Proje Tabanlı Öğrenmenin Beşinci Sınıf Fen Bilgisi Dersinde Öğrenme Ürünlerine Etkisi

Mehmet Gültekin[*]

ÖZ. Proje tabanlı öğrenme, öğrencilerin somut ürünler ortaya koymak amacıyla tek başlarına ya da küçük gruplar halinde çalışmaları temeline dayanan bir yaklaşımdır. Bu araştırmada, ilköğretim beşinci sınıf fen bilgisi dersinde proje tabanlı öğrenmenin öğrenme ürünlerine etkisi incelenmiştir. Öntest-sontest kontrol gruplu deneysel araştırma modeliyle gerçekleştirilen araştırmada, proje tabanlı öğrenmenin öğrenci başarısı üzerindeki etkisine bakılmıştır. Ayrıca, araştırmaya katılan öğrenciler ve sınıf öğretmeninin proje tabanlı öğrenmeye ilişkin görüşlerini almak amacıyla yarı yapılandırılmış görüşme yapılmıştır. Araştırma sonucunda ilköğretim beşinci sınıf fen bilgisi dersinde proje tabanlı öğrenme yaklaşımının uygulandığı deney grubundaki öğrencilerin akademik başarıları ile proje tabanlı öğrenme yaklaşımının uygulanmadığı kontrol grubundaki öğrencilerin akademik başarıları arasında deney grubu lehine anlamlı fark bulunmuştur. Ayrıca, araştırmaya katılan deney grubu öğrencileri ve sınıf öğretmeni, proje tabanlı öğrenmenin, öğrenci başarısını artırdığını öğrenmeyi zevkli, eğlenceli ve anlamlı kıldığını, öğrencilere çok çeşitli beceriler kazandırdığını ve az da olsa sorunlar yaşandığını belirtmişlerdir.

Key words: Proje tabanlı öğrenme, Fen bilgisi, İlköğretim

ÖZET

Amaç ve Önem: Proje tabanlı öğrenme, öğrencilerin bilgiyi almak yerine bilgiyi yapılandırdıkları ve hatta bilgiyi ürüne dönüştürdükleri bir yaklaşımdır. İlköğretimde, öğrenme etkinliklerinin gerçekleştirilmesinde ideal bir yaklaşım olan proje tabanlı öğrenme, öğrencinin bağımsızlığını desteklemekte, farklı yeteneklere sahip öğrencilere farklı yardımlar sağlamakta, programda esnek yaklaşım ve etkinliklere izin vermekte ve diğer öğretim yaklaşımları ile birlikte kullanılabilmektedir. Yeterli düzeyde veri olmamasına karşın, çalışılmış kimi modellerden elde edilen kanıtlar, proje tabanlı öğrenmenin etkisinin olumlu olduğunu göstermektedir Proje tabanlı öğrenme, öğrencilerin öğrenmeye etkin olarak katılmasını sağlayarak ve işbirliği içinde bir şeyler üretmelerine olanak vererek, Fen Bilgisi dersinin daha etkili, verimli ve üretici olmasını sağlayabilir. Bu araştırma, Fen Bilgisi dersinde proje tabanlı öğrenmenin öğrenme ürünlerine etkisinin ne olduğunun belirlenmesi amacıyla gerçekleştirilmiştir.

Yöntem: Öntest-sontest kontrol gruplu deneysel araştırma modeliyle gerçekleştirilen araştırmada, proje tabanlı öğrenmenin öğrenci başarısı üzerindeki etkisine bakılmıştır. Ayrıca, araştırmaya katılan öğrenciler ve sınıf öğretmeninin proje tabanlı öğrenmeye ilişkin görüşlerini almak amacıyla da yarı yapılandırılmış görüşme yapılmıştır. Araştırmada veri toplama araçları olarak ünite başarı testi, görüşme formu ve ünite ve proje tabanlı öğrenme yaklaşımını tanıtmaya yönelik olarak hazırlanan öğretim materyalleri kullanılmıştır.

Bulgular: İlköğretim beşinci sınıf Fen Bilgisi dersinde, proje tabanlı öğrenmenin öğrenme ürünlerine etkisini belirlemeyi amaçlayan bu araştırmadan elde edilen bulgular, proje tabanlı öğrenmenin Fen Bilgisi dersinde akademik başarı başta olmak üzere öğrenme ürünleri üzerinde etkili olduğunu göstermiştir. Fen Bilgisi dersinde proje tabanlı öğrenmenin öğrenme ürünlerine etkisine ilişkin ortaya çıkan bulgular şöyle özetlenebilir:

- *Proje tabanlı öğrenme öğrenci başarısını artırmaktadır*: Gerek deneysel olarak ortaya konan araştırma bulgusu, gerek öğrencilerin ve gerekse sınıf öğretmeninin görüşleri, proje tabanlı öğrenmenin akademik başarıyı artırdığını ortaya koymaktadır.
- *Proje tabanlı öğrenme, öğrenmeyi zevkli, eğlenceli ve anlamlı kılmaktadır*: Araştırma bulgularına göre, gerek öğrenciler ve gerek sınıf öğretmeni, proje tabanlı öğrenmenin en çok öğrenmeyi zevkli

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ve eğlenceli kıldığını ve öğrenmeyi anlamlı hale getirdiğini vurgulamaktadırlar. Öğrenmenin zevkli, eğlenceli ve anlamlı kılınması öğrencileri motive etmektedir. Bu nedenle, proje tabanlı öğrenmenin öğrencilerde ilgi ve istek yarattığı ve dolayısıyla öğrencileri motive ettiği ortaya çıkmaktadır.

- *Proje tabanlı öğrenme değişik yararlar sağlamaktadır*: Araştırmadan elde edilen bulgular, proje tabanlı öğrenmenin en önemli yararının başarıyı artırmak olduğunu göstermiştir. Başarının yanında, işbirliği ve dayanışmayı artırmak, zengin öğrenme deneyimi sağlamak, araştırarak öğrenmeyi sağlamak, öğrenmeyi kolaylaştırmak, kendine güven duygusu geliştirmek, öğrenmede sorumluluk almayı sağlamak ve yaparak yaşayarak öğrenmeye olanak sağlamak proje tabanlı öğrenmenin sağladığı diğer önemli yararlar arasındadır.
- *Proje tabanlı öğrenme öğrencilere çeşitli beceriler kazandırmaktadır*: Araştırma bulguları, proje tabanlı öğrenmenin öğrencilerde el becerisi, araştırma becerisi, drama becerisi, deney yapma becerisi, bir ürün geliştirme becerisi, yazma ve çizme becerisi, bilgisayar kullanma becerisi, düşünme becerisi, işbirliği yapma becerisi ve sunuş yapma becerisi gibi çok çeşitli beceriler kazandırdığını göstermektedir.
- *Proje tabanlı öğrenme sürecinde az da olsa sorunlar da yaşanmaktadır*: Araştırma bulguları, çok fazla olmasa da bilgiye ulaşma, grup üyeleriyle iletişim kurma ve ürün geliştirmede zorlukların olduğunu; sürecin başlangıcında yönteme alışamama ve konuları anlayamama sorunlarının da yaşandığını göstermektedir.

