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The effect of brightness of lamps teaching based on the 5E model on students' academic achievement and attitudes

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The purpose of this research was to examine and compare the effect of teaching the brightness of lamps, which is a topic for grade 11 physics lesson, on student achievement and attitude according to the 5E model belonging to the constructivist learning theory and the traditional teaching method. The research was conducted on 62 11th grade students in İdil High School during the spring semester of 2009/2010 academic year. The quasi-experimental method was used in the research and the significance level was p=0.05. A meaningful difference(p<0.05) was observed on the experimental group according to the results of the independent samples t-test related to the post-test scores of brightness of lamps Achievement Test(BLAT)" of the students in the experimental and control groups. It was concluded that the worksheets applied, cartoons, animation and laboratory activities used while teaching the topic "brightness of lamps " according to the 5E model provided better understanding for the students, increased the motivation related to the lesson, and created a positive effect on understanding abstract concepts. The results of the attitude scale showed that the differences between the groups were insignificant (p>0.05).

Key words: 5E model, constructivist learning, electric, attitude.

INTRODUCTION

Today, the most important purpose of reforms related to education is to provide a system which would help students learn with understanding. In order to manage this, it is agreed that it is necessary to apply new methods through learning and teaching in which prior knowledge of students are considered and the students would be able to attain the information on their own- that is to say that students actively engaged in learning process and take responsibilities in learning. Contemporary approaches emphasize a student-centered teaching which takes student learning as the base.

This is done by considering the individual difference of students and their learning characteristics. The effectiveness of the constructivist learning theory, which is one of

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these approaches, has increased recently. The accumulation of knowledge that a student or an individual possess at any time is very important in responding to new information or stimulus (Burhberger, 2000; Lewis, 2001; Osborne and Wittrock, 1983; Sensoy et al., 2006). Teachers in many countries, especially in developed countries are welcoming educational understanding based on the constructivist approach with open arms (Powell et al., 1986).

In this country, primary and secondary education curricula have been prepared based on the constructivist approach since 2005/2006 academic year. Secondary education physics curriculum was developed according to modern learning theories and approaches, and the constructivist approach was adopted in the studies of the curriculum. This was done because it is possible to say that it advocates a student-centered learning and tries to provide a learning environment which would contribute to increasing high-level student motivation and thinking skills (Boddy et al., 2003).

In constructivist student-centered classrooms, the mental energy of a student is always high in most of the lessons. Students are encouraged to hypothesize and test these hypotheses. They do not receive the explanations made by teachers passively. They acquire the necessary skills to apply what they have learnt to other problems (Limon, 2001; Smerdon et al., 1999).

The constructivist approach is student centered but it is controlled by teachers. The mental energy of a teacher is also elevated because he/she guides students during lessons as they structure the information. The increase in students' interest increases teachers' efforts and by this, a more productive and enjoyable learning environment is provided. An ideal learning environment increases involvement, critical thinking and permanence of knowledge (Lord, 1999). Also, by this, students may check their own learning process (Brooks and Brooks, 1999).

Different learning and teaching models have been developed for the use of the constructivist learning approach. One of these models which have been carried out recently with different process phases in the education process is the 5E learning model. The 5E model is a science teaching method which depends on research-based constructivist learning theory and experimental activities. This model was developed by Rodger Bybee, who is one of the leading names of Biological Science Curriculum Study (BSCS), in 1967 (MMS, 2002). In the researches conducted on the 5E model, there are findings which support that the model increases achievement of students, provides their conceptual development and positevly changes their attitudes (Ozsevgec et al., 2006; Saglam, 2006).

The 5E model has been built on the results of researches which have been determined within the standards of national science education (Newby, 2004).

The model consists of 5 phases they are:

1. Engage-Enter
2. Explore
3. Explain
4. Elaborate and
6. Evaluate (Carin and Bass, 2005).

The phases of the 5E model can be briefly explained as follows:

Engage: The lesson begins with an intriguing introduction which would provide a situation for students to understand a problem that they encounter.
Explore: Students produce ideas to solve problems by working together.
Explain: The teachers encourage students to describe what they have done and to explain the results while the teacher provides scientific explanations.
Elaborate: Students are encouraged to apply what they have learned to new situations.
Evaluate: This is the phase in which students are expected to reflect their understanding. In this phase, they also change their ways of thinking or their behaviours.

The 5E models helps in learning a new concept or understand a well-known concept thoroughly (Ergin et al., 2006).

