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INVESTIGATION OF EFFECTIVENESS OF DEMONSTRATION-SIMULATION BASED INSTRUCTION IN TEACHING ENERGY CONSERVATION AT 7 TH GRADE

Fatma Aggul, Mehmet Yalcin, Metin Acikyildiz, Erdal Sonmez

Abstract. *This study aimed to explore the effect of teaching through demonstration-simulation on students' achievement of energy conservation in comparison with traditional teaching. The sample consisted of fifty nine 7th grade students from a state primary school in Turkey. In the study, non-equivalent groups pretest-posttest design was used and the data was collected through an achievement test developed by the researchers, Energy Conservation Test. The conservation of energy concept was taught using a demonstration and a simulation in the experimental group and traditional instruction method in the control group. Data collected by the test was statistically assessed applying the analysis of covariance. To explore obviously the class atmosphere in experimental group, it was utilized from the teacher's observation notes and student interviews. The statistical comparison showed that there was a significant difference between groups with respect to students' scores of the test. Moreover, the analysis of the qualitative data indicated that such a class atmosphere supported the constructive and meaningful learning.*

Key words: *teaching conservation of energy, lecture demonstration, educational simulation.*

Fatma Aggul, Mehmet Yalcin, Metin Acikyildiz, Erdal Sonmez
Ataturk University, Turkey

Introduction

Energy education has become an area of major importance for those who are responsible for school teaching. Teachers, politicians and the public agree that school teaching should equip students with the knowledge, skills and abilities needed to live in a world faced with rising energy demands and shrinking energy resources (Trumper et al., 2000).

The results from the previous research have shown that, prior to any formal instruction in science, students generally hold scientifically incorrect conceptions of energy. Gilbert and Watts (1983) have summarized the general beliefs identified in these studies as follows:

1. Energy has to do with living and moving things,
2. Energy makes things work, and
3. Energy changes from one form to another.

Watts (1983) presented an exhaustive list of the most popular and persistent alternative frameworks about energy held by students:

1. Anthropocentric: energy is associated with human beings;
2. Depository: some objects have energy and expend it;
3. Ingredient: energy is a dormant ingredient within objects, released by a trigger;
4. Activity: energy is an obvious activity;
5. Product: energy is a by-product of a situation;

6. Functional: energy is seen as a very general kind of fuel associated with making life comfortable
7. Flow-transfer: energy is seen as a type of fluid transferred in certain processes.

The energy concept has been defined because it is conserved (Duit, 1981; Trumper, 1990a). The main characteristic of the conserved quantity called energy is that it appears in a large number of different forms. In the last few years, a number of texts used a variety of approaches, simply discussing the various forms of energy, the ways in which it can be transformed, and the law of conservation of energy. Duit and Haeussler (1994) went further and stated that consideration of content specific pedagogical knowledge led to four basic aspects of the energy concept because they are intimately interrelated: energy transformation; energy transport; energy conservation; energy degradation. The four basic aspects indicate that the science energy concept, on the one hand, stands for constancy amidst change but there is, on the other hand, a decline of energy value whenever a process is taking place.

"Conservation of energy" in everyday language means being careful not to waste any energy, it does not mean that the energy of the universe is constant. As visible movements tend to stop and living beings tend to die, it is understandable that students talk about energy as not being conserved. This recognition led researchers to the conclusion that what students call 'energy' is in fact closer to the physical concept of "free energy", a non-conserved quantity. This in turn led to teaching proposals in which free energy and a simplified version of the second law are taught before the energy conservation law (Ogborn, 1990). At least one of these proposals has been tried out and evaluated on a larger scale (Stylianidou, 1997). Independent from this line of work, some discussion has taken place on the correctness of school science in the light of currently accepted science. One line of discussion is about the correctness of picturing energy itself as 'something quasimaterial', as Duit (1987) called it. This quasi-material conception of energy is visible when energy is talked of as 'being stored in' a system like liquid in a container, or "flowing from" A to B. A teaching design that makes extensive and explicit use of energy as a "substance-like" quantity has been developed (Schmid,1982; Kaper and Goedhart, 2002).

Literature review with regard to students' and teachers' conceptions of energy and energy conservation and teaching energy concept

Researches about teaching energy (Bliss and Ogborn, 1985; Duit, 1981; Kesidou and Duit, 1993; Solomon, 1982, 1983a,1983b; Watts, 1983; Ametller and Pinto, 2002; Lawrence, 2007; Fry et al.,2003; Hassani, 2005; Liu et al., 2002; Blais, 2003) have occupied many research efforts during the last two decades.

