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Yapılandırmacı Öğretimin Fen Öğretimi Dersinde Başarı ve Tutuma Etkileri

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Abstract

The purpose of this study was to examine the effects of constructivist instruction on the fourth grade preservice science teachers' achievement, attitude towards science teaching of in Science Teaching Methods II course. Two groups were assigned from Hacettepe University Faculty of Education Department of Science Education. Experimental group consisted of 53 and the control group consisted of 50 preservice science teachers. Quasi experimental research design was used. Constructivist instruction was used in experimental group and traditional instruction was used in control group This research study was conducted in fall semester of the 2007-2008 academic year and lasted 15 weeks. A mixed between within ANOVA with repeated measures was used as a statistical technique for analyzing data. Statistical mean difference was obtained for all tests in favor of experimental group at the end.

Key Words: *Constructivist instruction, constructivist learning model, preservice science education, attitude towards science teaching, achievement in science teaching methods II course.*

Effects Of Constructivist Instruction On Achievement And Attitude In Science Methods Course

Özet

Bu araştırmanın amacı, yapılandırmacı öğretimin dördüncü sınıf Fen ve Teknoloji öğretmen adaylarının akademik başarı ve fen öğretimine karşı tutumlarına etkisini incelemektir. Hacettepe Üniversitesi Eğitim Fakültesi Fen Bilgisi Eğitimi'nden iki grup belirlenmiştir. Deney grubu 53, kontrol grubu ise 50 öğretmen adayından oluşmaktadır. Araştırmada yarı deneysel desen kullanılmıştır. Deney grubunda yapılandırmacı öğretim, kontrol grubunda geleneksel öğretim kullanılmıştır. Araştırma, 2007-2008 güz akademik döneminde gerçekleştirilmiş ve 15 hafta sürmüştür. Verileri analiz etmede tekrarlayan verilerde varyans analizi tekniği kullanılmıştır. Sonuçta deney grubu lehine istatistiksel olarak anlamlı bir farklılık elde edilmiştir.

Anahtar Sözcükler: Yapılandırmacı öğretim, yapılandırmacı öğrenme modeli, fen öğretmen eğitimi, fen öğretimine karşı tutum, fen öğretimi II dersindeki başarı.

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Introduction

Constructivism was especially recognized by elementary education field with the curricula developed in elementary education level during 2004-2005 academic year. Explaining and understanding the concept of constructivism became very important with this alteration process on education in Turkey. Turkish researchers started to conduct research regarding constructivism and their impacts on education at the beginning of 1990s. Most of the research studies were conducted in elementary level and researchers identified the implications of their studies. Suggestions and implications of the research studies about constructivism in elementary level in Turkey showed that Number of studies related to constructivism in preservice teacher education level is limited (Uzuntiryaki, 2003; Yurdakul, 2004).

"Constructivism is a theory about knowledge and learning; it describes both what "knowing" and how one "comes to know". Based on work in psychology, philosophy and anthropology, the theory describes knowledge as temporary, developmental, nonobjective, internally constructed, socially and culturally mediated." (Fosnot, 1996, p.ix). This definition stresses that constructivism is a theory about knowledge and learning, it is not an instructional theory and construction of knowledge is individual and influenced by socio-cultural characteristics in terms of this theory.

Every type of knowledge in the world can be changed in terms of learners' experiences, views and they are tentative and open to improve and change according to the constructivist approach rather than teaching students to accept "what is known" simply on the basis of authority in traditional approach. Explanations of events can be changed related to different consequences or multiple causal influences.

The concept of student-centered curriculum was more emphasized in Science Curriculum 2000 in Turkey than the other curricula which were implemented before. Teacher is not the person who only transfers knowledge to the students; but teachers learn with the students, being a guide for students and providing proper teaching and learning environments in terms of this curriculum. Students' role is to discover and learn the knowledge by themselves (MEB, 2000). This curriculum was changed four years later. The newly developed Science and Technology Curriculum was accepted and started to be piloted in some elementary schools in 2004-2005 academic year and started to be used all around the country in 2005-2006 academic year.

These changes in curricula also affected the pre-service teacher education. Teachers' abilities of teaching, their planning and decision making processes shaped the teaching and learning environments. Pre-service teacher education today is based on contrasting trends. Higher education Council in Turkey has done restructuring in pre-service teacher education programs in terms of the developments in elementary school curricula (Higher Education Council Course Definition Documents, 2006). Name and the content of the courses were changed also in science teacher education programs related to the application process of Science and Technology Curriculum in this renovation process. Science Teaching Methods course is one of the fundamental courses in pre-service science teacher education. This course which covers fundamental principles of science education and their application consists of two courses: Science Teaching Methods I and Science Teaching Methods II. In terms of the nature, purpose and description of the course, the meaning of constructivism and its applications related to the science education are given in Science Teaching Methods II course.