In this country, various activities and materials have been developed according to the constructivist learning theory (Gurses, 2006; Ozmen and Yildirim, 2005; Ozsevgec et al., 2006; Sifoglu, 2007). These developed activities and materials are generally prepared in accordance with the 5E model. It has been expressed that this is the model whose usability is the highest (Gurses, 2006). As a result of the review made in the literature, it has been observed that most of the materials which were prepared according to the 5E model are in accordance with all stages of the model and equal emphasis is laid on each stage (Er Nas et al., 2007; Gurses, 2006; Orgill and Thomas, 2007).

It is known that students in many conducted researches could not easily learn physics concepts, which are artificial, and they make mistakes in these concepts (Kucukozer, 2004). In his research, Keser (2003) determined that there were many conceptual problems which are thought to be caused by the contents of many artificial concepts such as atom, electric charge and electrification.

Teaching of electricity as a topic using the 5E model of the constructivist approach and researching the effect of this model on the academic success and attitudes of students would be important to provide effective, permanent and meaningful learning.

Aim of the study

The purpose of this research is to search the effect of teaching the brightness of lamps, which is an 11th grade physics lesson, using the 5E model of the constructivist learning theory and the traditional method on academic achievement and attitudes of students.

METHODOLOGY

The quasi-experimental method was employed in this research. The research has a pretest-posttest design with experimental and control groups. This method appoints the sample to the groups randomly and determines the groups (Cepni, 2010). The application was carried out in both the experimental and control groups by the researcher.

Participants

The study population of the research consisted of 62 grade 11 students attending İdil High school in the Şırnak province during the 2009/2010 academic year. The control group had 33 students and the experimental group, 29 students. These students were selected according to the random sampling rule. Group and individual differences of students in both groups were minimized before starting the application by means of random appointment.

Data collection tools

In this research, Brightness of Lamps Achievement Test (BLAT) and Science Attitude Scale were used as data collection tools.

Achievement test

The achievement test, which was used to determine the effect of the 5E model, was suggested for the constructivist learning theory on academic achievement of students. It was prepared by asking for experts' opinions. A test including 20 questions that match up with the attainments based on the grade 11 physics course book of the Ministry of National Education (MNE) was prepared. This test was conducted on 60 grade-12 students who studied this topic the previous year. Five questions whose item distinguishing index was 0.19 or less were eliminated in consequence of SPSS 16.0 item analysis and the number of questions in LPBT was decreased to 15. The reliability of the test was determined as 0.737 by using Kr-20. Thus, the tests carried out in the experimental and control groups were obtained.

Science attitude scale

The science attitude scale (SAS) which was carried out before and after the application was developed by Yaşar Baykul and its reliability was calculated as 0.92. This 30-item likert-type attitude scale consists of 5 degrees which are "I completely agree, I agree, I am doubtful, I disagree, I never disagree" (Dalkiran & Kesercioglu, 2005).

Data analysis

The data collected in the research was analyzed using statisitical package for social sciences (SPSS) 16.0 statistical package program. Independent t test was used in comparing the experimental and control groups with each other while evaluating the scores obtained from the brightness of lamps achievement test and the attitude scale related to physics lesson. The dependent t test was employed to compare the pretest and posttest scores within both groups. In both t-tests, the significance level was accepted as 0.05.

Application of the research

The research was designed and applied during the 2009/2010 academic year. The research was designed according to the semi-experimental method and its application was carried out during the spring semester. The application phase of the research was carried out 3 hours weekly for 3 weeks in the experimental and control groups.

During the 3 h of physics lessons per week, the students in the experimental group were divided into groups of two and three before applications. In order to provide an environment in which they would use their time productively while collaborating, students were allowed to choose their own group. This is appropriate for the 5E model. The purpose of dividing students into groups is to create a competitive environment between the groups and to encourage them help each other as a team. The Brightness of Lamps Achievement Test (BLAT) was applied as the pretest to the students in the experimental and control groups.

The students in the experimental group received worksheets and they did activities related to the topic. In order to enable the students in the experimental group to visualize the topic in their minds, increase visual richness during lessons, animations and demonstrations collected from various resources were displayed through computers. Besides, cartoons obtained from various resources and circuit schemas were exhibited at a location in the classroom that students could easily see during the application.

