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The effects of constructive learning method on students' academic achievement, retention of knowledge, gender and attitudes towards science course in “matter of structure and characteristics” unit

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Abstract

The purpose of this research is to examine on students' academic achievement, retention of knowledge and attitudes towards science course in matter of structural and characteristic subject with constructivist education version. This study was conducted with students 7/A (N=34) and 7/B (N=34) located in Ankara, during the spring period of 2008-2009 academic year. The study used a quasi-experimental research design with pre-test and post-test control group was used in this study. According to this research model achievement test and the scale of attitudes towards science were administered before and after instructional intervention. Achievement test were given both groups three months after intervention as retention test. Students in the control group were taught by traditional teaching method (narrative, question and answer, discussion, etc). The experimental group was taught constructive education besides traditional teaching method. The implementation was carried out in a four week period. After implementation, post-test (achievement test) was administered to both groups. The independent samples t-test was used to compare pretests and posttests of control and experimental groups. The findings of the study show that there is a significant difference in favour of the experimental group who taught by constructive education version over the control group regarding to averages of academic achievement scores. Achievement test scores of experimental group were found higher than the control group after instructional intervention. Results of the study showed no meaningful difference between the experiment and control group according to attitudes towards science course. It can be stated that the teaching method used in experimental group was more successful, thus students in experimental group was scored high in the achievement test for retention.

Keywords: Constructive learning, Academic achievement, Structure and Characteristics of Matter

1. Introduction

In constructivism, which wants individuals do not take knowledge passively from the environment but taking responsibility in learning process and being active, learning theories are used such as cooperative learning, problem based learning and project based learning. Constructivist learning applications predict a rich and interactive learning environment which supplies student requires to reach the knowledge, get and analyze it, arrange and use it in order to solve the problems by the way of cooperative learning activities. In the learning process, student is expected to produce his/her own product by searching, doing decisions, collaborating, using high level thinking skills and using his/her own creativeness. In this regard, constructivist learning applications encourage the pupils “doing about something” instead of “learning about something”.

The meaning of constructivism varies according to one's perspective and position. Within educational contexts there are philosophical meanings of constructivism, as well as personal constructivism as described by Piaget

(1967), social constructivism outlined by Vygotsky (1978), radical constructivism advocated by von Glasersfeld (1989), constructivist epistemologies, and educational constructivism (Mathews, 1998). Social constructivism and educational constructivism (including theories of learning and pedagogy) have had the greatest impact on instruction and curriculum design because they seem to be the most conducive to integration into current educational approaches (Jones & Brader-Araje, 2002).

During the recent years, there has been an increasing awareness of the importance of identification students' understanding and learning difficulties about many science topics (Nakhleh), 1992; Nicoll, 2001). These researcher indicated that teacher centred traditional approach fail to encourage students to think, share ideas and hypotheses and this cause the lower learning achievement (Acar & Tarhan 2007 and 2008; Bodner, 1986; Felder, 1996; Nakhleh, 1992).

The constructivist approach accepts that the learner constructs the knowledge him/herself both individually and socially (Özden, 2005). The common view of the philosophers influencing constructivism is that learners mentally construct the knowledge through the participation of students. The learner makes his/her own comment about the world she/he lives. According to constructivists, knowledge is actively constructed by the learner trying to make his experiences more meaningful (Yurdakul, 2005).

Purpose of the research

The purpose of this study was to use constructive learning method and identify its affects on students learning achievements, retention of knowledge and attitudes towards science course. To enhance this aim the following sub-questions were investigated;

- a) What is the level of 7th grade students' understanding of the basic concepts for learning '*structure and characteristics of matter*'
- b) What is the effect of constructive learning method on 7th grade students' understanding of '*structure and characteristics of matter*' in comparison with traditional approach?
- c) Does the approach of the students towards science differ significantly between different genders?

2. Sample

Sixty- eight 7th grade (14 years of aged) students from two different classes taught by the same teacher in a primary school in Ankara, in Turkey participated in this study. One of the classes was randomly assigned to experimental (N=34), while the other as a control group (N=34). Students in the experimental group taught with constructive learning method and those of in control group taught with teacher centered traditional approach.

3. Method (Instruments)

A pre-test by twenty-five multiple-choice items was developed to identify students' pre-knowledge and concepts that are basis for learning '*structure and characteristics of matter*' such as solubility, element, compound, mixture, pure substance, the number of neutrons. The Structure and Characteristics of Matter Test (SCMT) by twenty multiple choice including an open-ended part was developed to identify students understanding of '*matter of structure and characteristics*' by considering constructive learning method. For the content validation and reduction of errors, the items were examined by university members and elementary science teachers. The test was piloted with 252 8th grade students for the reliability. After the item analysis the reliability of test was found to be 0.72.