Although there are lots of studies measuring the effects of constructivist learning environments, Akar (2003) emphasized that there weren't enough research studies on the impact of constructivist teacher education on student learning and suggested to conduct more experimental research studies for understanding the impact of constructivist learning process on student learning in pre-service teacher education specifically. Beck and Kosnik (2006) claimed that pre-service educators and educational administrators were interested in considering ways to enhance their pre-service programming.

Pre-service educators may obtain valuable information from the research studies about new approaches in education for different fields. The number of studies about pre-service teacher education should be increased because of this reason.

Many of the research studies related to constructivism were conducted in primary and elementary schools. If the research studies about constructivism in pre-service, inservice teacher education and primary, elementary and secondary education levels were discussed together, meaningful suggestions can be obtained both theoretically and practically. Another significance of the study is that there are few studies about constructivism in Turkish pre-service science teacher education. Akar (2003) emphasized that there weren't enough research studies on the impact of constructivist teacher education on student learning and suggested conducting more experimental research studies to understand the impact of constructivist learning process on student learning in preservice teacher education specifically. Implementing a research study on the impacts of constructivist approach on some variables such as science process skills, attitude towards science teaching and achievement in preservice science teacher education can be significant and meaningful for several reasons. Another research study claimed that pre-service educators and school of education administrators were interested in considering ways to enhance their preservice programming. Preservice educators may obtain valuable information from the research studies about new approaches in education for different fields. Because of this, the number of studies about preservice teacher education should be increased (Beck & Kosnik, 2006).

The purpose of this research study was to examine the impact of using constructivist instruction on the fourth grade preservice science teachers' academic achievement and attitude towards science teaching in Science Teaching Methods II course.

This research study is also important for identifying classroom context and teachers' beliefs in detail. Understanding teachers' beliefs is very important because every researcher knows that whatever the curriculum is, teachers' beliefs will shape the classroom environment. Briefly, Turkish education needs research studies on constructivist approach in pre-service teacher education level and science teacher education is one of them. The significance of this study is to examine if using constructivist approach applications will be effective on pre-service science teachers' thinking and interpreting skills of curriculum, application of eclectic strategies rather than usual and rigid ones and to show clues for constructing future educational developments.

Methodology

Research Design

Quasi-experimental research design was used in order to investigate the impact of the constructivist instruction on the fourth grade pre-service science teachers' achievement and attitudes towards science teaching in Science Teaching Methods II course in this study. Since random assignment of subjects to the experimental and control groups was not possible quasi experimental research design was used in this research study.

Subjects

The subjects of the study were (N=103) fourth grade pre-service science teachers from Hacettepe University, Faculty of Education Department of Science Education. 103 pre-service science teachers were divided into two groups. One of them is called 01 section and consisted of 53 pre-service science teachers. The other one is called 02 section and consisted of 50 pre-service science teachers. Only the groups were randomly assigned as the experimental and the control. Constructivist based instruction (CBI) was used in experimental group and traditional instruction (TI) was used in control group. The equalivance of the groups were controlled by using independent sample t-test for comparing the pre scores of achievement test (PRECAT) and the attitude towards science teaching scale (PREATSTS). General distribution of the subjects of the study was shown in Table 1.

Table 1. Subjects of the study

Gender	Experimental Group	Control Group	Total
Male	21	19	40
Female	32	31	63
Total	53	50	103

Data Collection Tools

The following measurement and evaluation instruments were used to find answers to the research questions, to test the hypotheses and to use during the implementation process as instructional tools;

- Achievement Tests: Pre-test (PREAT), Post-test (POSTAT) and retention test (RAT)
- Attitude towards Science Teaching Scale: Pre-test (PREATSTS), post-test (POSTATSTS) and retention test (RATSTS)

Achievement Test: This test which consisted of 10 open-ended questions was prepared by the researcher before the implementation process. This test was piloted with 70 graduates of Hacettepe University Faculty of Education Department of Science Education who took Science Teaching Methods II (STM-II) course last year. Graded scoring key (rubrics) was created for this test by the researcher and two expert views were taken for the test and rubrics in terms of providing evidence for content validity. Correlation coefficient was calculated between the researcher scores and expert's scores. The correlation coefficient was calculated as 0. 78 first time for piloting. After grading 30 papers in total, the last and acceptable correlation coefficient was found as 0.9. The test covers the principles of learning and teaching skills in science education. Sample questions are how you can construct your science and technology lesson plan in terms of constructivist learning theory or which steps you follow when you plan a lesson plan related to problem-based learning, project based learning or creative drama. It was expected from student teachers to give their instructions on sample lesson plans.

