# THE EFFECTS OF CONTEXT-BASED PHYSICS EXPERIMENTS TO SCIENTIFIC PROCESS SKILLS OF PROSPECTIVE SCIENCE TEACHERS[+]

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**ABSTRACT**

The aim of this study was to determine if the lessons of General Physics Laboratory 1 course that were planned with context based learning approach affect the scientific process skills of prospective science teachers. This study was conducted with 51 prospective science teachers which were taking General Physics Laboratory 1 Course at a University inIstanbul in Turkey in the Elementary Education Department Science Education Program in 2011-2012 education year fall term.The study was planned with quasi-experimental method with pre-test and post-test control group model. 51 prospective science teachers were divided into two groups and one of these two groups was selected as to be control group and the other as experimental group randomly. There were 27 prospective science teachers in the control group and 24 prospective science teachers in the experimental group. Scientific process skills test was applied to both control and experimental groups as pre-test before the application and as post-test after the application. In result, it was found that context-based learning is an effective method to improve scientific process skills of prospective science teachers.

**Key Words:** Prospective science teachers, scientific process skills, context based learning, physics laboratory.

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## Introduction

Science Laboratory is an environment where a subject or concept is tried to be taught to students through either direct experiments or demonstration method (Ekici, Ekici and Taskin, 2002). Studies carried out in laboratories help explaining and meaning scientific events. Laboratory studies have a potential to be able to assess current problems of students, to regulate research stages and to encourage them in reaching conclusions (Ayas, 1998).

The method of laboratory also creates effects such as reasoning, critical thinking, improving scientific point of view, ability to solve problems (Orbay, Oner, Kara and Gumus, 2003).

When looking at activities students carried out in science laboratory, it has been specified that students usually work like technicians in laboratoryduring these activities. Studies in laboratory focus on laboratory activities in type of cook book that ensures that lower level skills improve and too few opportunities are given to the students for them to hypothesize, to test hypothesize and discuss their experimental faults (Hofstein, 1988). The emphasis for only theoretical knowledge in science and phsysics education weakens the ties between education and real life. It is important to direct science education with real problems (Can, 2004; Korucuoglu, 2008).

In 1600's Jan Amos Comennius emphasized that teaching must be with real life objects and it must serve student's sensors as much as possible . Although, in 400 years the importance of the effectiveness of the real life connected teaching has been emphasized in many studies, life based teaching did not take place in the programs until last years (Ayvacı, 2010).Context-based learning was introduced by a few researchers from York University in the beginnings of 1980's. The main aims of the context-based approach are (Sözbilir, 2007; Çam ve Köse, 2008):

- to teach the scientific concepts to the students with real lifeconditions
- to rise the level of their motivation and willingness for the learning
- to see the connections between scientific truths and the life
- to improve students' scientific process skills

Context-based learning is widely accepted as a promising approach of teaching and learning. Research results and theories about the development and support of interest, motivation and learning as well as experiences in practise have strengthened the idea of change towards a more context-based approach in consequence (Parchmann, Luecken, 2010). It has been seen that context based learning approach has attracted researchers' attention in many countries so far. Being US and UK in first place, many countries like Germany, Belgium, New Zealand, Netherland, Scotland, and Israel have adapted this teaching model into their own education system in the direction of their need (Acar and Yaman, 2011). Projects regarding context based approach were prepared by researchers (Ng & Nguyen, 2006). (Wilkinson, 1999b Whitelegg, 1996, Bennett & Lubben, 2006; Parchmann, Grasel, Baer, Nentwing, Demuth, Ralle & ChiK Project Group, 2006; Schwartz, 2006; Schwartz, 1999; Bulte, Westbroek, de Jong & Pilot, 2006; Hofstein & Kesner, 2006). In Turkey, context-based learning found a busy research area with a presentation of a study by Gilbert in the 7th National Science and Mathematics Education Congress in 2006 (Çam ve Özay Köse, 2008; Ayvacı 2010).

The understanding of science laboratory developed in recent years has turned into learning centres in which students carry out study individually or in a group with theoretical knowledge they learned at class, in which they designed research and proved these designs through experiments, in which they can see the relationship between results they obtain and situations (Tatar, Korkmaz and Oren, 2007).