In a study performed by Duit (1984), it was examined outcomes of physics instruction in grades 6 and 10 with regard to students' concept of energy in West Germany, Switzerland, and the Philippines. A two-part questionnaire was used before and after instruction in both studies. It focused on application of the principle of energy conservation in simple mechanics' processes. From interviews performed to clarify their responses (before and after instruction), it was shown that physics instruction does not alter drastically students' notions about energy and most students preferred conceptions and notions stemming from everyday experiences. In addition, he claims that energy should not be restricted to the ability to do work, that the traditional way to energy concept via work causes severe learning difficulties, and that energy conservation/degradation should be given more instructional emphasis.

Not only have students but also teachers have pervasive misconceptions and difficulties with regard to the idea of energy conservation. The results of a research examining 608 preservice elementary school teachers' concept of energy (Trumper,1997) in Israel revealed the following:

1. many hold alternative conceptual frameworks, not accepted scientific concepts;
2. many do not accept the idea of energy conservation or degradation;
3. they confuse energy and force; and
4. they have an ambiguous recognition of different types of energy.

Trumper (1990b) analyzed 14 aged students' alternative conceptual frameworks about energy,

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both before and after studying the concept in their Physics lessons and found: before studying Physics, the most pervasive alternative frameworks, held by almost all pupils, were:

1. the "anthropocentrica" framework,
2. the "cause" framework: energy causes things to happen, and
3. a broadened "product" framework: energy is the product of a certain process or processes.

After studying Physics, pupils generally continued to adhere to the same alternative frameworks held prior to formal study. More recently, Trumper (1993) carried out a crossage study in Israeli elementary and junior high schools and found:

1. No significant difference among pupils' alternative conceptual frameworks about energy in grades 6.
2. The building blocks in the teaching of the energy concept, the "cause" and the "product" frameworks, are held by students from 5th grade on.

The preconceptions that children bring to science lessons are known to cause difficulties for the secondary school teacher, and the teaching of conceptual science to primary school children can compound this problem if the science conceptions of teachers themselves are at variance with those accepted by scientists.

Solomon (1982, 1983a) has reported that children typically start with ideas of energy related to personal experiences of human activities, vitalism and activity - "jumping about" or "being lively". But objects such as machines, wind and waves can also have energy. Solomon (1983b) sees children's out-of-school conceptions of energy as being messy, contradictory and obstinately persistent. In his view, very few of the ideas that kids are reported to hold are totally incompatible with scientific meanings. To the extent that they are unscientific, many are simply incomplete while a few are overstated. Many of those overstated incorrect ideas, such as the widely-taught notion that "all energy comes from the sun", can easily be made valid, in this example by removing "all" or substituting "some".

In a study concerning teaching the energy concept , Trumper (1991) taking into account the students' pervasive alternative frameworks, investigated the effect of conceptual change strategies on teaching the energy concept based on the "cause" and "product" frameworks and He found the strategies helped students build the accepted scientific concept for themselves. The research carried out by Duit(1984) indicate that physics instruction has not been very successful with regard to the learning of the energy concept. Although significant impacts are apparent, they refer mostly to 'superficial effects'. The general features of the meaning of the word energy in colloquial language and in physics as learned by the grade 10 students who took part in the study are very similar. The main influence of physics teaching regarding the meaning of energy is a closer link with the term work and other physical terms. Furthermore, a larger number of energy forms come to the students' minds when confronted with the word energy. Where applications of the energy concept are concerned, severe limitations of the impact of physics instruction must be reported. Even when describing a simple process using the word energy there is much uncertainty reflected in the students' answers.

Demonstrations embedded within the instructional sequence are useful tools for introducing the abstract concepts in a concrete form**.** Teaching science using demonstrations or real world examples helps to introduce science topics. Teaching science concepts through demonstrations can benefit students at the time of the demonstrations or later on (Johnstone, 1991). Demonstrations help teacher to attract students' attention to the subject, makes students more interested and focused on what may happen. Thus, students become more enthusiastic about spending time studying the topic comprehensively. Teaching accompanied by demonstrations helps strengthen students' understanding of scientific phenomena. Demonstrations have become important cognitive aids that reflect real-life scientific concepts and laws. The use of lecture demonstrations as a technique to increase students' interest and learning in science has been strongly advocated by many science educators (Serlanz and Graham, 1998). Glasson (1989) investigated the effectiveness of teaching with hands-on and teacher demonstration laboratory methods on declarative and procedural knowledge achievement. He found that there was a significant difference with respect to procedural knowledge. The students taught with hands-on laboratory method were able to link related ideas that they experienced, and construct integrated knowledge (Azizoglu, 2004).

