrencilerin ön test sonuçlarına göre Sorgulayıcı Öğrenme Becerileri Algısı puanlarında anlamlı herhangi bir farklılık görülmezken, son Sorgulayıcı Öğrenme Becerileri Algısı puanları arasında deney grubu lehine anlamlı bir farklılık vardır. Deney ve kontrol gruplarının son Sorgulayıcı Öğrenme Becerileri Algısı puanları arasında anlamlı bir farkın olması, yapılandırmacı yaklaşıma dayalı buluş yoluyla öğrenme yönteminin Sorgulayıcı Öğrenme Becerileri Algılarını olumlu yönde etkilediğini göstermektedir. Fen derslerini, grup çalışmaları şeklinde etkinlikler ve deneyler yaparak işleyen öğrencilerin Sorgulayıcı Öğrenme Becerileri Algılarının, geleneksel öğretimle ders yapılan öğrencilere göre daha olumlu olduğu belirlenmiştir. Buluş yoluyla öğrenme yöntemine göre öğrenciler kendi bilgilerini kendileri keşfettiklerinden, bilgiyi geleneksel öğretim yöntemleri ile doğrudan aktarmak yerine, öğrencilerin aktif oldukları, grup halinde çalıştıkları, kavram ve bilgileri sorgulayarak

kendilerinin keşfetmelerini sağlayan; yaparak, yaşayarak ve düşünerek öğrenmelerini gerçekleştirebilecekleri öğrenme ortamları oluşturulmalıdır. Buluş yoluyla öğrenmeye dayalı uygulamaların daha verimli olması için öğrencilerin gruplar halinde sınıf içi etkinliklere katılmalarını ve fen laboratuarını aktif olarak kullanmalarını gerektirmektedir. Fen derslerinde, pahalı ve bulunması zor olan araç-gereçler yerine basit ve ucuz araç-gereçler kullanılarak çeşitli etkinlikler yapılabilir. Derslerde geleneksel öğretim yöntemleri yerine öğrencilerin aktif oldukları, öğretmenin ise onlara rehberlik ettiği çeşitli öğretim yöntemlerinden biri olan buluş yoluyla öğrenmenin kullanılmasının öğrenci başarısını, sorgulayıcı öğrenme becerilerini arttıracağı ve öğrenmede kalıcılığa etkisi olacağı düşünülmektedir.

Anahtar Sözcükler: Buluş yoluyla öğrenme yöntemi, sorgulayıcı öğrenme becerileri algısı, fen öğretimi, öğretim programı