Scientists initially analysis what a problem that they are confronted is. Then, they do study for solving the problem. The analysis of problem, collecting proofs through observing, developing a hypothesis, examining the hypothesis, (restarting it if it fails; re-examining it if it is correct) and finally stating a conclusion which brings an effective explanation to the essential problem complete the process. This process might be a complex process including important steps. Those who realize this process should have skills that called as scientific process skills (Tasar, Temiz and Tan, 2002).

Scientific process skills are skills that we use in all thinking activities that we used in reasoning on current problems, in reaching to conclusions and in constituting knowledge. A similar way to the ones that a scientist uses during his/her study should be followed to be able to constitute these skills and to be able to gain it to students. These skills to be given to students ensure how the thinking method in science and researches are understood by students (Lind, 1998).

Scientific process skills are regarded with every domain of science (Harlen, 1999). Usage area of scientific process skills should not be kept limited with natural sciences like physics chemistry and biology. Most of these skills are skills used in every area of daily life. Even professional people who have not got direct relationship with physics, chemistry or biology use these scientific process skills even if they are not aware of doing this. To give an example, a farmer who wants to increase yield in his field initially hypothesizes and tests it and then s/he tries the way of getting efficiency (Tan and Temiz, 2003).

Laboratory approach towards scientific process skills expresses usage of laboratory towards that students gain scientific process skills such as making observation, classification using place-time relationships, using numbers, measuring, deduction, foretell, interpreting data, planning and carrying out experiments. Students who improve their scientific process skills are able to learn knowledge regarding science (Ayas, 1998, p.103).

In the results of the study about learning physics using real-life contexts students generally found the context approach more accessible, interesting and memorable their previous experiences of physics learning (Whitelegg, Edwards, 2002).

There are available studies investigating the effect of different teaching methods on scientific process skills in physics laboratory lesson in science teaching education (Kanlı, 2007; Acisli, 2010; Karaca, 2011; Saka, 2012). There are also available studies stating that lesson taught by context based approach improves scientific process skills (Toroslu, 2011; Cam, 2008) Sozbilir, Sadi, Kutu and Yildirim, 2007)

For the meaningful learning in a physics course pre-knowledge of the students for an issue should be discovered and conceptual change in learning environments should be provided. Teaching environments should be planned with examples of real life conditions. In a consequence of this, context based physics experiments were planned and applied to prospective science teachers. The problem statement of this study was defined as "what is the effect of general physics 1 laboratory lesson taught with context based approach on scientific process skills of prospective science teachers ?".

## Method

In this study, quasi-experimental research model with pre-test – post-test control group design was used. It has been shown importance that groups in quasi-experimental with pre-test – post-test control group design are defined as control and experimental randomly between existing two groups. In a research with quasi-experimental pre-test – post-test control group design, initially a pre-test was applied to groups and application was carried on one of these groups and a post-test is applied at the end of application for both groups (Aypay et al., 2009; Fraenkel, Wallen & Hyun, 2012, p.275).The application of the study is modeled in table below:

**Table 1:**The experimental design of the study

| Group | Pre-test | Application | Post test |
|---|---|---|---|
| E (Experimental) | $O_{1.1}$ | X | $O_{1.2}$ |
| C (Control) | $O_{2.1}$ | | $O_{22}$ |

Two groups as one control and one experimental group were defined at the beginning of the study. Experimental group is the group that general physics 1 laboratory lesson taught with context based approach and control group is the group that general physics 1 laboratory lesson taught with traditional method. Pre-tests and after the application post-tests were applied to both groups.

## Study group

This study was conducted with 51 prospective science teachers which were taking General Physics Laboratory 1 Course at a University in Turkey in the Elementary Education Department Science Education Program in 2011-2012 education year fall term. 51 prospective science teachers were divided into two groups and one of these two groups was selected as to be control group and the other as experimental group randomly. There were 27 prospective science teachers in the control group and 24 prospective science teachers in the experimental group.