Attitude Towards Science Teaching Scale: This scale consists of 11 positive statements and 10 negative statements and was developed by Thomson and Shrigley in 1986. This is a five-point likert scale. The scale was adapted to Turkish by Özkan, Tekkaya and Çakıroğlu (2002). The cronbach alpha reliability coefficient of the scale is 0.83. The statements of the scale cover the preparation, application, measurement and evaluation, relationship between the other subjects of science teaching. This scale was piloted with 220 preservice teachers for this study with the first, second and third year students of Hacettepe University Faculty of Education Department of Science Education and the third year students of Middle East Technical University Faculty of Science Education in the first week of fall semester 2007-2008 academic year. The reliability coefficient of the scale was found as 0.862. The cronbach alpha reliability coefficient of the sample of this research study was found as 0.882.Sample scale items are "I like to conduct laboratory and simple daily life activities during science", "I am not be afraid of showing a sample case related to science in my class" or "I expect to increase my students' positive tendencies toward science".

Data Collection Procedures

After official permissions were taken; the pre-tests (Achievement Test and Attitude towards Science Teaching Scale) were conducted to both the experimental and the control groups. From the beginning to the end of the process, constructivist instruction was used in the experimental group. The activities and tasks during the process were mainly based on the Yager's (1991) Constructivist Learning Model. In terms of this strategy, the first step is called as *invitation*. The teacher asked the students some questions at the beginning of the instruction in order to activate students' prior knowledge and promote student-student interaction and agreement before presenting the concept. For example, the teacher started to lecture with a question asking what is meant by a scientific literacy or constructivism in science education. The second step is called *exploration*. In this step, students were allowed to discuss the question in groups by using their previous knowledge related to learning and teaching approaches, strategies and techniques. The teacher created groups by assigning numbers to each student and then same numbers came together and to form a group. The members of the groups changed each time and learners have the opportunity to meet different people. Each group consisted of approximately five students. They shared different ideas, were respectful of all ideas and integrated different ideas in a view. They created different outcomes. Researchers did not interfere with students' discussions. The third step was called as *proposing explanations and solutions*. The groups expressed their own ideas, provided their own reasons in this step and the teacher integrated all the ideas according to the course aims. The fourth and the last step was called as *taking actions*. Students brainstormed and discussed how they could relate and transfer their learnings into the daily life situations and make use of them. These steps were explained according to the content in constructivist-based lesson plans during the implementation process (See Appendix I)

The instructor of the course was an observer in the study. The researcher and the instructor attended both the experimental and the control groups for 15 weeks. For about five weeks, two observers (one is the instructor of the course and the other one is a research assistant from different university in science education) observed the applications in both the experimental and the control groups. The purpose of working with an instructor and having an observer was to minimize the internal threat to overcome the researcher bias in the study. The same content was taught in the control group. The difference between the two groups was that critical and reflective thinking questions, group activities, self and group directed assessment activities were carried out in the experimental group, but not in the control group. Although the course included the same content, the control group had teacher- directed instruction and most of the activities were carried out individually by the participants in the implementation process. While the instruction was teacher-centered in the control group, the instructor was a guide and facilitator in the experimental group. Approaches, strategies and techniques like dialogue collaboration, research, peer teaching, peer evaluation, project and problem based learning, role playing, question-answer, inquiry-based learning, creative drama, brainstorming, writing in a role, cooperative learning, six hats were used in experimental group. Presentation, lecturing, question-answer were generally used as approaches, strategies and techniques in control group.

Theoretical part of the course was carried out in seven units: "General Philosophy and Properties of Science and Technology Curriculum", "Problem-Based Learning in Science Education", "Project-Based Learning in Science Education", "Creating Indoor Activities in Science Education", "Creating Outdoor Activities in Science Education", "Teaching Concepts in Science Education", and "Creative Drama Applications in Science Education". At the beginning of these units, general introduction and presentation of course outline were provided to the preservice science teachers. Pretests of Achievement (PREAT) and Attitude towards Science Teaching Scale (PREATSTS) were applied to both the experimental and the control groups and the participants in the groups were compared regarding these three scores for providing equivalence at the beginning of the course. Post tests of Achievement (POSTAT) and Attitude towards Science Teaching Scale (POSTATSTS) were also administered to both the experimental and the control groups after the whole process. Ten weeks after the completion of the treatment, retention tests of Achievement (RAT) and Attitude towards Science Teaching (RATSTS) were applied to both the experimental and the control groups in order to assess the retained scores of achievement and attitude towards science teaching.

Data Analysis

Data collected was analyzed by using descriptive and inferential statistical analysis methods. Reliability analysis was conducted to test the reliability of the Attitude towards Science Teaching Scale. First, the descriptive statistics were conducted to report the differences between the experimental group and control group on achievement and attitude towards science teaching and retention. Later, Mixed Between- Within Subjects Analysis of Variance (ANOVA) with Repeated Measures was conducted for testing the hypotheses at the level of significance ρ=0.5. For the analysis of the data, SPSS 15.0 (Statistical Package for Social Sciences) was used.

Findings

The Results of the Achievement Test

The hypotheses related to achievement variable is given as follows;

Null Hypothesis 1. There is no significant difference between the immediate achievement test scores of the preservice science teachers who were exposed to constructivist instruction and those who were exposed to traditional instruction.

Null Hypothesis 2. There is no significant difference between the retained achievement test scores of the preservice science teachers who were exposed to constructivist instruction and those who were exposed to traditional instruction.