The increasing availability of computer-related technologies in classrooms (Becker, 1991) has prompted the investigation of their influence on processes of conceptual development. Simulations are particularly adept at representing complex processes. The ability of simulations to portray phenomena and allow users to interact with the dynamics of a model system creates an arguably unique way of helping learners conceptualize. A well-designed simulation allows learners to choose their mode of informational representation on the computer screen; it allows them to develop hypotheses about phenomena that accommodate their way of solving problems (Windschitl and Andre, 1998).

Computer simulations are believed to be effective for explaining abstract or invisible phenomena in science, and a variety of simulation software has been developed regarding the energy transformation for educational purposes (Imai et al. 2003). Zietsman and Hewson (1986) used a computer simulation to diagnose and remediate alternative conceptions about velocity. Their results indicate that computer simulations can be credible representations of reality, and that remediation produced significant conceptual change in students holding alternative conceptions. Other studies have found little or no effect using simulations to promote conceptual change. In a study on electrical circuits, Carlsen and Andre (1992) found that using text designed to produce conceptual change resulted in better performance on tests, but that using a computer simulation in addition to the text produced no greater change than the text alone. When used to provide an introductory framework to formal classroom instruction, simulations have facilitated learning gains in the areas of knowledge (Thomas and Hooper, 1991) and application of knowledge (Brant et al., 1991; Windschit and Andre, 1998)

The concepts of potential energy, kinetic energy and their interconversions are ones which are important and fundamental for teching conservation of energy concept and embedded in the core curriculum of most science programs in Turkey. These concepts are in general presented simplistically and taught only by defining in classes, and so students are tempted to misconceptualize them as being static state phenomena. But, it is important for students to realize the complexity and fluidity of energy conversion in the natural world, like that of mechanic energy. There are also the researches that point out teachers' difficulties with regard to conception of energy. Therefore, the teaching conservation of energy concept struggling both students' and teachers' miconceptions and difficulties is substantially important issue. There are researches that show that using together various teaching styles brings about different effects in comparison with the their usage separately, for they interact with each other (Carlsen and Andre, 1992). *There have been many emprical studies that verify lecture* demonstrations and computer simulations to be more effective than traditional instruction with regard to course achivement. But, there is little research that emphasis the combined effect of a demonstration and a simulation on primary school students' achievement, especially on a*chievement* of Energy Conservation Concept. For this reasons, the *purpose of the present study was to examine whether there was a difference between a* demonstration-simulation based instruction and *traditional instruction with regard to seventh grade students' achievement* of Energy Conservation Concept Test, and also to determine if there was difference between *them in terms of* gender. Thus, following research hypothesises are stated:

Research Hypotheses

$H_0$1: There is no a significant difference between 7th grade students' achievements of *Energy Conservation Concept Test* acoording to treatments groups

$H_0$2: There is no a significant difference between 7th grade students' achievements according to gender across treatment groups

$H_0$3: There is no a significant difference between 7th grade students' achievements according to pre-test (prior knowledge) across treatment groups

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Methodology of Research

Design

In the research, quasi-experimental nonequivalent groups pretest-posttest design was used. This design is very prevalent and useful in education, since it is often impossible to randomly assign subjects. In the design, the researcher uses intact, already established groups of subjects, gives a pretest, administers the treatment condition to one group, and gives the posttest (McMillan and Schumacher, 2001). Because ANCOVA allowed researchers to adjust for any pretreatment differences that exist between the experimental and conrol group and was an appropriate and informative technique to make a reliable inference from a pre-test-post-test control group design, it was chosen as statistical analysis technique (Dugard and Todman 1995). The variables in the study are given in Table 1.

Table 1. Variables and the place in experimental design.

Variable	The role in experimental design
Pre-test scores	Covariate
Posttest scores	Dependent variable
Gender	Independent variable
Teaching method	Independent variable

Participants

The sample of the study was composed of total of 59 seventh grade students (from two parallel classes) enrolled to Science-VII course (3 hours per week and 14 weeks in a semester) at a state primary school in Erzurum city centre in Turkey at the second semester of 2005-6 education year. Experimental and control group include 29 and 30 students with medium socioeconomic level and ranging age of 14 to 16 in each class, respectively. Classes were randomly assigned as experimental (class 1) and control (class 2) group.