## Data Collection

Scientific process skills test was applied to both of the groups as pre-test before the application.Scientific process skills test (SPST), that was prepared by Burns, Okey and Wise

(1985) has 36 items and adapted to Turkish by Özkan, Avşar and Geban (1992) was used in this study. SPST was applied to both of the groups as pre-test before the application. The sub-skills that the test measures are:*Identifying Variables, Operationally Defining, Stating Hypothesis, Data and Graph Interpretation, Designing Investigations*(Kanlı ve Temiz, 2006). Kanlı and Temiz (2006) found the cronbach α coefficient as 0,79. In this study the reliability analysis of questions was determined and one item for having low reliability was removed. SPST was used with 35 items and the α (alpha) coefficient was estimated as 0, 713.

Results obtained were assessed by using SPSS package program. Test was assessed on 35 points, as 1 point per question.Shapiro-wilk test was applied to decide if the data of SPST pre-test and post-test results shows normal distribution or not for the groups separately. All the data shown normal distribution so parametric analysis tests were used to campare the results.

**Application**

Prospective science teachers conducted the experiments in groups both in control and in experimental groups. The groups were formed with five prospective science teachers at most. After performing experiments they wrote experiment reports induvidually. In order to prevent data exchange between the groups, the schedule of courses was arranged accordingly. The experiment sheets were prepared by the researchers before the lessons and given to the prospective science teachers just before doing experiments. The prospective science teachers wrote the experiment reports just after the experiments before leaving the laboratory. The experiments done by the prospective science teachers were: Simple pendulum, Springs, Centripetal Force, Kinematics-Dynamics, Collision in Two Dimension, Inclined Plane, Changes in the Potential Energy, Density and Surface Tension-Viscosity.

In control group experiments done with traditional method and in experimental group experiments done with context-based approach. In traditional method; concepts, principals and theories were introduced, procedures were explained prospective science teachers were informed about the analysis of the data, the prospective science teachers followed the procedure step by step and collected the data, wrote them to the tables in the sheet and done the calculations induvidully. Inexperimental group the same laboratory sheets were used. Just before the experiments power point slides were used to show daily life problems and stories with real life examples. For example;a story about an accident of two cars was given before the "collision in two dimension" experiment. A few questions like: "*What would be if one of the cars was stopping? What would be if the velocities of the cars were different* ?"directed to the prospective science teachers by the researcher, it was provided that prospective teachers noticed the subject is related with their life. Prospective science teachers also give examples from their life and commended the events in the presentation. It was provided that the prospective science teachers found the key concepts for every experiment.

## Findings

**Table 2: Shapiro-wilk test results for normality distribution of SPST of the control and the experimental group**

| Grup | SPST | N | $\bar{X}$ | S | Statistic | p |
|---|---|---|---|---|---|---|
| Control Group | Pre-test | 27 | 22,296 | 3,923 | 0,930 | 0,097 |
| | Post-test | 27 | 22,667 | 3,912 | 0,959 | 0,424 |
| Experimental group | Pre-test | 24 | 22,542 | 3,048 | 0,965 | 0,481 |
| | Post-test | 24 | 25,208 | 4,114 | 0,956 | 0,297 |

As it is seen in Table 2 pre-test post-test data belong to control group and experimental group statistically has normal distribution. According to table 1., it has been concluded that data obtained from control and experimental groups in research would be able to be assessed via parametric tests.

**Table3:** Independent –Samples t test results for pre-tests of the control and experimental group

| Test | Grup | N | $\bar{X}$ | S | df | t | p |
|---|---|---|---|---|---|---|---|
| Pre-test | Kontrol | 27 | 22,296 | 3,048 | 49 | 0,251 | 0,803 |
| | Deney | 24 | 22,542 | 3,923 | | | |

According to table 3 arithmetic average of pre-test scores of prospective science teachers in control group is 22,296 and arithmetic average of pre-test scores of prospective science teachers in experimental group is 22,542. According the independent-t test results it is seen that p value is bigger than 0,05 (p=0,803). So, it has been found that there is no statistically significance difference between scientific process skills of pre-test scores of prospective science teachers in control group and experimental group. This can be explained in the way that the scientific process skill levels of prospective science teachers in control and experimental group are equal before the application.