To ensure the reliability of this study and also make more information about students' unclear responses to Structure and Characteristics of Matter Test, 15 minute semi-structure interviews were carried out with five students from

experiment and five students from control groups whose responds were the most irrelevant. During the interviews researchers asked the students to explain the reasons of their answers.

4. Tables and Results

In order to identify students’ prior knowledge which are basic for learning ‘ Structure and Characteristics of Matter Test’ (SCMT) the pre-test was applied. T-test was used to compare the tests scores of the experimental and control groups. As seen in **Table 1**, it was found that the mean scores of the experimental and control groups were 10.26 and 7.97 respectively and statistical results showed that there were significant differences among experimental and control groups in terms of pre-test, $t(66) = 2.91, p = .005 < .05$.

Table 1. Independent Sample for t-Test Results of the Groups’ Pre-Test Scores on SCMT

Group	n	\bar{X}	S	t	df	p
Exp.group	34	10.26	3.96	2.909	66	.005
Contr group	34	7.97	2.34			

In order to identify students’ understanding of ‘Matter of Structure and Characteristics’, the achievement test was applied and the test scores of the experimental and control groups were compared by T-test. The results showed that while the mean score of the experimental group was 17.15, the mean score of the control group 10.53 and there was significant difference between group (**Table 2**).

Table 2. t-test Results of Achievement Test

Group	Pre- test			Post- test		
	n	\bar{X}	S	n	\bar{X}	S
Experimental	34	10.26	3.96	34	17.15	2.06
Control	34	7.97	2.34	34	10.53	1.78

In order to identify students’ attitudes towards science, the attitudes test was applied and the test scores of the experimental and control groups were compared by T-test. The results showed that while the mean score of the experimental group was 118.47, the mean score of the control group 107.79 and $t(66) = 3.08, p = .003 < .05$. Therefore, there was significant difference between experimental group and control group (**Table 3**).

Table 3. Comparison of the pre-test scores of attitude towards science of experimental and control group

Group	n	\bar{X}	S	t	df	p
Experimental	34	118.47	13.26	3.08	66	.003
Control	34	107.79	15.21			

The results showed that while the mean score of the experimental group was 125.29, the mean score of the control group 115.97. Therefore, there was significant difference between experimental group and control group (**Table 4**). Moreover, there is an increase in both experimental group and control group in attitude towards science.

Table 4. Comparison of the post-test scores of attitude towards science of experimental and control group

Group	Pre- test			Post- test		
	N	\bar{X}	S	n	\bar{X}	S
Experimental	34	118.47	13.26	34	125.29	9.40
Control	34	107.79	15.21	34	115.97	9.99

The results showed that while the mean of pre-test score of the girls was 9.03, the mean of pre-test score of the boys 9.24 and $t(66) = -0.255$, $p = .800 > .05$. Therefore, there was not a significant difference between girls and boys in terms of achievement (**Table 5**).

The results showed that while the mean of post-test score of the girls was 13.79, the mean of post-test score of the boys 13.90 and $t(66) = -0.107$, $p = .915 > .05$. Therefore, there was not a significant difference between girls and boys in terms of achievements (**Table 5**). Moreover, there is an increase in both girls and boys at achievements.

Table 5. t- Testi Results of achievement pre-test and post-test in terms of their genders

Test	Group	N	\bar{X}	S	t	Sd	p
Pre-test	Girl	39	9.03	3,41	-0.255	66	.800
	Boy	29	9.24	3,51			
Post- test	Girl	39	13.79	3,28	-0.107	66	.915
	Boy	29	13.90	4,55			

The results showed that while the mean of pre-test score of the girls was 113.95, the mean of pre-test score of the boys 112.03 and $t(66) = 0.512$, $p = .610 > .05$. Therefore, there was not a significant difference between girls and boys in terms of attitude towards science (**Table 6**).

The results showed that while the mean of post-test score of the girls was 121.31, the mean of post-test score of the boys 119.72 and $t(66) = 0.600$, $p = .550 > .05$. Therefore, there was not a significant difference between girls and boys in terms of attitude towards science (**Table 6**). Moreover, there is an increase in both girls and boys at attitude towards science.

Table 6. t- Testi Results of attitude towards science pre-test and post-test in terms of their genders

Test	Grup	N	\bar{X}	S	t	Sd	p
Pre-test	Girl	39	113.95	15.81	0.512	66	.610
	Boy	29	112.03	14.42			
Post-test	Girl	39	121.31	10.78	0.600	66	.550
	Boy	29	119.72	10.73			

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