The lesson plan given to the students in the experimental group was also provided for the students in the control group within the period according to the traditional teaching methods. It is possible to characterize the traditional teaching environment as a classroom environment in which students study on their own and they are extremely dependent to course books and workbooks. Therefore, the students in the control group were informed about the topic to be studied one week before and they were told to come to lesson prepared. The subject to be studied was explained by the researcher and significant points were emphasized. Then, the students were asked various questions in order to measure whether they understood the topic and to help them strengthened the information. Techniques which are supplementary resources oriented, worksheets and course book-centered tests were also used, along with verbal lecture. In consequence of the study process, The Brightness of Lamps Achievement Test (BLAT) was applied as the posttest to both experimental and control group.

FINDINGS

The BLAT pretest scores of the students of the experimental group in which the lesson was studied according to the 5E model and the students of the control group in which the lesson was taught according to the traditional teaching method were compared using the independent t-test and the results are given in Table 1 and Figure 1.

Table 1. Results of t-test related to the BLAT pretest scores of the students in the experimental and control groups.

Measurement	N	X	Std. Dev.	Df	t	p
Pretest (Control)	33	3.88	1.244	60	-0.121	0.904
Pretest (Experimental)	29	3.93	2.086			

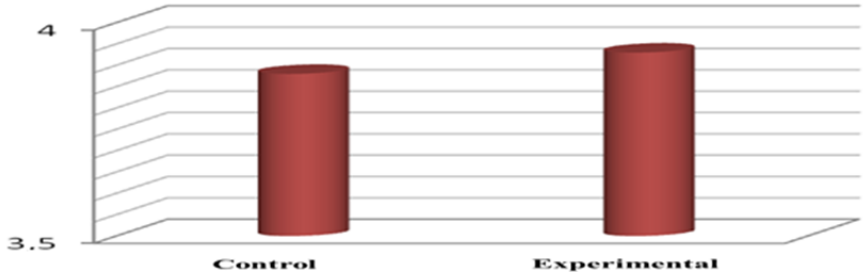

Figure 1. BLAT pretest mean value.

Table 2. Results of the t-TEST related to the BLAT posttest scores of the students in the experimental and control groups**.**

Measurement	N	X	Std.Dev.	Df	t	p
Posttest (Control)	33	5.73	2.541	60	-4.349	0.037
Posttest (Experimental)	29	8.31	2.072			

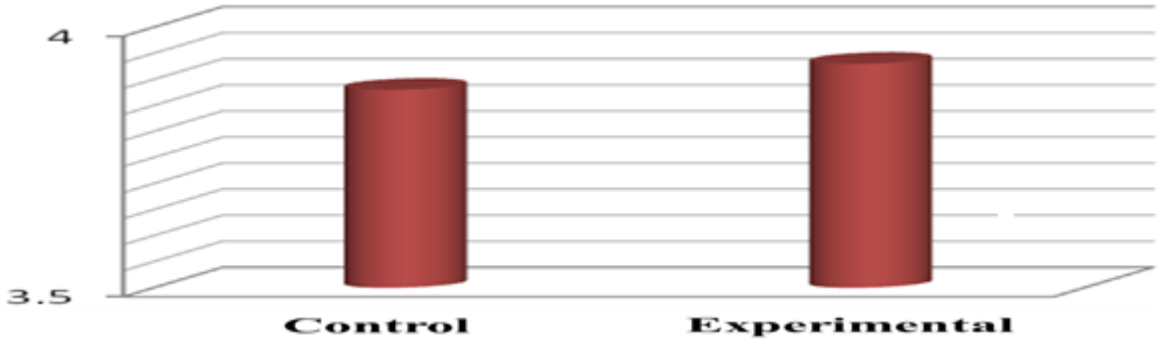

Figure 2. BLAT posttest mean values

As can be seen in Table 1, there is no meaningful difference between the pretest scores of the experimental and control groups (p= 0.904 >0.05). Accordingly, it is likely to say that both groups were close to each other before studying the topic. BLAT posttest scores of the experimental and control groups were compared by means of independent t-test, and the results are given in Table 2 and Figure 2.

Table 2 shows that there is a considerable difference between the posttest scores of the control group and the experimental group (p = 0.037 <0.05). In the post test, the experimental group was more successful than the control group. The dependent t-test analysis was conducted in order to understand whether there was a meaningful difference between the pretest and posttest scores of the students in the experimental and control

Table 3. Results of the t-test related to the BLAT pretest and posttest scores of the students in the experimental group.

Measurement	N	X	Std. Dev.	Df	t	p
Pretest	29	3.93	2.086	28	-18.639	0.000
Posttest	29	8.31	2.072			

Table 4. The results of t-test related to the BLAT Pretest-posttest scores of the students in the control group.