Instrumentation and Procedure

Students' achievement of energy conservation

Students' achievement of energy conservation concept was compared using a test developed by researchers. The test that composed of 12 multiple choice questions was developed in the light of the students' learning difficulties and misconceptions. The questions include potential-kinetics energy and their applications in daily life, changing energy from one form to another, and mechanical energy conservation. So, main concepts considered during the test preparation are as follows:

i) Potential and kinetics energy, their properties.
ii) Changing energy from one form to another.
iii) Mechanical energy and its conservation.

The test was piloted with a group of students from another state primary school in Erzurum took Science-VII course and modifications were made in terms of language and design of the test. The validity of the test was achieved by consulting science educators and the researchers in this study. With respect to the reliability, The test was administered to a group of 48 eighth year students from government primary school in Erzurum took Science-IIV course year before and reliability coefficient was found as (α= 0.68). This level of reliability coefficient obtained for the achievement test indicated that the test could be considered satisfactorily reliable (McMillan and Schumacher 2001; p.245). Two sample questions of the test can be seen in Appendix. The conservation of energy concept was taught by the same teacher, one with an experience of 10 years, to both experimental and control gorup. To explore what is lived within class in experimental group, it were used the observation notes taken by teacher after each lesson and the interview data from two student, one with low grade and other with high grade selected randomly according to posttet scores.

Demonstration Equipment

The image of demonstration equipment used is shown in Figure 4. In this image; A, B, C, D, and E symbolize starting point of motion, slopes, floor, switches, and electronic apparatus respectively. In the view to using in the discussions at relationship of potential energy-kinetic energy, this tool built. The average velocity of each marble can be calculated as it travels down the slope from this equipment. By marking the place on the floor where the marbles land, students also learn that no matter what the velocity, if objects of equal mass receive the same amount of potential energy (height), they will produce the same amount of kinetic energy (distance traveled). The demonstration equipment is made up of three section, electronic apparatus, slope and switches. Electronic apparatus determines crossing time of marbles from A to D. Slope composed of different grades three roads made of plastic and switches to issue a command to electronic apparatus for starting and finishing time. The equipment's frame is metal with dimensions of 75 cm length, 15 cm width and 20 cm height. Class and group discussions about the results of experiment accompaning the demonstrations performed by the teacher were carried out and the demonstration was repeated some times by the student groups.

Energy Conservation Simulation

Energy conservation simulation (ECS) made by using *Macromedia Flash MX* program was developed by researchers. Before the treatment, the teacher was instructed about the software. All students used software in the computer laboratory of school. A section of ECS is given in Figure 5. Energy conservation simulation aims at facilitating students' understanding to transform potential and kinetic energy to each other. "B*all's mass*" and "*height*" are among changeable options of ECS. The data supplied from ECS gave the connection with velocity and height at any time of ball released from top of slope. Changing the variables like mass and height, students individually experienced conversation of mechanical energy many times.

Procedure

Two weeks ago from the treatment, the test was administered as pre-tests, within 40 min. One of the authors met with the teacher involved in the study, briefed her on what was expected of them and assisted them in planning their lessons on energy conservation. While used only the traditional teacher centered instruction in the control group, lecture demonstration and simulation were predominantly used in the experimental group. The traditional instruction was based on lecturing in class. It was not designed explicitly to facilitate conceptual understanding or conceptual cchange. In experimental group, the teacher carried out the demonstration and simulation activities together with students. Before the treatment, the teacher divided the students into groups. The treatment involved the activities students participate individually and in group. The lessons included also class and group discussions. Students discussed about both the questions about the conservation of energy directed by their teacher and the outcomes they reached as group (six group, each of which has five students), comparing it with that of other groups. Treatment was completed in six lecture hours (each 40 min) in two weeks (three lecture hours per week). One week later after the treatment, the achievement test was administered to both control and experimental group as post-test.

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Data Analysis

Test scores were analyzed by using SPSS software in order to explore the effect of the treatment on students' achievement of energy conservation. Previously, whether the data meet the assumptions of variance analysis was investigated. Then research hypothesises were tested respectively. The teacher' observation notes and student interviews were analysed by searching the specific outcomes of the treatment. At first, interview records were transcripted. The transcripts and teacher observation notes were analysed according to effects of the treatment on students'learning and class atmosphere.

Results of Research

Descriptive statistics related to total mean scores of pre-test and post-test are given in Tablo II according to groups and gender.