Tartışma ve Sonuç: Bu araştırmanın en açık sonucu, proje tabanlı öğrenmenin akademik başarıyı artırması, öğrenmeyi zevkli, eğlenceli ve anlamlı kılması ve öğrencilerde kimi beceriler geliştirmesidir. Bir başka deyişle, proje tabanlı öğrenme, öğrenmeyi zevkli, eğlenceli ve anlamlı kılarak öğrencileri öğrenmeyle meşgul etmekte, öğrenmeyle meşgul olan öğrenciler motive olmakta ve motive olan öğrenciler de başarılı olmaktadırlar. Araştırmanın proje tabanlı öğrenmenin öğrenci başarısını artırdığı ve öğrenmeyi zevkli, eğlenceli ve anlamlı kıldığına yönelik bulguları, yurtiçinde ve yurt dışında gerçekleştirilen araştırma bulgularıyla örtüşmektedir. Sonuç olarak, proje tabanlı öğrenme, geleneksel öğretime göre öğrenciye zengin öğrenme yaşantıları sağlayarak öğrencileri öğrenme sürecinde mutlu etmektedir.

The Effect of Project Based Learning on Learning Outcomes in the Fifth-Grade Science Education

Mehmet Gültekin[*]

ABSTRACT. Project-based learning is an approach based on the work that students produce either on their own or in small groups for the purpose of creating tangible products. In this research, the effects of project-based learning upon learning outcomes in the fifth grade science lesson were investigated. The research was carried out using the experimental research model with pretest-posttest control groups, and the effects of project-based learning on the student's achievement were observed. In addition, a semi- structured interview was held made to learn the opinions of students and classroom teachers involved in the study. The results revealed a significant correlation between academic achievements and project-based learning: the experimental group which underwent project-based learning outperformed the control group which did not receive such treatment. Moreover, students of the experimental group and the classroom teachers involved in the study indicated that project-based learning increased the achievement of students by providing them with various skills and making learning more enjoyable, entertaining, and meaningful. However, a few problems were also reported.

Key words: Project-based learning, Science teaching, Primary education

INTRODUCTION

Primary education is a basic step of education that provides the child with the qualities he/she will need all his/her adult life. The qualities required for a child in primary education are acquired with the programs carried out on this step. There are various lessons intended to fulfil the objectives of primary education. Among them, science lessons, also called as core lessons, have an important place.

Science education helps students acquire the knowledge and skills that will be useful for a lifetime; improves their quality of life by enabling them to learn critical thinking, problem solving, and decision making; urges them to take responsibilities in activities by encouraging environmental awareness and sensibility; guides them to participate in a universal society shaped by citizens having science literacy (Krajcik et al, 1999). Therefore, everybody should be enabled to get science education especially if it is assumed that every individual is a candidate to hold a position of social authority and responsibility (Yaşar & Selvi, 1999).

It is not possible for children of primary education, who need special requirements in terms of development, to have effective and efficient education in classes where general education is given with traditional teaching methods. Teachers, however, can meet the needs of these students by making use of the individualized teaching methods. One of the individualized teaching approaches that can be used in primary education is project-based learning (Rose, 1999).

On Which Theoretical Bases Does The Project-Based Learning Stand?

Project-based learning has a long historical background (Grant, 2002). It was first discussed in W. Kilpatrick's article "The Project Method", published in 1918 (Wrigley, 1998). After John Dewey's "problem solving" method began to resemble the traditional teaching method, W. Kilpatrick began to spread "The Project Method" (Oğuzkan, 1989). That is why the project-based learning can be said to have emerged as a synthesis of John Dewey's and Kilpatrick's views on learning.

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The modern approach to project-based learning is based on Dewey's discussion which argues that "scientific and technical knowledge emerges from the need to meet the difficulties of life". Dewey emphasized that projects should be designed in such a way that will not only urge students to collect information but also urge them to use experimental methods of observation and proof (Ferreti & Okolo, 1996).

In 1900's John Dewey's thought of supporting "learning by doing" found its reflection in constructivism (Grant, 2002). Therefore the program, as well as the teaching and evaluation design in project-based learning is designed in the basis of costructivist theory which emphasizes that students build the new information upon the previous. The project-based learning which requires the individualization of teaching and evaluation is student centered (Moursund, 1998).

Two significant developments in the last 25 years have had an effect on the emergence of project-based learning. The first development is that the researches on the fields of neuro-science and psychology have expanded the cognitive and behavioral models of learning. Today, it is accepted that learning is a social activity and grows from previous experiences under social and cultural conditions. The second development is the changing of the world. Almost all teachers have come to terms with the fact that in the 19th and 20th centuries the industrial culture shaped the organization and administration of schools and that the schools should be adapted to the new century. To that effect, the need for the education to adjust to the changing world has been the cause that has made project-based learning popular (BIE, 2002).

What is Project-Based Learning?

Project-based learning has been defined in many ways. For this reason there exists no single definition. In the given definitions, project-based learning has been referred to as a "model", "approach" or a "technique", or as "learning" or "teaching". It appears that no common agreement has been reached yet. In this study, project-based learning has been considered as an "approach".

Project-based learning is a comprehensive approach designed to engage students in the investigation of authentic problems and it is based on teaching and learning within the class environment (Blumenfeld et al, 1991). It is an individual or group activity that lasts for a particular period of time, which results in a product, a demonstration or a performance (Moursund, 2001).