Measurement	N	X	Std.Dev.	Df	t	p
Pretest	33	3.88	1.244	32	-4.499	0.000
Posttest	33	5.73	2.541			

Table 5. Results of the t-test related to the "affection" subfactor of the students in the experimental and control groups.

Pretest	Groups	N	X	Std.Dev.	Df	t	p
Affection	Control	33	25.33	6.392	60	1.033	0.878
	Experimental	29	23.76	5.495			

groups.

BLAT pretest and posttest scores of the students in the experimental group was compared using dependent t-test, and they are given in Table 3. As seen in Table 3, there is a significant difference between the pretest and posttest scores of the experimental group (p= 0. 000 <0.05). Students in the experimental group were more successful in the posttest in comparison with the pretest. The results of the t-test related to BLAT pretest-posttest scores of the students in the control group are given in Table 4.

When Table 4 is examined, it is seen that there is a meaningful difference between the pretest and posttest scores of the control group (p =0. 000 <0.05). The control group was more successful in the posttest in comparison with the pretest. When the groups are compared, it is seen that BLAT pretest mean score of the experimental group is 3.93; pretest mean score of the control group is 3.88. Posttest score means of the experimental and control groups are 8.31 and 5.73 respectively. As seen, there is no a meaningful difference between the pretest scores of the groups but there is a significant difference on f the experimental group in terms of posttest scores.

The results of the attitude scale

The attitude scale used in the research has 3 subfactors. The items numbered 1,4,7,10,13,15 and 18 are related to the "affection" subfactor, the items numbered 2,5,8,12,14 are related to the "interest" subfactor and the items numbered 3,6,9,11,16 and 17 are related to the "importance of physics in daily life" subfactor. The results of the scale were evaluated using t-test according to these factors.

Examination of "affection" subfactor

Pretest scores of the experimental and control group students related to "affection" subfactor were compared using independent t-test and the results are given in Table 5. According to Table 5, there is no significant difference between the pretest scores related to the "Affection" subfactor of the students in the experimental and control groups (p =0. 878 >0.05). Posttest scores related to the "Affection" subfactor of the students in the experimental and control groups were compared by means of independent t-test and the results are displayed in Table 6. As seen in Table 6, there is no significant difference between groups (p=0.738 >0.05). This result shows that there are no changes in the attitudes of the students in terms of "affection" subfactor.

Examination of "interest" subfactor

Pretest scores of the experimental and control groups

Table 6. Results of the t-Test related to the posttest scores belonging to the “affection” subfactor of the students in the experimental and control groups.

Posttest	Groups	N	X	Std.Dev.	Df	t	p
Affection	Control	33	24.36	7.176	60	0.226	0.738
	Experimental	29	23.97	6.598			

Table 7. Results of the t-test related to the pretest scores belonging to the “interest” subfactor of the students in the experimental and control groups.

Pretest	Groups	N	X	Std.Dev.	Df	t	p
Interest	Control	33	11.67	2.723	60	-1.169	0.450
	Experimental	29	12.52	3.007			

Table 8. Results of the t-test related to the posttest scores belonging to the “interest” subfactor of the students in the experimental and control group.

Posttest	Groups	N	X	Std.Dev.	Df	t	p
Interest	Control	33	11.45	2.862	60	-0.837	0.558
	Experimental	29	12.10	3.244			

related to the “Interest” subfactor were compared using independent t-test and the results are given in Table 7. According to Table 7, there is no considerable difference between the pretest scores of the experimental and control groups related to the “Interest” subfactor of the attitude scale (p=. 450 >0.05). Posttest scores related to the “Interest” subfactor of the experimental and control groups were compared using independent t-test and the results are given in Table 8. According to Table 8, as the significance level is (p=0.558>0.05), there is no meaningful difference between the groups. It is possible to say that this study could not make a meaningful difference in the attitudes of the students in terms of “interest” subfactor.

Examination of “importance of physics in daily life” subfactor

The pretest scores of the experimental and control groups related to the “importance of physics in daily life” subfactor were compared using independent t-test and the results were given in Table 9. When Table 9 is examined, it is seen that there is no significant difference between the pretest scores of the experimental and control groups in terms of “importance of physics in daily life” subfactor (p=0.114>0.05). The posttest scores of the experimental and control groups related to the subfactor “importance of physics in daily life” were compared using independent t-test and the results are given in Table 10. As the significance level was (p=0.214>0.05) according to Table 10, no significant differences were determined between groups. It is possible to say that this study did not make any differences in student attitudes in terms of “importance of physics in daily life” subfactor.