In order to test Null hyptheses 1 and 2, A Mixed Between Within Subjects of ANOVA with Repeated Measures with one independent variable (treatment) with two levels (CBI and TI) and dependent variable with three levels (PREAT, POSTAT, and RAT) were applied. To investigate the effect of CBI, a 3 (pre, post and retention) X 2 (groups) ANOVA with repeated measures was employed to the achievement scores of the experimental group and the control group participants. The assumptions of ANOVA which consisted of independence of the observations, normal distribution of the dependent variables, equality of error variances and equivalence of population covariance matrices were provided for the achievement variable. The normality assumption was conducted with Kolmogorov-Smirnov test (K-S test). This test indicated that pretest scores of achievement test were normally distributed for both groups D (53) = .10, p = .20 and for control group D (50) = .13, p = .20 were both normal.

Table 2 shows the results of the change between the pre, the post and the retention test scores of achievement scores for experimental and the control groups taking time into consideration.

Table 2. The results of the 3X2 ANOVA with repeated measures of PREAT, POSTAT and RAT of the TI and CBI groups.

Source	Sum of Square	*df*	Mean Square	*F*	*p*	η^2
			<u>*Between Subjects*</u>			
Groups	34164.466	1	34164.466	323.822	.00	.76
Error	10655.883	101	105.504			
			<u>*Within Subjects*</u>			
Time (PREAT, POSTAT and RAT)	11546.526	1	11546.526	1087.027	.00	.91
Group* Time	12139.769	1	12139.769	1142.877	.00	.91
Error (Time)	1072.833	101	10.622			

A 3 (Time) x 2 (Group) mixed-model ANOVA revealed that the main effect for group was statistically significant F (1, 101) = 323.822, p = .00. This means that there was a difference in the achievement scores of participants in the experimental group when compared to the participants in the control group. The results of ANOVA with repeated measures indicated a significant time main effect of tests scores for the pretests, F (1, 101) = 1087.027, p = .00, though this was a very large effect η^2 = .91. The indicators were defined by Cohen (1988) (.01=small effect, .06=moderate effect, .14=large effect). This means that achievement test scores after the implementation were significantly higher than before the implementation.

There was a statistically significant mean difference in the retained scores of achievement between the experimental group who were exposed to the constructivist instruction and the control group who were exposed to traditional instruction in favor of the experimental group. The comparison of the experimental and the control groups was shown by independent sample t-test in Table 3, Table 4 and Table 5.

Table 3. Results of t-test for POSTAT and RAT for experimental group

Group	Variable	*N*	*M*	*SD*	*t*	*df*	Sig.
Experimental	POSTAT	53	86.28	6.538	7.231	52	.00
	RAT		84.06	6.458			

Table 4. Results of t-test for POSTAT and RAT for experimental group

Group	Variable	*N*	*M*	*SD*	*t*	*df*	Sig.
Experimental	POSTAT	53	86.28	6.538	7.231	52	.00
	RAT		84.06	6.458			

Table 5. Results of t-test for POSTAT and RAT for control group

Group	Variable	*N*	*M*	*SD*	*t*	*df*	Sig.
Control	POSTAT	50	53.96	6.546	2.482	49	.017
	RAT		53.30	6.649			

Results of Attitude towards Science Teaching Scale (ATSTS)

The null hypotheses of attitude towards science teaching variable were given as follows;

Null Hypothesis 3. There is no significant difference between the immediate attitude towards science teaching scale scores of the preservice science teachers who were exposed to constructivist instruction and those who were exposed to traditional instruction.

Null Hypothesis 4. There is no significant difference between the retained attitude towards science teaching scale scores of the preservice science teachers who were exposed to constructivist instruction and those who were exposed to traditional instruction.

In order to test Hypotheses 3 and 4, Anova with Repeated Measures were conducted. Table 6 indicates the change between the pre, the post and the retention test scores of attitude towards science teaching scores for the experimental and the control groups taking time into consideration.

Table 6. The results of the 3X2 ANOVA with repeated measures of PREATSTS, POSTATSTS and RATSTS of the TI and CBI groups.

Source	Sum of Square	*df*	Mean Square	*F*	*p*	η^2
			Between Subjects			
Groups	23822.276	1	23822.276	266.153	.00	.72
Error	9040.093	101	89.506			
			Within Subjects			
Time (PREATSTS, POSTATSTS and RATSTS)	8416.938	1	8416.938	569.389	.00	.84
Group* Time	9927.035	1	9927.035	671.544	.00	.86
Error (Time)	1493.024	101	14.782			

A 3 (Time) x 2 (Group) mixed-model ANOVA revealed that the main effect for group was statistically significant $F(1, 101) = 671.544$, $p = .00$. This means that there was a difference in the attitude towards science teaching scores of the participants in the experimental group compared to the participants in the control group. The results of ANOVA with repeated measures indicated a significant time main effect of tests scores for the pretests, $F(1, 101) = 569.389$, $p = .00$, though this was a very large effect $\eta^2 = .86$. The indicators were defined by Cohen (1988) (.01 =small effect, .06=moderate effect, .14=large effect). This means that attitude towards science teaching scores after the treatment were significantly higher than before the treatment

The paired sample *t*-test was conducted separately to test if there was a difference between the post and the retention mean scores of attitude towards science teaching scale in both the experimental and the control groups. Table 7, Table 8 and Table 9 showed that there was a statistically significant difference between the immediate and retained attitude towards science teaching scale mean scores of the students exposed to the constructivist instruction in the experimental group and the students exposed to the traditional instruction in the control group.