Considering these definitions, project-based learning can be defined as a learning approach based on students' working for a period of time in order to intensively investigate the real world issues or problems in an interdisciplinary approach so as to produce something concrete through individual efforts or pair-work. Judging from these definitions, project-based learning can be said to consist of four basic elements; *extented time frame, collaboration, an investigation or research and a task-based performance or a demonstration*. Characteristics of project based learning may be explained too:

- Projects need *extended time frame* varying between a few lessons to a whole year of education (Moursund, Bielfeldt & Underwood, 1997). A good project is not an activity of a single move; it requires a long time. It may last for days, weeks or even months. Projects require working in *collaboration* to achieve a goal. Students can work in teams made up of two or more members (Simkins, 1999).
- Projects deal with *real-world problems* that arouse interest in students (Curtis, 2002). Students interact with the real world through such projects (Simkins, 1999). Generally, projects require an important question and problem that directs the activities, and the activities result in an artifact or product (Peterson & Myer, 1995; Blumenfeld et al, 1991).
- Projects include the improvement of a *product, a presentation or a performance* that can be observed and utilized by others. The product can be a artifact or a demonstration (Moursand, 1999a). Projects lead to the development of the products/works which are manifested as the solutions of the problems posited. They also represent what the students have understood about their particular field of study, thereby allowing them to surface the reflections of their friends (Ferretti & Okolo, 1996).
- Project-based learning is different from traditional teaching methods. One of the basic features of project-based learning is that it is *student-oriented*. In project-based learning, the student defines the problems, discusses the views, prediction, collects data information, shows data in graphs, makes conclusions, combines views and creates a product (Blumenfeld et al, 1991).

- Projects usually incorporate *many disciplines*. Students benefit from many field of science in their project work (Moursund, Bielfeldt and Underwood, 1997). They make interdisciplinary connections between various ideas (Curtis, 2002).
- Projects focus on *diriving questions, or problems*. An authentic question or problem provides a framework in arranging concepts and principles (Thomas, 2000; Ferretti and Okolo, 1996). A real world question or a problem prompts and directs the activities (Ladewski et al, 1994). A good question or a problem should be feasible, whorthwhile, contextualized and meaningful (Krajcik et al, 1994).
- Projects require the use of *multimedia*. In order to do demonstrations and improve their capacity of analytical thinking, students use authentic tools and technologies (Curtis, 2002; Simkins, 1999; Ferretti *&* Okolo, 1996).

What are the Advantages and Limitations of Project-based Learning?

There are a lot of advantages of project-based learning with regard to both learners and teachers. These advantages may be explained under the followig headings:

It increases the motivation. Project-based learning arouses interest and desire in students (Solomon, 2003; Victor *&* Kellough, 1997). They become motivated in order to learn the important concepts in an important question or a problem case (Blumenfeld et al., 1991). Students put more effort and spend more time for the project and they also start participating in the classroom activities much more. Within the process of project-based learning, teachers state that the ratio of students attending school has increased and the number of late-arriving students has decreased. Students, also, state that the projects are more enjoyable and more attractive compared to other activities of the curriculum (Moursund, Bielfeldt *&* Underwood, 1997).

- *It develops knowledge and skills.* Project-based learning focuses on high level skills including problem solving, being an independent researcher, setting one's own aims and evaluating oneself (Moursund, 1999a). Project-based learning develops both speaking and leadership skills as well as research and collaboration skills (Holst, 2003).
- *It increases cooperation.* In project-based learning students make more cooperation with each other, carrying out less independent studies. Teachers guide more and lecture less. (Carr *&* Jitendra, 2000). In the process of project-based learning, students establish a versatile communication and they comprehend that they are responsible for their own learning. They learn how to work and produce as a team (Preuss, 2002).
- *It provides the implementation of an interdisciplinary study.* Project-based learning requires the use of an interdisciplinary approach in solving problems and understanding subjects thoroughly (Solomon, 2003). Thus, it provides opportunities for interdisciplinary learning (CTCs, 2003). Students establish relationships between the fields of mathematics, social sciences, literature and science in order to get answers to open-ended questions (Curtis, 2002).
- *It leads students to observe the real world problems.* Project-based learning provides opportunities for students to relate to life outside the classroom and to face real world problems (CTCs, 2003; Blumenfeld et al., 1991).

The most evident results of project-based learning are increasing feeling of pride with regard to achievement and personal development of students (self-confidence, responsibility, self-esteem and etc.), increasing ratio of attendance, and empathy with others (Carr *&* Jitendra, 2000). Project-based learning means learning through experience. Projects engage students' attention with learning through serious and authentic experiences. Projects give way to some alternative approaches which take into consideration personal differences, learning styles, intelligence levels, talents and inadequacies of students, and provide students with the opportunity to reveal their personal differences (Solomon, 2003; Grant, 2002).

Project-based learning has also some limitations apart from advantages. It may not be possible to predict all the problems beforehand owing to the dynamic structure of this kind of learning (Moss *&* Duzer, 1998). If students are not given adequate guidance, a project may frequently turn into an experience preventing both the student and the teacher from achieving their objectives (Victor *&* Kellough, 1997). The limitations of project-based learning may be listed as follows:

- In project-based learning, it may be difficult to select *a subject* that is appropriate for the aims and the requirements of the curriculum and to determine *the driving question* lead to all the activities (Marx et al., 1994).
- It may take a very *extended time frame* to complete a project. Thorough observations in projects often take more time than expected (Moursund, 1998; Solomon 2003; Simkins, 1999; Marx et al., 1997). Challenge 2000 Multimedia project indicates that students spend a good deal of time when busy with complex thinking processes while designing and directing their presentations (Solomon, 2003).
- *A balance problem* may come up in activities of project-based learning, which may also manifest itself in more than one form. While the teachers give the message, "get deeper" to the students dealing with especially multimedia projects, they feel worried about the fact that projects may take longer and thus fail to cover all the materials. On the other hand, it is crucial to determine the time to be spared for technology learning and content learning. For this reason, setting a balance between width and deepth and teaching content and technology learning bears great importance (Simkins, 1999). Also, it may prove difficult to set a balance between the independence of students and the atmosphere (structure) of the class and the expectations of teachers and the knowledge acquired by students (Marx et al., 1994).
- Multimedia projects to be carried out in the scope of project-based learning require much more *equipment*. The use of required equipment may be expensive (Simkins, 1999). Computers and other technologies of the 21st century bear great importance in project-based learning. Students ask questions by e-mail, chat rooms and videoconferencing system. Students resort to expensive advanced telescopes and portable personal digital assistants for scientific research (Curtis, 2002).
- One other important limitation encountered in project-based learning is *evaluation*. As students create products indicating what they learn, it is important to provide constructive and reliable feedback concerning the aims of the study. It is difficult for teachers to determine how to evaluate the development of students in an effective and applied way (Simkins, 1999).

What Are The Stages of Project-Based Learning?

There are some fundamental stages in the process of project-based learning and these stages bear great importance in the completion of the projects successfully. Although the mentioned stages are basically identical, they have been interpreted in different ways according to the viewpoints of those engaged in this field.