RESULTS AND DISCUSSION

In the research, the effects of teaching the topic “Brightness of Lamps” according to the 5E model on academic achievement and attitudes of students were investigated and the following results were obtained:

It was observed that there were no significant differences between the results of the BLAT pretest applied to the students in the experimental and control groups. As a result, it was observed that the students in the experimental group in which the 5E model was carried out were more successful than the students in the control group. For the experimental group in which lessons were studied in accordance with the 5E model, a considerable difference was observed between the success points of BLAT which was carried out before and after the application. Based on this result, it is possible to say that lessons which are taught in accordance with the constructivist E model with computer-support and material use, have a great effect on the students’ achievements.

Table 9. Results of the t-test related to the pretest scores of the students in the experimental and control groups in terms of “importance of physics in daily life”.

Pretest	Groups	N	X	Std.Dev.	Df	t	p
Importance of physics in daily life	Control	33	21.94	2.715	60	2.314	0.114
	Experimental	29	20.14	3.409			

Table 10. Results of t-test related to posttest scores of the students in the experimental and control groups in terms of the subfactor “importance of physics in daily life”.

Posttest	Groups	N	X	Std.Dev.	Df	t	p
Importance of physics in daily life	Control	33	22.18	3.015	60	2.144	0.214
	Experimental	29	20.41	3.480			

Similar results were found in consequence of investigation in other literatures (Akdeniz and Keser, 2003; Aydogmus, 2008; Balcı et al., 2006; Er Nas et al., 2010; Ergin et al., 2006; Gurses, 2006; Hand and Treagust, 1991; Kilavuz, 2005; Ozerbas, 2008; Ozmen and Yildirim, 2004; Ozsevgec, 2007; Ozsevgec et al., 2006; Saglam, 2006; Saka, 2006; Wilder and Shuttleworth, 2004; Yildiz, 2008).

In the research, it was determined that the worksheets used in the lessons which were taught according to the 5E model had positive effects on understanding abstract concepts by students. The search done in the literature provided similar results obtained in this research (Gurses, 2006; Ozmen and Yildirim, 2005). According to the results obtained from some researches, the strengths of worksheets which are considered to be effective on students’ achievements can be regarded as: depending on individual group work and collaborative learning (Ozmen and Yildirim, 2005; Saka, 2006); placing emphasis on association with daily life (Ozsevgec, 2007); and including activities which are based on simple equipment (Keser, 2003).

In the research, it was observed that the cartoons, animations and laboratory activities which were used in lesson teaching based on the 5E model increased students’ motivation towards the lesson and created positive effects on understanding abstract concepts. Similar results were found (Yalcın, 2003). In the research, it was determined that one-on-one interviews with the students and group works in the experimental group affected their motivation to learn in a positive way. Similar results were provided in Ozmen and Yildirim (2005) and Turker (2009).

The results of the attitude scale applied in the research shows that there are no significant differences in terms of attitude levels towards physics lesson between the experimental and control groups, but it was observed that the students in the experimental group were more willing and interested in the lesson during application. The search in the literature shows that there are researches having similar (Aydogmus, 2008) and contrary results- that is to say, researches show that the lessons which are studied according to the 5E model change the attitudes of the students in a positive way (Akar, 2005; Balcı et al., 2006; Baser, 2008; Boddy et al., 2003; Kocakulah and Kocakulah, 2007; Seyhan and Morgil, 2007; Turker, 2009).

In the research, it was seen that it is quite hard under the conditions of our country to teach all lessons through activities in which the 5E model is used. Similarly, it was determined by Sezen et al. (2009) in their research which was conducted with teachers of that some subjects were not appropriate for the 5E model and the models had some problems such as the time-consumption. It was stated that preservice teachers had difficulties in the phases of the model during application; they could not establish classroom authority. Related to the students, it was observed that their prior knowledge was inadequate and they got bored using of the model continually. In some research, it was expressed that materials were inadequate while using the 5E model (Baskan et al., 2007; Bozdogan and Altuncekic, 2007).

SUGGESTIONS

1. Teachers should be informed about the use of constructivist approach, which is one of the new learning approaches.
2. While evaluating student success, performance of students should be considered, along with written exams and tests. Besides, students should save their works and portfolios ought to be formed in order to take these works into evaluation.
3. It has been observed that while applying the 5E model, application phase takes long time. It is possible to use

time more effectively by giving students homework for enter and evaluation phases.
4. It is necessary to use multimedia combining graphics, animations, simulations, sounds, colors, softwares and video clips in the teaching environment, along with real models and shapes.

Conflict of Interests

The author has not declared any conflict of interests.

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