Table 2. Observed means, adjusted means and standart devations for achievement, by treatment and gender.

groups	gender	n	pre-test		post-test	
			M	SD	M	SD
experimental	*male*	16	36.45	13.2	73.12 (74.89)*	20.8
	female	14	48.21	16.0	77.74 (73.58)	15.5
	total	**30**	**41.94**	**15.5**	**75.27 (74.23)**	**18.3**
control	*male*	14	38.69	11.6	65.83 (66.48)	14.5
	female	15	37.22	12.9	63.89 (65.27)	15.6
	total	**29**	**37.93**	**12.1**	**64.82 (65.87)**	**14.8**

*Adjusted means are given in parentheses

Table 3. Analysis of Covariance of Students' Achievement of Energy Conservation Test

Source	SS	df	MS	F	p
Model	4359,60	4	1089,90	4,45	0,003
Intercept	14065,05	1	14065,05	57,50	0,000
Pretest (covariate)	2563,08	1	2563,08	10,48	0.002
Gender	22,49	1	22.49	0.092	0.763
Treatment	999,88	1	999,88	4,09	0,048
Treatment-Gender	4,40E-02	1	4,40E-02	0,000	0,989
Error	13208	54	244,59		
Total	307834,38	59	244,59		

ANCOVA was performed with achievement with regard to energy conservation as dependent variable and pretest achievement as covariate. The independent variables were treatment and gender. The two treatment conditions were demonstration-simulation based instruction and traditional instruction. The interaction of treatment with covariate, *one of the assumptions of variance analysis*, that was used to test for homogeneity of regression for achievement was not statistically important, F (1,59) = 0.132, p = 0.718 . The homogeneity of regression test for the interaction between gender and covairate was also not statistically significant, F (1,59) = 0.097, p = 0.757. This showed that assumptions of parallelism of slopes was met. This situation that supports the result of statistical test given above is also clearly seen in Figure 1a and 1b indicating the graphical distribution of pretest scores across posttest scores. From Figure 1a and 1b, it is clear that there are a parallel and linear tends between pretest and posttest scores. Furthermore, Levene's test for homojeneity of variances showed that variances can be assumed as homogen, F (3,55) = 1,24, p = 0.304. By plotting normal P-P graphics and detrended P-P graphics for pretest and posttest scores, normality assumption of raw scores was tested. The linear trends (Figure 2a and 2c) and random disributions (Figure 2b and 2d) in Figure 2a, 2b, 2c, and 2d indicated that the assumption was also met. ANCOVA was repeated excluding the interactions between treatment and covariate from the model. For the model, Means and standart deviations of scores for the energy conservation achievement pretest and posttest, as well as the adjusted means for the energy conservation achievement posttest, are given in Table II . Result of ANCOVA (Table III) showed a statistically significant main effect for treatment, F (1,59) = 4.09, p = 0.048, (*partial eta squared* = 0.070), favoring simulation-demonstration based instruction over traditional instruction. Thus, the first null hypothesis was rejected. It was accepted the claim that there is a significant difference between 7th grade students' achievements of *Energy Conservation Concept Test* acoording to treatments of demonstration-simulation based instruction or traditional instruction. But, gender or an interaction between treatment and gender on achievement, have not statistically significant effects (Table 3), F (1,59) = 0.092, p = 0.763 and F (1,59) = 0.000, p = 0.989, respectively. Considering the P value concerning the gender, the second null hypothesis was accepted. Also, the interaction between treatment and gender on achievement is given in Figure 3 . Furthermore, as seen in Table 3, the covariate (pretest) has a statistically significant effect, F (1,59) = 10.48, p = 0.002. So, the third null hypothesis was rejected. It means that students' prior knowledges had a significant effect on their posttest scores. It can be said from this that including the pretest in the statistical model as covariate was an appopriate judgement. Also, the findings from the teacher' observation notes and the interview results indicated that there was an atmosphere allowing the students to construct their own learning in class. The followings excerpts were taken from the analysis of the teacher' observation notes and the interviews, which support the claim expressed above:

The experiment attracted most students' attention… they asked me much more questions than other group students do (he mean *traditional group*). " my teacher, the ball' energy increases because it speeds up, do not?"-"when the ball is a higher position from table, its potential energy is higher, isn't it? (teacher's observation note)

> … the students directed their attention to the way the equipment work and experiment equipment, i guess… that is why i experienced little discipline problem. However, i also observed that there were few reserved students exhibiting still some unwillingness (from teacher's observation notes).

> In simulation experiments, some students had had difficulty to use the simulation programe, so i instructed how to use the software. In addition, i allowed them to converse and to interact with eact other during lesson. I think that this approach (he imply using simulation) helped them share their experiences and the results with their peers…. i think that the usage of simulaton attracted most students' attention and helped them understand better the energy topic (from teacher's observation notes).