Chard (1998) and Katz (1994) point out that project studies consist of three parts; introduction, development and conclusion. In this approach, which is mostly stipulated for pre-school education, the subject is determined in the first stage and a field study is carried out in the second one. In the third stage, the study is completed, with the results being shared. Wrigley (1998) stated that most projects are composed of stages of subject selection, planning, product development, and sharing the results with others. Solomon (2003) has classified the stages of project-based learning into six: putting forward the project idea, determining timing, planning the activities, making an evaluation of the plan, carrying out the project, and sharing the results of the project. For a lesson of project-based learning, Moursund (1999b) proposes 21 steps composed of three basic stages, which are; from student's point of view and from teacher's point of view; starting, planning, and completing the project.

What Do Research Findings Suggest?

Upon examining the education literature, it is clear that project-based learning has recently been an important subject of research. In spite of insufficient data, some evidence obtained through some models shows that the effect of project-based learning is positive (Solomon, 2003). Research indicates that project-based learning increases the motivation of students and improves products of learning. It has also been shown to be effective in developing skills related to problem-solving and high level thinking. Project-based learning becomes more effective when supported with educational technology. It is understood that project-based learning has relative effects on student achievement compared to traditional learning activities (Regie Stites of SRI, 1998).

Following are some of the future studies needed for a better appreciation of project-based learning according to Thomas (2000):

- Studies testing the effectiveness of project-based learning
- Studies putting forward the effect of project-based learning on learning
- Studies concerning the best applications (Strategies for planning, realizing and managing project-based learning)
- Studies determining the initiative of the teacher in project-based learning
- Studies concerning the institutionalization of project-based learning

Why Project-Based Learning?

The expectation of a good education system is one in which the knowledge acquired at school can be used in problem solving inside and outside the classroom. However, data of the research done so far show that in schools the information is merely presented to students. Students surely know something yet they may still fail to make use of this information (Howard, 2002). However, project-based learning is an approach which allows students to structure the knowledge and even turn it into products instead of only learning that information.

Projects are ideal tools for carrying out learning activities in primary education. They ensure the development of the child as a whole, the integration of his/her grammar and skills, the independence of the student, different aids for students having different skills, and flexible approaches and activities in the program (Phillips, Sarah & and Dunford, 1999). Besides, project-based learning is a teaching approach that may easily be used together with other teaching approaches (Moursund, Bielfeldt & Underwood, 1997). As put forward by the results of various researches, project-based learning, in terms of its basic features, is an effective approach that ensures meaningful learning and internalising when applied to primary education. Thus, the teaching-learning process in primary education should be carried out along with activities making the student active, creative and productive, instead of those making the student go through routine mechanical practice which leads to memorization (Krajcik et al, 1994).

Project-based learning may ensure more effective, prolific and productive science lessons by making students actively participate in learning and by generating opportunities for them to produce something cooperatively. This research was inspired by the necessity to determine the extent of the effect of project-based learning on learning outcomes in science lessons.

Aim of the Research

The basic aim of this research is to determine the effect of project-based learning on learning outcomes in fifth grade science lesson. Answers to the following questions were sought in the study:

- Is there a difference in academic achievements between the experimental group which received a project based learning and the control group which did not?
- What are the opinions of students and the classroom teacher in the experimental group regarding the project-based learning approach applied in their fifth grade science lessons?

METHODOLOGY

Research Design

In this research, which aims to identify the effects of project-based learning on learning outcomes in fifth-grade science lessons, quantitative and qualitative methods were used together. As Bogdan and Biklen (1998) indicated that tendency to use qualitative and quantitative research methods together seems to have increased lately. Descriptive statistics and qualitative findings are generally presented together in such research.

In the quantitative stage of the study, a pre-test-post test control group model was used, and experimental and control groups were tried to be homogenized. In the qualitative stage of the study, interview method was used and interviews concerning project-based learning were made with students and the classroom teacher in the experimental group. Data were collected through semi-structured interviews, and analyzed by the descriptive analysis technique.

Subjects

This research was held in Eskişehir in Şehit Ali Gaffar Okkan Primary School in the second term of the academic year of 2003-2004. There are some reasons why the research was particularly held in

this school. First of all, it showed many similarities to the school in which we did the pilot study the previous year. There were also other similarities in terms of the socio-economic level of the students, the faculty, the equipment, and the facilities. Moreover, the willingness of the school administration and the teachers to participate in the research was another reason.

In this study 5/A and 5/B classes participated and class 5/A was control group and class 5/B was the experimental group selected. There were 34 students in class 5/B and there were 38 students in class 5/A. The subjects of experiment in experimental and control groups were intended to be similar in the terms of the following features: science grades of the results of the personal information questionnaires, and the scores from the achievement tests of the units used in the research. As a result, in both groups, students not having an equivalent counterpart in terms of these features were left out of the research; a total of 46 students, 23 in the experimental group and 23 in the control group, were included in the study. The characteristics of the subjects are shown in Table 1.

Table 1: Characteristics of Subjects of Experiment Involved In the Study

Characteristics	Experimental group		Control group	
	number	ratio (%)	number	ratio (%)
Marks				
2	1	4,34	1	4,34
3	6	26,08	6	26,08
4	8	34,78	8	34,78
5	8	34,78	8	34,78
Sex				
Female	8	34,78	8	34,78
Male	15	65,22	15	65,22
Having private lessons or going to a private course				
Yes	3	13,04	3	13,04
No	20	86,96	20	86,96
Total	23	100,00	23	100,00

When we look at Table 1, we see that students in experimental and control groups are equal to each other in numbers and percentages in terms of their final course marks. The data from the personal information survey as well as the final marks were used in the equalization. As for the sex of the subjects of experiment, there is an equal number of girls and boys both in experimental and control groups. The subjects are also equal in terms of having private science lessons or going to private courses.

In the final stage of the equalization, the pre-test scores that the subjects of experimental group got from achievement tests, which were developed for the unit named "Heat and Its Travel in the Matter" in science lesson, were taken into consideration. According to pre-test results, the subjects in both groups have appeared to be equal in terms of their background about the subject matter to be used in the implementation of project-based learning.

Instruments of Data Collection

In the research, different measurement instruments were used in order to collect data.

Achievement test: In order to assess the academic achievement of students, an achievement test relevant to the unit "Heat and Its Travel in the Matter" in the science lesson was developed. This test is composed of 40 questions.

In the development of achievement test, firstly, overall and acquisition of the unit "Heat and Its Travel in the Matter" were determined and an table of specifications showing how many questions are needed to examine these objectives was established. Then, 40 questions based on these overall and behavioural objectives, were prepared. The prepared test was examined by experts of the field, a test development expert and classroom teachers in terms of its validity and appropriateness to the student's level.