Table 7. Results of t-test for POSTATSTS and RATSTS for experimental group

Group	Variable	*N*	*M*	*SD*	*t*	*df*	Sig.
Experimental	POSTATSTS	53	88.98	6.770	8.011	52	.00
	RATSTS		85.81	6.881			

Table 8. Results of t-test for POSTATSTS and RATSTS for control group

Group	Variable	*N*	*M*	*SD*	*t*	*df*	Sig.
Control	POSTATSTS	50	60.56	5.814	2.768	49	.008
	RATSTS		59.78	5.715			

Table 9. Results of independent t-test for retained scores of attitude towards science teaching scale

					Levene's Test				
Variable	Groups	*N*	*M*	*SD*	*F*	Sig.	*t*	*df*	Sig.
RATSTS	Experimental	53	85.81	6.881	.467	.496	20.819	101	.00
	Control	50	59.78	5.715					

Levene's Test was used to show the equality of variances were not significantly different (p= .804). By looking at this value, test results were interpreted considering that equal variances were assumed and it was found that there was no statistically significant difference between the mean scores of the students in the control group and those in the experimental group on pretest scores, t (101)= 1,079, p = .283.

Both descriptive and inferential statistics results mainly revealed that there was a statistically significant mean difference between the post test and the retention test scores of attitudes towards science teaching and achievement. The experimental group participants' post test and retention test scores of attitude towards science teaching scale and achievement were significantly higher than the control group participants' posttest and retention test scores. This means that the implementation in the experimental group had significant statistical effect on the participants' attitude towards science teaching and achievement.

Discussion

It is difficult to load just one term to constructivism. It is commonly assumed as a philosophy or an approach in education. Many developed countries in the world applied the constructivist approach and benefited from what it provides before it is implemented in Turkey. This approach became important in Turkey after the developments and improvements in curricula development process in both primary and secondary education in the year of 2000. Science and Technology Curriculum was developed under the light of constructivist approach although there was not enough theoretical and practical background for science teachers to apply the approach in their classrooms. Although pilot schools were selected for the application of the newly developed curricula, they did not have enough knowledge and practice to use interactive engagement methods according to constructivist approach in classrooms. The changes in the curricula in primary and secondary level caused the changes in preservice education level. Preservice science education programs were changed by Higher Education Council in 2006 on the basis of changes in elementary and secondary curricula. The education in preservice science education was not planned according to constructivist approach. This research study provided findings and discussion according to the constructivist approach in preservice science education and showed that using Constructivist instruction (CBI) in teaching and learning environments affect preservice science teachers' beliefs and abilities during science teaching.

The posttest results of achievement test showed that there was a statistically significant mean difference between the experimental and control group's achievement in favor of experimental group. Similarly, in other research studies, achievement mean scores became higher and these mean differences were statistically significant in favor of the groups which had been exposed to teaching and learning environments according to constructivist learning model than the groups who had traditional instructions in their teaching and learning processes (Akar, 2003; Akcay, 2007; Akkuş et al., 2003; Connoly & Beqq, 2006; Gatlin, 1998; Hamlin, 2001; Koç, 2002, Savaş, 2006; Şengül, 2006; Thomson & Soyibo, 2002; Uzuntiryaki, 2003; Yurdakul, 2004). All these research studies were conducted in preservice teacher education level.

The findings obtained from the retention test of achievement also showed that there was a statistically significant mean difference between experimental and control groups in favor of experimental group. The results of the data analysis showed that there was a strong increase in preservice science teachers' achievement scores in favor of experimental group and this change was not statistically permanent after ten weeks for both experimental and control groups. The skill, achievement and attitude mean scores of both experimental and control groups were decreased. This conclusion is in contrast with Akar (2003). Post-test and retained scores of achievement scores were permanent in Akar's study. Although the mean differences were not high in both the experimental and control group, knowledge and skills were decreased among time. Although the treatment had a strong effect in the experimental group, this decrease was due to the fact that the experimental group participants could not see such environments after the treatment. Longitudinal processes are needed for providing permanent knowledge and skill learning. If experimental group participants were in constructivist teaching and learning environments after the treatment process, they would have permanent learnings.

