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THE EFFECT OF CONCEPTUAL CHANGE APPROACH ON STUDENTS' ECOLOGY ACHIEVEMENT AND ATTITUDE TOWARDS BIOLOGY

KAVRAMSAL DEĞİŞİM YAKLAŞIMININ ÖĞRENCİLERİN EKOLOJİ BAŞARI VE BİYOLOJİ TUTUMLARINA ETKİSİ

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ABSTRACT: This study investigated the effectiveness of conceptual change texts oriented instruction accompanied by demonstrations in small groups on students' ecology achievement and attitude towards biology. 78 ninth grade students in a public high school participated in this study. While the control group was taught with the traditional method, the experimental group was instructed by the conceptual change approach within small groups in five weeks time period. Conceptual change texts were prepared for remediation of students' misconceptions about ecology. Conceptual change texts were supported with worksheets requiring demonstration tools and visual aids. Independent samples t-test was used to analyze the data. The results revealed that the conceptual change approach oriented instruction made a statistically significant difference between the experimental group and the control group in students' ecology achievement in favor of the experimental group, although there was no statistically significant mean difference between the experimental group and the control group in students' attitude towards biology.

Keywords: Conceptual change approach, attitude towards biology, ecology concepts.

ÖZET: Bu çalışma, küçük gruplarda demonstrasyon destekli kavram değiştirme metinlerine dayalı öğretim yönteminin öğrencilerin ekoloji başarıları ve biyolojiye karşı tutumlarına etkisini incelemiştir. Bu çalışmaya bir devlet lisesindeki 78 dokuzuncu sınıf öğrencisi katılmıştır. Beş haftalık uygulamada kontrol grubunda geleneksel metodla ders işlenirken, deneysel grupta ise küçük gruplarda kavram değiştirme yaklaşımına dayalı ders işlenmiştir. Kavram değiştirme metinleri, öğrencilerin ekoloji konusuna ait kavram yanılgılarını gidermek için hazırlanmıştır. Kavram değiştirme metinleri, demonstrasyon ve görsel araçlar gerektiren çalışma yaprakları ile desteklenmiştir. Veri analizinde, bağımsız örnekler t testi kullanılmıştır. Sonuçlar kavram değiştirme metinlerine dayalı öğretimin, öğrencilerin ekoloji başarıları açısından deneysel grup ve kontrol grup arasında, deneysel grubun lehine istatistiksel olarak anlamlı bir değişiklik oluşturduğunu ortaya koyarken, öğrencilerin biyoloji tutumları açısından deneysel grup ve kontrol grup arasında istatistiksel olarak anlamlı bir değişiklik oluşturmadığını ortaya koymuştur.

Anahtar sözcükler: Kavram değiştirme yaklaşımı, biyoloji tutumu, ekoloji kavramları.

1. INTRODUCTION

Students may have some alternative conceptions and scientifically acceptable understandings in the same content area. When students enter the classroom with informal ideas (alternative conceptions) about scientific phenomena, these ideas affect how the corresponding scientific explanations are learned. Palmer (1999) investigated whether these two types of understandings are linked, and if so, how. This study involved sixty-three 11-12-year-old students and forty-four 15-16-year-old students. He conducted interviews with students in order to identify students' conceptions of biological role (i.e. every living thing has a role to play in nature) as applied to a range of different types of living things. The results obtained in the

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study showed that many students had both an alternative conception and a scientifically acceptable conception. Students' explanations demonstrated that they were using an "If…then" type of reasoning which linked the two conceptions.

Students' alternative ideas can influence achievement. Several factors can affect students' achievement in science such as students' prior knowledge, attitude, teacher, and textbook. In recent science education literature, a large amount of several researcher investigated students' understanding of some biological concepts such as inheritance, human biology, human body, homeostasis, natural selection, human circulatory system, plants as living things, amino acids and translation, respiration, and nutrient cycling in ecosystems (Adeniyi, 1985; Bahar, Johstone, and Hansell, 1999; Hellden, 1992b; Okeke and Wood-Robinson, 1980; Stavy, 1991).