> "At first, i did not understand the experiment, but when my teacher repeated it, i understood better….i did never be bored doing experient." (interview from student 1)

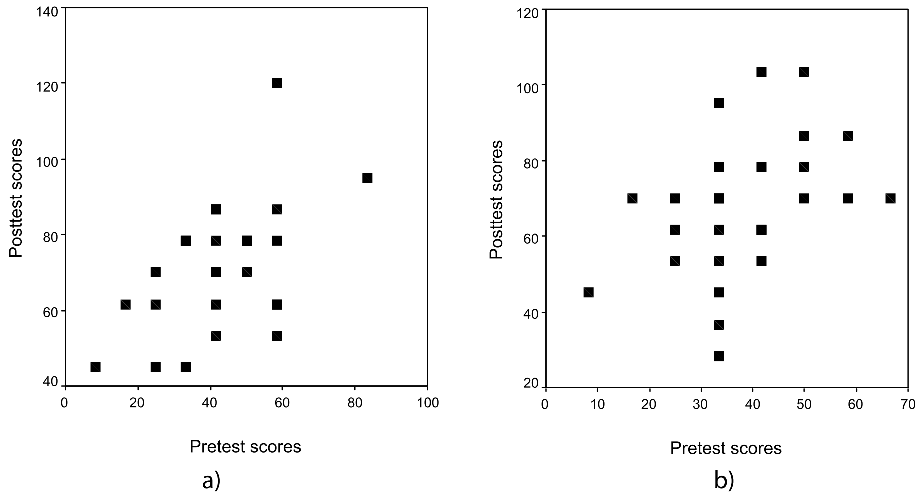

Figure 1. **The graphical distribution of pretest scores across posttest scores according to gender (a- Female b-Male) for homogeneity of regression test.**

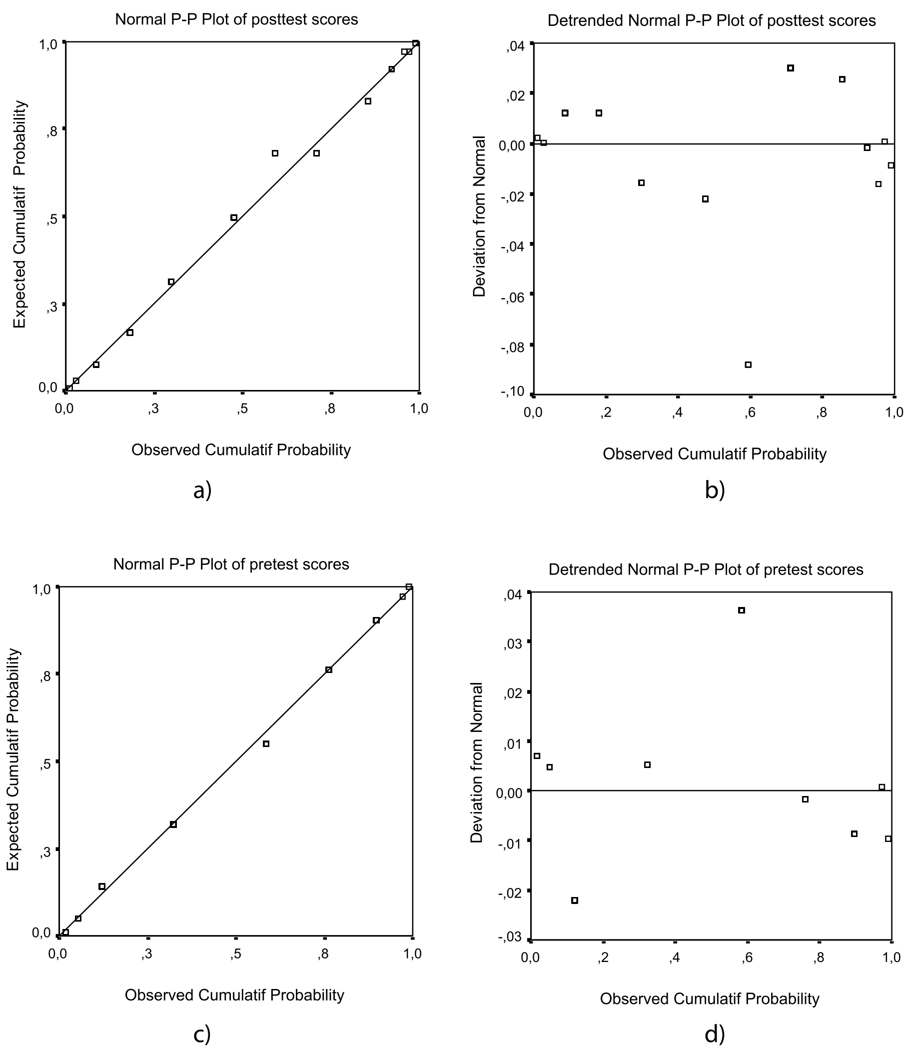

Figure 2. **Normal P-P and detrended P-P plots for pretest (c and d) and posttest scores (a and b)**