The posttest results of attitude towards science teaching scale showed that there was a statistically significant mean difference between the experimental and control group's attitudes towards science teaching through a five point likert scale in favor of the experimental group. This means that posttest findings of the research study indicated that attitude scores towards science teaching increased after the implementation and this increase was statistically significant in favor of the group which had teaching and learning environment according to constructivist learning theory than the group who had traditional instruction in their teaching and learning processes. (Uzuntiryaki, 2003; Savaş, 2006; Akcay, 2007). Student-centered methodologies provide learners to have responsibility of their own learnings and have a chance to learn by doing and living. This process helps to develop positive attitudes toward the course. On the contrary, Akar (2003) found that the attitude scale mean scores of the control group who had traditional learning environment were significantly higher than experimental group who had constructivist learning environment. The cognitive load of the experimental group is considered as the reason of this finding. The findings which were obtained from the retention test of attitudes towards science teaching showed that there was a statistically significant mean difference between experimental and control groups in favor of the experimental group. The retention test scores were not commonly calculated for attitude in the other research studies, but considering the duration of the experiment procedure and time between post and retention tests, it was expected that retention test give valid results.

The t-test which was conducted for comparing immediate and retained scores of attitude towards science teaching showed that there was a statistically significant mean difference between immediate and retained scores of science process skills. Retained scores were lower than immediate scores. Attitudes towards science teaching gained after the treatment process were not permanent. Experimental group participants' attitude towards science teaching scores were decreased due to the fact that they couldn't have the opportunity to be in constructivist-based learning environments and apply student-centered methodologies in science education. Having permanent tendencies and attitudes need long term applications so if student teachers used to be in constructivist environments, they will probably have a strong chance to have permanent positive attitudes toward science teaching.

The results of this research study showed that constructivist instruction provided preservice science teachers with the opportunity to improve their understanding of constructivist learning and teaching environments. This finding is in parallel with the review article of Hudson (2004), who stressed the importance of constructivist mentoring including scaffolding, facilitating and coaching processes. These are considered crucial in constructivist science education. Also, Plourde and Alawiye (2003) stated that the correlation coefficient for the student teachers' beliefs towards constructivist knowledge and application had a relationship (r =.76). This means that if the student teachers' knowledge of constructivism increased, their belief that they would be "able to apply constructivist principles in the classroom learning situation" tended to increase.This is an important finding which shows the relationship between teacher knowing and thinking-decision making-planning processes.

Creating constructivist learning environments for preservice science teachers motivated them and increased their positive beliefs and attitudes towards effective science teaching. Researchers in science education generally dealt with applications of constructivism in primary and secondary education level. It should also be remembered that constructivist teaching and learning environments can be created by well educated preservice teachers. In other words, teachers have very important roles in creating constructivist teaching and learning environments. Due to the fact that organizing both preservice and inservice science teacher curricula by observable and measurable outcomes and activities are very important for providing effective teaching and learning environments related to constructivist approach. This could be provided by conducting many more research studies in both elementary and preservice education level in a parallel pattern in Turkey. One of the key points of this research study is avoiding overgeneralizations because as constructivist approach considers social aspects of societies and their characteristics, its application procedures can differ in various social contexts. Therefore, it is difficult to claim that using one method in teaching and learning environments can be effective according to constructivist learning approach. Constructivist learning approach needs to use multiple learning-teaching strategies, methods and techniques and measurement-evaluation approaches. The results of the research studies related to constructivist learning theory is important for providing clues to organize preservice and inservice teacher education programs.

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Geniş Özet

Giriş

Oluşturmacı Öğrenme Yaklaşımı Türkiye'de ilk olarak uluslar arası sınavlardaki başarı durumumuzun değerlendirilmesi ve ilköğretim programlarındaki yeniden yapılanma sürecinin ardından önem kazanmaya başlamıştır. Oluşturmacı Öğrenme Yaklaşımıyla ilgili geçmişte pek çok araştırma yapılmış, eğitim alanında yapılan araştırmalar ise 1990 yılında önem kazanmaya başlamıştır. Oluşturmacılığın birçok bilim insanı tarafından tanımı yapılmıştır.