To determine the reliability of the test, it was applied to the 6th grade students of a primary school having the features of the school the research was carried out in. The reliability of the test was calculated by the halving technique. In this method, the test was divided into two coequal halves, and

odd and even numbered questions were evaluated separately; the correlation between the scores of students from both halves of the test was calculated. As this formula determines only the reliability of the half test, Spearman-Brown formula is used to determine the reliability of the whole test. As a result of the calculations, a coefficient figure of .78 reliability was calculated for the achievement test on the unit "Heat and Its Travel in the Matter" developed for science lessons.

The interview form: Interviews were made in the qualitative scope of the research so as to determine the views of teachers and students on project-based learning. In order to set forth the views of teachers and students, semi structured interview technique was used in data collection.

After having decided to use semi structured interview technique in the collection of research data, an interview form was developed by the researcher. In the preparation of the interview form, great care was taken to ask easily comprehensible questions, prepare focused questions, ask open-ended questions, avoid leading and asking multi dimensional questions, prepare alternative questions, write different types of questions and order them in a logical way.

In order to determine the validity of the questions used in the research, the interview form was examined by the experts who study qualitative research and project-based learning. They checked the interview form in terms of whether or not it was open and clear, it covered the subject discussed, and it provided the necessary information. As a result of these studies, the items proved to be valid and the questions adequate. The questions in the interview form are given below:

1. What do you think about project-based learning?
2. What kinds of differences occurred in the science lesson when it was taught with project-based learning approach?
3. What kinds of benefits has project-based learning had?
4. What kinds of limitations (problems) has project-based learning had?
5. What kinds of skills has project-based learning improved in you?

Before the interviews began, an interview handbook containing all the details relevant to the interview was prepared by the interviewer. All the interviews were conducted by the researcher one to one in accordance with the interview handbook. For a better evaluation of the results in a more detailed way all the interviews were recorded with the content of the interview.

The data related to the interview were collected on 11th May, 2004. Interviews were held at a place and time predetermined with the teachers and students. Interviews were made with 23 students in the experimental group and lasted for 5-10 minutes for each student and 10 minutes for the teacher.

Teaching materials intended to introduce the unit and project-based learning approach: The unit called "Heat and Its Travel in the Matter" which is in the scope of science lessons was chosen for implementation. Lesson plans and teaching materials were developed for the unit to be taught based on the principles of the project-based learning approach. Within the basic features of project-based learning approach, first plan was made about how the activities in the science lesson would be carried out. The lecturing period of units are determined by the classroom teacher according to the scope of unit. These conditions were taken into consideration while planning.

Firstly, PowerPoint presentations introducing the unit and project-based learning approach were prepared as teaching materials. The presentation outlines the unit in the direction of the objectives of the unit and includes the most basic information to be explained in a lesson. The presentation introducing project-based learning was prepared to be explained in a lesson and includes the definition and scope of project-based learning, its features, benefits and limitations, stages, roles of the teacher and the student. This presentation has also been prepared to be explained in a lesson. In the preparation of presentations introducing the unit and project-based learning, whether the presentations met the needs and whether they were suitable for the level of the students were taken into account; presentations were shown to the experts in the field and underwent a pilot study.

Experimental Process

Once the instruments of data collection and the materials to be used in the project-based learning approach were identified, the study was ready to implement. At the stage of forming of the experimental and control groups, both the experimental and control groups were informed about how the research would be carried out. As the teacher of 5/B wanted the project based learning approach to be carried out in his class if possible, class 5/B was determined to be the experimental group and 5/A

as control group. Students of 5/B were told that they were the experimental group, having been informed about the scope of the research. Then both of the groups were given the "Achievement Test of Heat and Its Travel in the Material" as a pre-test.

The research was carried out in 26 lessons in the second term of the academic year between 22 March and 6 April in 2004. Students excluded from the research as a result of equalization were the classmates of those found eligible for the study. During the implementation, the project-based learning approach was applied to the experimental group, while the control group was applied the traditional teaching methods.

Before starting the project-based learning approach, an implementation guide was prepared by the researcher; implementation was carried out by the researcher himself in agreement with this guide. The classroom teacher participated in the process as an observer during the research but sometimes assisted the researcher.

The implementation started with a power point presentation, aiming to introduce the unit subjects with basic headlines to the students. In the second lesson, project-based learning was introduced to the students with a PowerPoint presentation once again. In this introduction, definition and scope of the project-based learning, its features, benefits and limitations and stages were summed up.

The application was carried out in the direction of the stages adapted by Erdem (2002):

Determining the objectives: Within this framework, the aims of the study unit which were determined in the curriculum were adopted verbatim. The following aim was set for the project in the research: *"Developing a product or making a performance (drama, poster or brochure, model, newspaper, presentation, experiment, etc.) explaining the effects of heat and temperature on human life"*.

Determining and defining the work to be done or the problem to be tackled: After establishing the learning objectives, the stages of determining and defining the work to be done, as well as the problem to be tackled or the case to be analyzed were defined. The subject of the project was defined after it was transformed into a question form. The question, which could be characterized as 'The Driving Question', was *"What would you do if you were a scientist doing research on the effects of heat and temperature on human life?"*

Determining the characteristics and the presentation style of the results report: It is crucial to determine the quality and the presentation style of the outcome product at the end of the process in terms of the quality of the study. To this end, particular attention was paid so that the results report of the projects which were prepared by the students would include the following features:

- *If the product is a poster or brochure*, it should include visual information, such as pictures and photographs, rather than written information. If it *is a brochure,* it should be determined whether it will be distributed in class; and if yes, what settings will be required for the distribution of the brochures.
- *If the product is a newspaper or magazine*, written information should also include visual support, such as pictures, photographs, or graphics.
- *If the product is a drama*, the presentation style should be determined and the required setting for the presentation should be arranged.
- *If the product is a presentation*, it should be prepared in PowerPoint on a computer and animated images should be used for this purpose.
- *If the product is a model*, the features of the model and materials to be used should be determined.
- *If the product is an experiment*, the subject of the experiment should be selected and the required setting for the presentation should be determined.

Within this framework, the following features of results reports were set concerning the projects to be prepared by the students.

Determining the evaluation criteria: Evaluation is an indispensable part of the project-based learning. The following evaluation criterion was used for the activities or processes to be carried out in this research: *determining the main questions and division of labour (15%), research/collecting information (25%)*, *writing reports (25%)*, *presentation (15%)*, *working in cooperation (20%)*.

After the completion of the projects, each team, as well as the teacher, evaluated other groups based on this criterion. The highest scoring team became the winner.