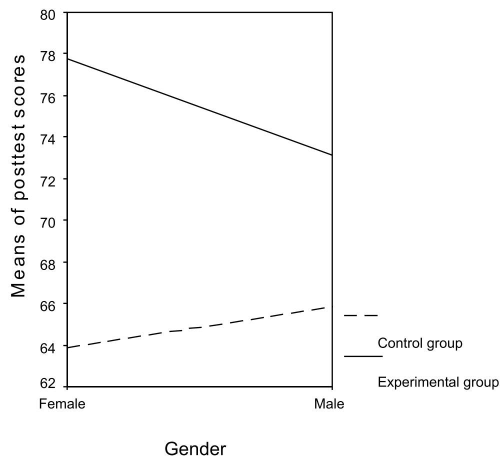

Figure 3. The interaction between treatment and gender on achievement

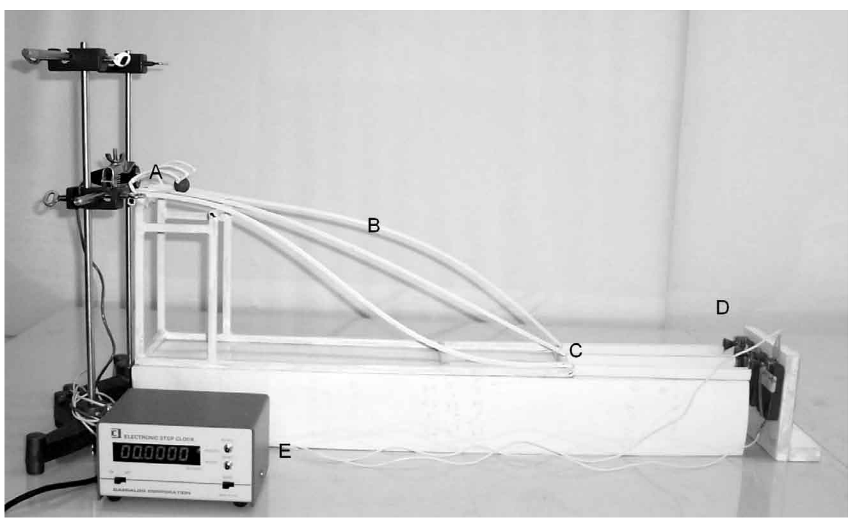

Figure 4. The picture of demonstration equipment.

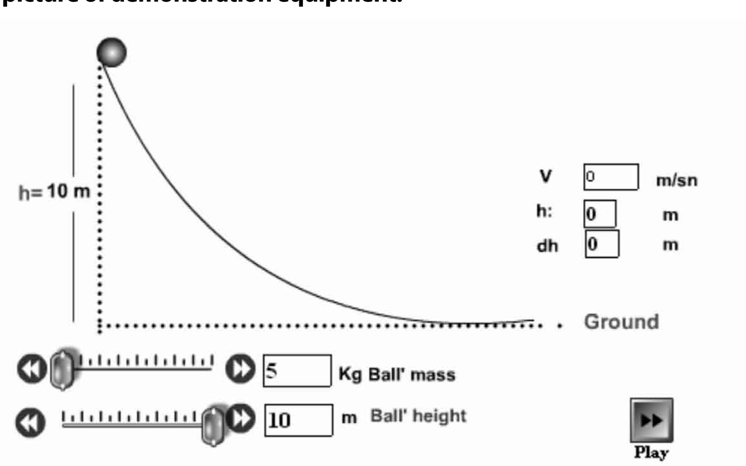

Figure 5. The cross-section for simulation used in the study.

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Conclusions and Implications

The findings of the study showed that there was a significant difference in the energy conservation achievement of 7th grade students according to the treatment of demonstration-simulation based instruction or traditional instruction. Demonstration-simulation based instruction is a more efective way than traditional instruction as regarding learning energy conservation in 7th grade. But, no any difference in achievement was found according to gender across treatment groups. That is to say, both male and female benefited from participation in demonstration-simulation based instruction.

The results of the study showed that using the combined effect of demonstration- simulation instruction in the teaching energy conservation helped students to improve their academic achievement. Both male and female students benefited the same extent from participation in demonstration-simulation based instruction. The findings from the reasearch supported the claim that the analogies, concept maps, and pictures helped students to improve their academic achievement connected with their attitudes and concretizing degree of concepts (Pittman,1999). We believe that simulations and the demonstrations that were organized well will help students to see practice of theoretical principle about energy conservation.