Oluşturmacılık, bilgi ve öğrenmeye ilişkin bir teoridir, bilme ve öğrenenin bilme sürecine gelme aşamalarını açıklar. Bu teorinin içsel olarak oluşturulma, objektif olmama, sosyal temelli olma gibi özellikleri bulunmaktadır. Öğrenci merkezli öğretim ve program ilk olarak fen öğretimi açısından 2000 Fen Bilgisi Öğretim Programında ortaya koyulmuştur. Bu programın yaklaşımına göre öğretmen öğrencilerine sadece bilgiyi aktaran değil aynı zamanda da onlarla birlikte öğrenen kişidir. Öğrencinin rolü ise programda kendi kendine keşif yoluyla öğrenen olarak tanımlanmıştır. Dört yıl sonra değişen 2004-2005 Fen ve Teknoloji Öğretim Programının felsefesi oluşturmacı öğrenme yaklaşımıdır. Fen ve Teknoloji Öğretim Programı'nın temel anahtar noktaları yapılandırmacılık ve fen-teknoloji okur-yazarlığının boyutlarını kapsamaktadır. Fen Programlarındaki değişiklikler hizmet öncesi öğretmen eğitimini de etkilemiştir. Öğretmenlerin öğretme yeterlikleri, planlama ve karar verme süreçleri öğrenme ve öğretme ortamlarına şekil vermiştir. Bu araştırma oluşturmacı öğrenme yaklaşımın farklı disiplinlerdeki uygulamalarını görmek ve diğer disiplinlerle karşılaştırmak açısından da önem taşımaktadır. Araştırma sonucunda günümüz bilgi çağının gerektirdiği tipte insan yetiştirme yolunda bilgi yerine beceri temelli öğretim kapsamında önerilerde bulunmuştur. Araştırmanın önemi oluşturmacı öğrenme yaklaşımının eklektik yapısının öğretmen adaylarının öğrenci merkezli stratejileri kullanma, programı yorumlama anlamında gelecek araştırmalara ışık tuttuğu düşünülmektedir.

Yöntem

Oluşturmacı öğretimin fen bilgisi öğretmen adaylarının fen öğretimine karşı tutum, ders başarısı gibi değişkenler açısından etkisini araştırmak amacıyla bu araştırmada ön test son test kontrol gruplu yarı deneysel desen kullanılmıştır. Araştırma devlet üniversitelerinden birinde Eğitim Fakültesi Fen Bilgisi Eğitimi Anabilim Dalı'nda öğrenim görmekte olan ve Özel Öğretim Yöntemleri II dersini alan 103 dördüncü sınıf Fen Bilgisi öğretmen adayıyla gerçekleştirilmiştir. Araştırma 2007-2008 Güz Dönemi'nde gerçekleştirilmiş olup toplam 15 hafta sürmüştür.

Araştırmanın deney grubunda 53, kontrol grubunda 50 öğrenci bulunmaktadır ve bu öğrenciler dönem başında Öğrenci İşleri tarafından 01 ve 02 şubeleri olarak belirlenmiştir. Deney ve kontrol gruplarının denkliğini sağlamak amacıyla deney ve kontrol grupları arasında ön test puanları açısından anlamlı bir fark olup olmadığı t-testi aracılığıyla kontrol edilmiş ve iki grup arasında anlamlı bir fark bulunmadığı tespit edilmiştir.

Araştırma Özel Öğretim Yöntemleri II dersi kapsamında gerçekleştirilmiştir. Araştırma öncesinde her iki gruptaki öğretmen adaylarına Fen Öğretimine Karşı Tutum Ölçeği (ÖNFÖKTÖ) ve Başarı Testi (ÖNBT) uygulanmış, araştırmanın sonunda yani sürecin başlangıcından 15 hafta sonra son Fen Öğretimine Karşı Tutum Ölçeği (SONFÖKTÖ) ve Başarı Testi (SONBT) uygulanmıştır. Son testlerin uygulanmasından 10 hafta sonrasında üç test için kalıcılık testleri uygulanmıştır (KALFÖKTÖ ve KALBT). Araştırmanın verilerini analiz etmek için tekrarlayan verilerde varyans analizi tekniği kullanılmıştır.

Bulgular

Araştırmanın bulguları aşağıdaki gibi özetlenebilir;

-T-testi sonuçlarına göre öğretmen adaylarının önceki başarı puan ortalamaları arasında anlamlı bir fark bulunmamaktadır.

-Deney ve kontrol gruplarının ön test puanları arasında anlamlı bir fark bulunmamaktadır.

-Hem betimsel istatistik sonuçları hem de tekrarlayan verilerde varyans analizi sonuçları bilimsel süreç becerileri, fen öğretimine karşı tutum ve ders başarısı değişkenleri açısından deney grubu son test puan ortalamaları kontrol grubu son test puan ortalamalarından istatistikî olarak anlamlı derecede yüksektir. Bu durum deney grubunda yapılan uygulamanın fen öğretimine karşı tutum ve ders başarısı açısından etkili olduğunu göstermektedir.

-Deney ve kontrol gruplarının kalıcılık puanları karşılaştırıldığında deney grubunun kalıcılık puanları kontrol grubunun kalıcılık puanlarından istatistikî olarak anlamlı derecede yüksektir.

-Deney grubu son ve kalıcılık puanları karşılaştırıldığında son ve kalıcılık puanları arasındaki fark az görünse de istatistikî açıdan anlamlı bir düşme görülmüştür.

-Kontrol grubu son ve kalıcılık puanları karşılaştırıldığında son ve kalıcılık puanları arasındaki fark az görünse de fen öğretimine karşı tutum ve ders başarısı değişkenleri açısından kalıcılık puanları yönünden istatistikî anlamda anlamlı bir düşme görülmektedir.