Forming the teams: Project-based learning may be carried out not only as an individual study but also as a whole class or team study. The projects in the present research were carried out by heterogeneous teams of 6-7 students with different skills. The teams were mostly been formed according to the desires of the students, but the classroom teacher also guided them to a certain extent due to knowing them well. The characteristics of presentation reports (experiments, school newspapers, dramas, etc.) had a particular effect on forming the teams. In the process of forming the teams, students were asked guiding questions concerning the determination and definition of the work to be done or the problem to be tackled first. Then, efforts were made in order to ensure students to take place in the teams suitable for their skills by explaining the possible kinds of studies. Next, each student took part in one of the teams. Each team chose a name for itself.

After the formation of the teams, the teams decided on a project considering the characteristics and presentation type of the project results report. Thus, one team decided to realize a project-based on *posters and brochures*, while another team decided on *newspapers*. Still one team decided on *model,* another team decided on *dramas* and two others decided on *experiments*. As a result, six teams prepared six different projects.

Determining the sub-questions and planning the process of collecting information: Sub-questions, which students were supposed to answer, were determined considering the curriculum objectives of the unit being dealt with in the research. Sub-questions were determined by the students in the class with the help of the researcher's guidance. Teams carried out their studies considering the sub-questions determined. These sub-questions were as follows:

- What are the heat generators in our environment?
- What is heat? What is temperature? What is the difference between heat and temperature?
- What is the importance of heat and temperature in our lives?
- How is heat transmitted in solid, liquid and gas substances?
- What is heat insulation? What is the importance of heat insulation in our lives? What are the precautions preventing heat loss?
- What kinds of fuels are used for providing heat?
- What kind of precautions should be taken in order to prevent fuels from polluting the environment?
- How does heat affect substances? What are the positive and negative effects of expansion? How can we make use of this characteristic in our daily lives?

Making a work schedule: A work schedule acts as a guide in planning lesson periods in the best way. It determines the type of activities to be carried out in every single lesson and the time allocated for these activities. In the present research, the schedule was made considering the working days and timing allocated to the related unit by the classroom teacher.

Determining the check points: Check points in the work schedule were determined to be a post-stage of every single process/step in the schedule. The present project was implemented two hours a week, which added up to a total of six hours. In each two-hour period of lesson, the activities which were supposed to be done in the previous lesson were reviewed. The project was meant to be completed on time by means of frequent checking and inspections.

Collecting information: As dictated by the nature of the research topic or the research question, project-based learning is not a study that can be realized by obtaining information from a single source. The teams should compile relevant information from various resources. The following resources of information were sought in the research process: Libraries and publications like encyclopedia, magazines, books, newspapers, almanac; databanks including electronic resources as CD or video cassette; computers/Internet and informants

Arranging the information into reports: In project-based learning, arranging the information that was collected in an effective way is as important as gaining access to information about the topic being covered. Some of the questions that may be of some help to students in arranging the information available are as follows (Erdem, 2002):

- Was the information gathered grouped so it can answer the questions determined beforehand?
- Was the information arranged in the most appropriate form (graphics, tables, text etc.)?
- Was the systematisation (from general to particular and vice versa, etc.) to be used in the arrangement of this information determined?

- Was this systematisation followed?
- Were the transitions between information units made coherently?
- Was written, numerical and visual information balanced?
- Were the relative positions of this information determined?
- Did the students relate the information to their opinions?

Presenting the project: At this stage, which is the last stage in project-based learning, the projects were presented as they were determined during the planning stage. The teams first presented their projects within the predetermined time. The researchers and the students provided the teams with feedback concerning the presentations. Then, each team presented their project to the other teachers and students in the school as well as parents on a day and time determined by the classroom teacher and the researcher. This last demonstration was made in the presentation room of the school with a high level of participation. Students had the opportunity to get feedback from the principal, teachers, and parents in this presentation room.

Analysis and Interpretation of Data

After the completion of the research, the quantitative and qualitative data were analyzed separately. In the analysis of the quantitative data, mean scores and standart deviations were used. In addition, a two-way 't' test was used in order to check whether there were significant differences between the mean and standard deviations of the scores obtained from the results of pre and post tests, as well as of those obtained from the achievement tests applied to the experimental and control groups. Significance level was specified as .05 in all statistical analyses and SPSS package software was used. The descriptive analysis technique was used for the analysis of the data obtained from interviews. The stages of the descriptive analysis are as follows (Yıldırım and Şimşek, 2000):

Data inventory: Voice recordings of the students interviewed were transferred into separate interview forms at this stage. Later, %25 of these interview forms were selected objectively (Gay, 1987) and the compatibility between the voice recordings and the interview forms was examined by an expert.

Forming a coding key for the interview: An interview coding key was formed at this stage by compiling the answers given by the students, under the relevant questions. An expert and a researcher marked the 25% of the interview forms selected objectively (Gay, 1987) on the interview coding key independently. The data transferred by the expert and the researcher to the interview coding key was examined one by one for each of the answers; and thus the final form of the interview coding key was established.

Comparison of coding and reliability: At this stage, unfilled interview coding keys of all interviews were duplicated and evaluated by an expert and the researcher separately. The reliability of the research was determined by means of the following formula after finding out of the number of "Agreement" and "Disagreement" (Miles & Huberman, 1994): Reliability= Agreement/Agreement + Disagreement. Reliability among the graders was ensured if the results were around or over 90% (Miles and Huberman, 1994). The reliability of the data obtained from the research was 91. And this result shows that the optimal level of reliability was achieved.

Defining and interpreting the findings: Data arranged according to the interview coding key was defined to ensure a more easily readable and interpretable form. Qualitative data obtained through semi-structured interviews was digitized here. Frequency calculations were used in the numerical analysis of data. Defined findings were interpreted by being association with one another.

FINDINGS AND INTERPRETATION

The first aim of the research is to find an answer to the following question; "Is there a difference in academic achievement between the experimental group which received a project based learning and the control group which did not?"

First, the mean and the standard deviation of the scores received in pre-test of the achievement test on the unit titled "Heat And Its Travel in the Matter" were calculated and the difference between the mean levels was tested by the t-test. Findings have been presented in Table 2.

Table 2: Findings Related to Pretest Scores of Unit Achievement Test of the Experimental and Control Groups

Student Groups	N	X	Ss	Sd	T	P
Control Group	23	36,6957	9,5605			
				44	0.015	>0.05
Experimental Group	23	36,6522	9,4658			

t table: 2.02

Findings in Table 2 indicate that there is no significant difference between the mean scores of each group. In other words, there is no significant difference between the condition of the students in either group concerning their knowledge before studying the unit "Heat and Its Travel of Heat in the Matter".