Additionally, as ecology is one of the key concepts in most biology syllabuses, there are some studies on students' misconceptions on ecology (Adeneyi, 1985; Çetin, 1998; Griffiths and Grant 1985; Hellden, 1992a; Hellden, 1992b; Hogan and Fisherkeller, 1996; Keng, 1997; Leach, 1995; Özkan, 2001; Web and Bolt, 1990). For instance, Adeyini (1985) studied on common ecology misconceptions on junior secondary school students. Students had several alternative conceptions about food chain, energy flow, and pyramid of energy, and the carbon cycle. The findings of the study showed that a few of them appeared after instruction, although some of these misconceptions might have existed before instruction and also students' prior misconceptions tended to block understanding of new concepts and generalizations.

Therefore, alternative conceptions in science can be problematic for the teacher. They should be overcome through instruction (Beeth, 1998). To overcome students' alternative conceptions, several techniques like conceptual change approach can be used in science. A large amount of research has explored the effects of conceptual change approaches on students' conceptual change in science concepts with different conceptual change instructional tools such as concept maps (Novak, 1990; Wallace and Mintzes, 1990), analogy (Stavy, 1991), conceptual change texts (Chambers and Andre, 1997; Mikkila-Erdmann, 2001; Sungur, Tekkaya, and Geban, 2001), and refutational change texts (Hynd, Mcwhorter, Phares, and Suttles, 1994).

For example, Chambers and Andre (1997) examined the effect of conceptual change text manipulations in learning about direct current. Their study demonstrated that the conceptual change text led to better conceptual understanding of electrical concepts than traditional didactic text. Sungur et al. (2001) found that the conceptual change texts oriented instruction accompanied by concept mapping made a statistically significant difference between the experimental group and the control group in students' understanding of the human circulatory system. Özkan (2001) studied on remediation of seventh grade students' misconceptions on ecological concepts through conceptual change texts. She found that the experimental group achieved significantly better than the control group.

Beside that students' alternative ideas can influence students' achievement in science, there are many studies investigating the relationship between attitude and achievement. Papanastasiou and Zembylas (2002) examined the effect of attitudes on science achievement among high school pupils. The results of the study demonstrated that science achievement and science attitudes could have differential effects on each other depending on the characteristics of the educational systems of the country.

However, attitude can be an affecting factor on achievement in science. Greenfield (1996) found that students in grades 3-12 showed the most positive attitudes toward science and the most positive perceptions of their own science ability and achievement.

1.1. Purpose

The purpose of this study was to investigate the use of conceptual change texts accompanied by demonstrations within small groups as a means of improving ninth grade students' achievement of ecology concepts and their attitude towards biology.

2. METHOD

2.1. Sample

This study involved 78 ninth grade students from four ninth grade classes in a public high school taught by two biology teachers. To determine the classes and teachers, convenience sampling was used. Each teacher had two classes, one experimental group and one control group. While the experimental group was taught with the conceptual change text oriented instruction within small group work accompanied by demonstration, the control group was taught with the traditional method.

2.2. Measuring Tools

Two measuring tools were used in this study, Ecology Concepts Test (ECT) and Attitude Scale towards Biology (ASB).

The ECT was constructed by the researchers. It was administered to the control and the experimental groups as pre-test and post-test. The main aim of the ECT was to identify students' misconceptions about ecology and to measure students' ecology achievement before and after the treatment. Ecology concepts test items were developed based on examination of the objectives about ecology in the ninth grade biology curriculum approved by the Ministry of Education. While writing the questions, the Ecology Concepts Test on eight grade developed by Çetin (1998) was also utilized. Additionally, some other sources such as secondary science textbooks, ninth grade biology textbook, university ecology textbooks, University Entrance Exam questions, and related literature of misconceptions about ecology were used to write the items (Börü, Öztürk, ve Cavak, 2000; Çetin, 1998; Jones, 1997).

The ECT included the following ecology concepts: non-living and living factors of environment; producer, consumer, and decomposer relationships in matter and energy flow; symbiotic relationships; food chain and food web; cycle of matter; population; community; ecosystem; environmental population; environmental conservation and erosion.