**Table 4:** Paired Samples t test results for pre-test and post test results of the control group

| Control Group | N | $\bar{X}$ | S | df | t | p |
|---|---|---|---|---|---|---|
| Pre-test | 27 | 22,296 | 3,048 | 26 | 0,550 | 0,587 |
| Post-test | 27 | 22,667 | 4,114 | | | |

According to table 4,arithmetic average of SPST pre-test scores of prospective science teachers in control group is 22,296 and the SPST arithmetic average of post-test scores is 22,667.The analysis of paired samples-t test shows no statistically meaningful difference between these scores. This means that that the scientific process skill levels of prospective science teacherswith whom lesson was taught with traditional approach did not increased significantly.

**Table 5:** Paired Samples t test results for pre-test and post test results of the experimental group

| Experimental group | N | $\bar{X}$ | S | df | t | p |
|---|---|---|---|---|---|---|
| Pre-test | 24 | 22,542 | 3,923 | 23 | 2,289 | 0,032 |
| Post-test | 24 | 25,209 | 3,912 | | | |

According to table 5 arithmetic averages of pre-test scores of prospective science teachers in experimental group is 22,542 and of post-test scores is 25,209. According to paired samples t test for the scores of pre-test and post test results of the experimental group there is a statistically significant difference between pre-test and post scores of prospective science teachers in experimental group. This result shows that scientific process skills of prospective science teachers in experimental group has increased in a statistically meaningful level. According to this, it could be said that general physics-I laboratory lesson taught with context based approach has increased the scientific process skill levels of prospective science teachers.

**Table 6:** Independent –Samples t test results for post-tests of the control and experimental group

| Test | Group | N | $\bar{X}$ | S | df | t | P |
|---|---|---|---|---|---|---|---|
| Post-test | Control | 27 | 22,667 | 4,114 | 49 | 2,254 | 0,029 |
| | Experimental | 24 | 25,208 | 3,912 | | | |

According to table 6 arithmetic average of post-test scores of prospective science teachers in control group is 22,667 and arithmetic average of post-test scores of prospective science teachers in experimental group is 25,208. According the independent-t test results it is seen that p value is smaller than 0,05 (p=0,029). So, it has been found that there is statistically significant difference between scientific process skills of post-test scores of prospective science teachers in control group and experimental group. According to this, it could be said that general physics-I laboratory lesson taught with context based approach has increased the scientific process skill levels of prospective science teachers more than the scientific process skills of the prospective science teachers whom taught with traditional method.

## Conclusion and Discussion

At the end of study, it has been found that general physics-I laboratory lesson is more effective in increasing scientific process skills of prospective science teachers than traditional approach. So, this study shows that context-based learning is an effective method to improve scientific peocess skills. When looking at studies in which the effect of context based approach on prospective science teachers' scientific process skills, it has been found that studies on this subject reach to similar results. In his study on energy subject which Toroslu (2011) carried out by using 7E learning model supported with life based approach and in study that is carried out by Cam (2008) and that life based approach was used in biology lesson, it has been seen that life based learning increases prospective science teachers' scientific procedure skills. This situation is consistent with the results obtained. At the same time, this result supports idea developed by Sozbilir, Sadi, Kutu and Yildirim (2007) that "*Ensuring that students note the relationship between science and subjects in real life is to develop students' scientific process skills*". In study carried out by Topuz, Gencer, Bacanak and Karamustafaoglu (2013) in which science and technology teachers' opinion and level of practicing about life based approach were investigated, it has been seen that science and technology teachers define the context based approach as an approach that improves scientific process skills.Context-based physics, which involves placing physics material within a real-life context in an attempt to improve student motivation, problem solving, and achievement (Taasoobshirazi, Carr, 2008).

In the new program of Turkey context-based learning is seen as an effective method (Tekbıyık ve Akdeniz, 2010). If it would be applied in schools first the teacher should learn context based approach. So, if we use this method in the universities for the education of prospective science teachers, they can learn and may use it in their professional life. In conclusion it is suggested that context based approach should be used at universities to educate prospective science teachers.

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