Findings related to the final-test scores of the achievement test taken by experimental and control groups have been presented in Table 3.

Table 3: Findings Related to Final-test Scores of Unit Achievement Test of the Experimental and Control Groups

Student Groups	N	X	Ss	Sd	T	P
Control Group	23	59.8696	14.1008			
				44	2.655	< 0.05
Experimental Group	23	69.5652	10.6714			

t table: 2.02

As can be seen from Table 3, there is a score difference of 9.6962 in favour of the experimental group between the final-test score averages of students in the experimental group and those of the control group. The significance of this difference was tested by the t test and the value was determined as t = 2.655, which is much greater than the table value of 2.02 at .05 significance level of 44 degree of freedom. This result indicates that there is a significant difference between the academic achievement of the students in the experimental group and the student in the control group. Based on this finding, it is possible to conclude that the project-based learning approach increases students' achievement levels in the fifth grade science lessons of primary education. Furthermore, the students participated in the study held the opinion that the project-based learning increased their achievement levels.

The second aim of the present study is to find an answer to the following question, "What are the opinion of students and the classroom teacher in the experimental group regarding the project-based learning approach applied in their fifth grade science lessons". Findings obtained as a result of these interviews have been presented in Table 4.

As it can be seen in Table 4, the question "What do you think about the project-based learning?" was the first question asked to the students and the classroom teacher in order to have their opinions about project-based learning. Students in the interview mostly gave the following answers; "It made learning entertaining and enjoyable" and "It provided meaningful and retention of learning". Students thought that project-based learning made learning entertaining and enjoyable and that it made learning meaningful. Besides, students emphasized some other points as "It increased rapport and collaboration, provided extensive learning experience, provided learning by means of researching, facilitated learning, made individual learning possible". "It increased achievement, developed self-confidence, increased motivation, ensured taking responsibility in learning, enabled learning possible by doing". These are among the opinions put forward by the students concerning project-based learning. It is clear that students regard the project-based learning as a rather positive approach. Likewise, a student has supported this positive opinion by stating that "*project-based learning should be applied in all schools, classrooms and units taught*".

The classroom teacher made the following statement about project-based learning: "*It was a really wonderful study. The children had the opportunity to express themselves. They became very happy. This is the most important thing. They studied with pleasure. While children were unwilling to study some subjects because they had to, they readily participated in project-based learning. I am so glad about this; I mean all my students were so willing*". These teacher opinions are compatible with the

student opinions expressing that project-based learning is more enjoyable and entertaining and that it motivates them.

Table 4. Opinions of the Students Related to Project Based Learning

Opinions of Students Related to Project Based Learning	f
It made learning enjoyable and entertaining	8
It provided meaningful and retention of learning	6
It increased rapport and collaboration	2
It provided extensive learning experience	2
It provided learning by researching	2
It facilitated learning	2
It enabled individual learning	2
It increased achievement	1
It developed self-confidence	1
It increased motivation	1
It ensured taking responsibility in learning	1
It enabled learning by doing	1
Total	29
Opinions Of Students Related to The Differences in Science Lessons When They Are Taught by Project-Based Learning Approach	
It was entertaining, different and enjoyable	13
It increased learning	8
It increased achievement	3
It ensured taking responsibility in learning	2
It increased rapport and collaboration	2
It encouraged us to investigate	1
It provided retention of learning	1
It ensured the creation of products	1
Total	31
Opinions of Students Related to the Benefits of Project Based Learning	
It increased achievement	12
It provided meaningful learning	7
It ensured the creation of a product	3
It provided entertaining and enjoyable learning	3
It increased motivation by allowing eagerness to work	2
It encouraged us to investigate	1
It provided different learning opportunities	1
It increased rapport and cooperation	1
It ensured taking responsibility in learning	1
Total	31
Opinions of Students Related to the Problems in (Limitations of) the Project Based Learning	
I had difficulty in having access to information	1
I sometimes found it difficult to communicate with group members	1
I had difficulty in developing products	1
I couldn't get used to the method in the beginning of the process	1
I couldn't understand the subjects in the beginning of the process	1
Total	5
Opinions of Students Related to Their Skills Improved in the Process of the Project Based Learning	
Manipulative skills	6
Research skills	5
Drama	5
Making experiments	5
Product developing skills	2
Writing and drawing skills	2
Computer skills	1
Thinking skills	1
Self-confidence	1
Collaboration skills	1
Total	29

The question "What differences did project-based learning make in the teaching of science lessons?" was asked to the students and the classroom teachers. The students replied it mostly: "It was entertaining, different and enjoyable" and "It increased our learning". Students also thought that project-based learning "encouraged them to investigate, provided meaningful and retention of

learning, ensured the creation of products". It is obvious that students thought there were some differences in the teaching of science lessons with the project-based learning approach and they especially stated that it made lessons more entertaining, different and enjoyable and that it brought about an increase in learning. Likewise, a student stating "*It is surprising that the teacher doesn't lecture*" and another one saying "*Of course the teacher has given us lectures before, but we have not learnt by doing research ourselves. Thus, we better comprehended the subjects*". This suggests several of the differences created by project-based learning.

The classroom teacher replied to the same question "What differences did project-based learning make in the teaching of science lessons?" as follows; "*Children learned much more easily. I mean, to be honest, I felt that we were wearing ourselves out as classroom teachers, and tried very hard to have the students comprehend the lessons. But now I know that, in my future studies, I mean, I thought yesterday, that I can start this process even in the 2nd grade*". This shows us that the classroom teacher believes that project-based learning facilitates learning and at the same time ensures meaningful learning. The classroom teacher emphasizes in a striking manner that he/she was lecturing with traditional methods with a teacher oriented teaching style before, but that this is not correct. Also, it may be inferred that the classroom teacher finds project-based learning more positive compared to traditional teaching and that he/she adopts project-based learning.

The third question asked to the students and the classroom teachers was: "What kind of benefits did project-based learning have?" Students mostly answered this question as "It increased achievement". Students agreed that project-based learning increased the level of achievement. Besides, they particularly indicated that "project-based learning provided meaningful learning". Apart from increasing achievement and providing meaningful learning, answers such as "It helped the creation of a product, provided enjoyable and entertaining learning, increased motivation by creating eagerness to work" reflect the benefits declared by students. Moreover, they mentioned other benefits of project-based learning by saying, "It encouraged us to investigate, provided different learning opportunities, promoted collaboration and rapport, made us take responsibility in learning". One of the students said; "*I used to get 4 from the exams, now I got five*". And another said, "*Lessons were so enjoyable, we created products, and became succesfully*". They emphasized the benefits of project-based learning.