Energy is a difficult scientific concept. Various ideas have been put forward about how to teach it. One extreme point of view is to completely eliminate energy from elementary teaching and to introduce and build up an understanding of it mathematically and on the basis of the concept of work (Warren, 1982).

Kemp (1984) suggested that the concept of energy and the first law can be presented with greater clarity without the notion of work and heat. Programmes should avoid using any simple definition of energy for not being misconceptions. It must not be too complex for the level of development of the students, nor must it be too simple, allowing students to merely use recall. Shadmi (1984) states their common approach: The scientific study of energy has to be done by a step by step definition, while performing several experiments in which we investigate the transformation between an already defined form of energy and a new one; this quantitative investigation can be performed only by use of the working hypothesis that energy is conserved during all its transformations. There is some typical energy for each phenomenon; whenever there is an interaction between two phenomena, the process can be described by means of energy transformations- during all these transformations, the quantity named energy is being conserved.

Computer simulations are believed to be effective for explaining abstract or invisible phenomena in science, and a variety of simulation software has been developed regarding the energy transformation for educational purposes (Imai et al. 2003). Computer simulations also provide students with highly focused objects for reflection and discussion. Working in small groups, students can discuss and argue about their ideas and negotiate meaning. When confronted with discrepant results, they have to reflect on their ideas, discuss and try new approaches, and rerun the program. Students' conversational interactions while working together on the program can provide valuable data for eliciting their conceptual development (Krajcik et al. 1988). Yet, because of the small effect size for the analysis (*partial eta squared* = 0.070; it mean that main effect accounts for %26 of variance), we are aware that these results should be interpreted with caution. In addition, the present research has some limitations, such as time, size of the sample studied and age range of the students, which reduce the population and environment generalizating of the finding of the study. So, it is proposed that 7th grade students' achievement of energy conservation as regarding the effect of demonstration-simulation based instruction be explored further in research studies of greater length across the curriculum and grades.

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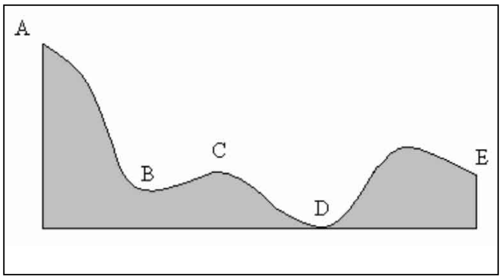
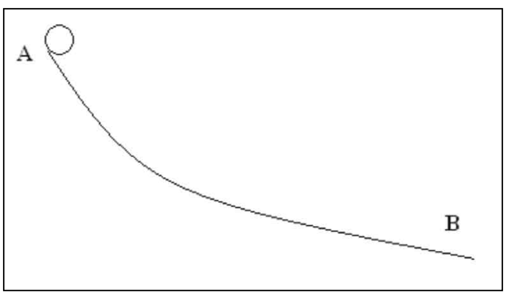
Appendix

Question 1. A rolls down a toboggan run starting from A, as shown, at which point is the ball's kinetic energy a maximum?



A) E
B) B
C) C
D) D

Question 2. Which of the following statement is true for the ball released from A.?



A) The ball's velocity decreases
B) The ball's kinetic energy does not change.
C) The ball's potential energy increases.
D) The ball's potential energy decreases.

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Fatma Aggul	Research Asistant at Ataturk University, Turkey. Ataturk University, Kazım Karabekir Education Faculty, Department of Secondary Teacher Training, 25240 Erzurum, Turkey. Phone: +0904422314030 E-mail: afatma25@mynet.com
Mehmet Yalcin	Assistant Professor at Ataturk University, Turkey. Ataturk University, Bayburt Education Faculty, Department of Primary Teacher Training, 69000, Bayburt, Turkey. Phone: +9004582114682 E-mail: myalcin@atauni.edu.tr
Metin Acikyildiz	Research Asistant at Ataturk University, Turkey. Ataturk University, Kazım Karabekir Education Faculty, Department of Secondary Teacher Training, 25240 Erzurum, Turkey. Phone: ++0904422314030 E-mail: macikyildiz@atauni.edu.tr
Erdal Sonmez	Research Asistant at Ataturk University, Turkey. Ataturk University, Kazım Karabekir Education Faculty, Department of Secondary Teacher Training, 25240 Erzurum, Turkey. Phone: ++0904422314030 E-mail: esonmez@atauni.edu.tr