Tartışma

Araştırma sonucunda elde edilen bulgular alanyazın bulgularını destekler niteliktedir. Oluşturmacı öğrenme ortamlarında bulunan kişilerin ders başarılarının ve tutumlarının geleneksel öğretim ortamlarında bulunan kişilere oranla daha yüksek olduğu sonucuna ulaşılmıştır. Kalıcılık puanlarında ise ders başarısı ve fen öğretimine karşı tutum açısından yine deney grubundaki bireylerin ortalamalarının kontrol grubundaki bireylerin ortalamalarından daha yüksek olduğu sonucuna ulaşılmıştır. Ancak kendi aralarında değerler incelendiğinde deney grubundaki her iki değişken için düşme az olmasına rağmen istatistiki olarak anlamlı bulunmuştur. Kontrol grubunda ise kalıcılık puanlarıyla son test puanları açısından anlamlı bir fark bulunmazken diğer puanlardaki düşme az olmasına rağmen istatistiki olarak anlamlı bulunmuştur. Araştırma sonucuna göre fen öğretimine karşı tutum öğrenme öğretme süreçlerinin organizasyonunda büyük rol oynamaktadır. Bu nedenle oluşturmacı öğrenme modeli diğer disiplinlerdeki tutumları da pozitif yönde geliştirmek için kullanılabilir ve oluşturmacı Öğrenme Modeli, bu araştırma kapsamında fen öğretmen adaylarının öğretme becerilerini olumlu yönde etkilediği için diğer öğretim metodoloji derslerinde de kullanılabilir.

Appendix I

Sample Lesson Plan

Week 2: General Characteristics of Science and Technology Curriculum

Rationale

This is the second unit for Science Teaching Methods II course. There are several characteristics which cover this unit were given as follows;

(1) Identfying the students' prior knowledge about newly developed Science and Technology Curriculum

(2) Recognizing students' misconceptions about general philosophy of Science and Technology Curriculum

(3) Exploring and discussing the basic concepts and principles of science education

(4) Understanding the development, implementation and assessment processes of Science and Technology Curriculum

(5) Providing a constructivist learning environment in which learners recognize the principles of preparing a constructivist learning environment to their students.

Goals and Objectives of the Unit

Lower-level Cognitive Outcomes

After processing this unit, students;

1. Explain the general characteristics of Science and Technology Curriculum

1.1. Explain the term of "Scientific Literacy" and its dimensions.

1.2. Explain the term of "Constructivist Approach" and its implications to the teaching and learning environment.

1.3. Understand the Science-Technology-Society-Environment relationships and their connections with the Science and Technology Curriculum

1.4. Tell the attitude and value outcomes of Science and Technology Curriculum

1.5. Explain the kinds of methodologies used in the implementation and assessment process of Science and Technology course.

2.Understand the duties of curriculum development team

2.1. Explain the field experts' duties in Science and Technology Curriculum Development Team

2.2. Explain the program developers' duties in Science and Technology Curriculum Development Team

2.3. Explain the measurement and evaluation experts' duties in Science and Technology Curriculum Development Team

Higher level cognitive outcomes

3. Make interpretations and inferentions about the general philosophy of Science and Technology Curriculum

3.1. Identify and write their own ideas about the development process of Science and Technology Curriculum

3.2. Recognize the probable problems about curriculum development process and Science and Technology Education.

3.3. Identify the similarities and differences between the concepts related to the

Science and Technology Curriculum

Affective Outcomes

4. Give value to the preparation process of Science and Technology Curriculum

4.1. Recognize the importance of Constructivist Learning Approach.

4.2. Internalize the general idea and fundamental concepts of Science and Technology Curriculum.

4.3. Value group working and other friends' different ideas.

4.4. Carry responsibility for others' learning in the working environment.

Performance Outcomes

5. Prepare and present a report about the preparation and implementation process of Science and Technology Curriculum

5.1. Integrate different people's ideas and reflect into a report

1.1. Identify criteria about their performances.

1.2. Write a report according to criteria

1.3. Prepare a presentation about the report and present.

1.4. Realise their own cognitive and affective development about Science and Technology Curriculum.

Time: 4x50 minutes

Number of students: 53

Approaches, Strategies and Techniques: Problem-based learning approach, question-answer technique, writing in a role technique, creative drama method, discussion method, group working technique.

Expected Student Skills: Creative thinking, critical thinking, analyzing, synthezing, realizing how to learn (meta-cognitive thinking), group interaction.

Content: General Principles and Fundamental Concepts of Science and Technology Curriculum

Level: Senior Faculty of Education Department of Science Education students.

Materials: Different pieces of paper, pencils, colorful markers, whiteboard and boardmarker.

First Level: Starting the lesson (Invitation)

Teacher asks students about what they know about the general philosophy of Science and Technology Curriculum. Teacher lists what the students tell. After that teacher wants students to prepare questions about the concepts that are written on the board. Teacher wants from the students for looking at the board and identify if there is a problem in their mind. Also teacher asks questions about the concepts like "What do you think here? Why do you think in this way? Are you sure?"