The classroom teacher's response to the question about the benefits of the project-based learning was: "*First of all, the children were led to do the research. Academic achievement was good. Learning was easy. Since what they gain through personal efforts is not easily forgettable, learning never comes to an end*". The teacher, just like the students, indicated that project-based learning increased achievement, encouraged them to investigate and providing easy and retention of learning.

The fourth question asked to the students and the classroom teacher was: "What kind of problems (limitations) did the project-based learning have?" Most of the students responded to this question as *"We had no problem"*. A small group of students responded as "I had difficulty in gaining access to information, I sometimes had difficulty in communicating with group members, I had difficulty in creating a product, I could not get used to the method at the beginning of the process, I could not understand the subjects at the beginning of the process". It seems that students had few difficulties in gaining access to information, communicating, and creating a product. Moreover, it is understood that they could not get used to the method at the beginning of the process and therefore had difficulty in understanding the subjects. One student expressed the problem he had at the beginning by saying, "*At first, we were not willing to work with projects. Later on, we got used to it. We want to do it now and we will do it*". Another student indicated the problem by saying; "*I did not understand some subjects and tried to memorize them. Later, however, while preparing for the presentations, I understood them and there was no need to memorize*".

The classroom teacher answered the question "What kind of problems did you have in project-based learning?" as "We had no problems" and did not mention any problems. The teacher emphasized the difference of the project-based learning rather than its problems. "*As you know, we are studying in groups. We do it in a primitive way because we always follow the same rule within a particular rule. This began to bore the students. The same student became the head of the group and the same shared the labor*". The classroom teacher emphasized that they had done group work before but it was not efficient enough. She, therefore, indicated that project-based learning provided better learning.

Lastly, students were asked the question "What skills did project-based learning improve in you?" They answered it mostly as "crafting skills, research skills, drama skills, designing experiments". In addition to these skills, skills such as; "creating a product, writing and drawing" and "computer using, thinking, self confidence, collaboration" are the ones mentioned by students. Thus, one student expressed his opinion by saying "*It improved our manipulative skills, we researched, collected information from the next door class*" while the other one said "*My experiment designing skills got better*".

What the teacher said about what skills project-based learning improved in the students was: "*First of all, they learned the following: What is a project? What is creating a project? What is presentation? We used to do this presentation thing with an overhead projector. But now they use the computer and know what projection is. We have always had the computer at school but I never used it. I had friends who used it but I can say I am a bit behind technology. I'm not really interested. But I like it now. I got delighted. I can say I had phobia about computers. I used to get bored when I sat in front of one but this project-based learning made even me get used to it*". The classroom teacher emphasizes that project-based learning improves especially "presentation skills" and "computer skills".

DISCUSSION and CONCLUSION

The conclusions drawn from the data collected through this study, which attempts to determine the impact of project-based learning on the learning outcomes in Science course at primary education level fifth classes, are the following:

According to the findings derived from the data of the first aim of the study, project-based learning increases student achievement. Both experimental research findings and qualitatively – collected student opinions suggest that project-based learning increases *academic achievement*. The finding of the research as to the fact that project-based learning increases academic achievement and brings about retention of learning matches with those of Balkı-Girgin (2003), Holst (2003) and Sheperds' (1998) study.

Both students and classroom teacher, according to the data concerning the second minor-aim of the study, mostly point out that project-based learning makes learning fun and enjoyable and also meaningful. Moreover, this motivates students. Therefore, it is apparent that project-based learning yields a sense of interest and enthusiasm in students and motivates them. This finding is similar to that of Penuel et al (1999) suggesting project-based learning makes learning fun, to those of Bartscher, Gould and Nouther (1995) suggesting that projects contribute to motivation and interest in study topics; its finding that project-based learning yields retention of learning and meaningful learning.

The findings of the data from the third minor-aim of the study suggest that project-based learning enhances collaboration and cooperation as well as academic achievement, creates rich learning experiences, promotes learning by searching, facilitates learning, improves a sense of self-esteem, provides autonomy in learning and creates opportunities for learning through experience. These findings match with those of Frank and Barzilai (2004), Wolff (2002), Thomas (2000), Baron (1998), Meyer (1997) and Krajick et al (1994) suggesting that project based learning *makes students gain autonomy for learning*. Besides, the finding that *it enhances collaboration and cooperation* matches with those of Holst (2003), Wolff (2002), Thomas (2000), Penuel et al (1999), Gaer (1998), Meyer (1997), Horan, Lavaroni and Beldan (1996), Tretten and Zachariov (1995) and Krajick et al (1994); the finding that it *improves self-esteem* with those of Frank and Barzilai (2004), Holst (2003), Thomas (2000), Shepherd (1998) and Tretten and Zachariov (1995). Also, the finding that *it yields learning through searching* with the finding of Demirhan (2002) suggesting that projects support active participation of classroom teachers and students, their access to knowledge through searching and their presentation of the researches and with the findings of Haliloğlu and Asan (2004), Marx, Blumenfeld, Krajick and Soloway (1997), Meyer (1997).

The findings of the data from the fourth minor-aim of the study suggest that project-based learning makes students gain a range of skills such as hand skills, research skills, drama skills, experiment skills, skills for product improvement, thinking skills, collaboration skills and presentation skills. These findings match with those of Haliloğlu and Asan (2004), Marx, Blumenfeld, Krajick and Soloway (1997) and Meyer (1997) suggesting that project-based learning improves *research skills*;

and with those of Wolff (2002), Shepherd (1998), Meyer (1997), Horan, Lavaroni and Beldan (1996) and Tretten and Zachariov stating that it improves *higher order thinking skills*.

According to the findings of the data from the fifth minor-aim of the study, there are few problems with project-based learning process. Research findings suggest that there are some, though not many, problems and difficulties in accessing knowledge, communication among group members, product development, getting used to the method at first and being able to understand the subjects. These findings match with that of Frank and Barzilai (2004), Marx, Blumenfeld, Krajick, Soloway (1997) and Haliloğlu and Asan (2004) suggesting that some problems emerge in the communication among group members, and with the findings of Frank and Barzilai (2004) pointing out that students are struggling to cope with a learning framework which is not a pre-constructed one.

In conclusion, the most obvious result of this research was that project-based learning increased academic achievement and made learning enjoyable, entertaining and meaningful, in addition to improving the skills of students. In short, project-based learning provided the students with an experience in extensive learning. Following suggestions can be made based on the study results:

- Project-based learning can be used in primary education.
- As a priority, teachers can be educated about project-based learning through an in-service training programme.
- Successful applications of project-based learning can be made widespread.
- Further studies can be made to reveal of the role of the teachers in project-based learning.

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