The ECT involved 17 items and it included two sections. In ten multiple-choice items part, each question has one correct answer and three distracters. Students were asked for selecting correct answer and writing reason(s) of that correct answer. In seven open-ended items part, students would be enable to give an opportunity to express their ideas on ecology concepts more openly. Students got 0-3 grades for each question and students' possible total ECT scores could range from 0 to 51. The ECT was administered as pre-test and post-test. Time completion for the ECT by students was approximately 45 minutes. The reliability of this scale was found as. 69.

In this study, the Attitude towards Biology was used to determine students' attitude towards biology. It was developed by the researchers. The ASB has 15 items with a 5-point likert type scale: absolutely agree, agree, neutral, disagree, and absolutely disagree. It included both positive and negative statements. In this scale, scoring was ranged from 5 to 1; absolutely agree to absolutely disagree respectively for the positive statements and completely visa versa for the negative statements. It was administered to all subjects of the study as pre-test and post-test. Time completion for ASB by students was approximately 10-15 minutes. Total possible ASB scores could range from 15 to 75 with higher scores showed positive attitude towards biology and lower scores showed negative attitude towards biology. The reliability of this scale was found as .91.

2.3. Procedure

This study included 78 students from four biology classes taught by two teachers. Each teacher had one control group and one experimental group. The treatment took five weeks in a public high school. Each instruction lasted two 45-minute sessions per week.

The control group was taught by the traditional instructional method, while the experimental group was instructed by the conceptual change text oriented instruction accompanied by demonstration within small groups. In the control group, each teacher taught the ecology courses almost similarly; using lecture type, questioning, and using Biology textbook approved by the Ministry of Education. Teachers completed ecology topics according to the sequence of topics in the textbook.

In the experimental group, conceptual change texts were used during the lessons. Students were also allowed to use the Biology textbook. Conceptual change texts were prepared on living organisms and their environment, cycles of matter, and environment pollution. Before the treatment, the teachers were informed about conceptual change texts oriented instruction accompanied by demonstrations in small groups.

At the beginning of the treatment, the ECT and ASB were administered to all students in the experimental and the control groups. Then, the students in the experimental group were divided into 4-5 people. The first conceptual change text was given the students and then, the students were informed about the nature of the conceptual change texts and the small group work. Conceptual change texts were prepared to eliminate the students' common misconceptions of ecology and improve students' understanding of ecology. Students were asked for reading the conceptual change texts before 2-3 days ago from the ecology courses.

In the classroom, the teacher read some common misconceptions about ecology to the students in the experimental group. Thus, it was attempted to dissatisfy the students with their existing conceptions. Later, the students were given out worksheets. Using worksheet would provide to activate students' misconceptions by presenting some questions and demonstrations. After demonstrations, students discussed the questions in worksheets in five minutes. Discussions were guided by the teacher. Finally, the teacher made whole class discussion and explained some missed points about the ecology topic to the students.

At the end of the treatment, the ECT and ASB were administered to all students in the experimental and the control group again.

3. RESULTS

This study examined the effectiveness of using conceptual change texts accompanied by demonstrations in small groups on ninth grade students' learning of ecology. The teachers conducted the conventional methods and the conceptual change approach oriented instructional methods in their ecology courses successfully. The ECT and ASB were conducted to all students as pre- and post-test. Independent samples t-test was used to analyze the data at a significance level of .05.

According to the analysis of students' pre- and post-test ecology achievement scores by independent-samples t-test, the results of students' pre-test ecology achievement scores showed that there was no significant mean difference between the experimental and the control groups in understanding ecology ($t= 1.70$, $p > .05$). However, the results of students' post-test ecology achievement scores indicated that there was a significant difference between the experimental and control groups in understanding ecology concepts, in favor of the experimental group ($t= 2.14$, $p < .05$). The conceptual change text oriented instruction was more effective in improving students' understanding more than the traditional method.

According to the analysis of students' pre- and post-test attitude towards biology scores by independent samples t-test, there was no significant mean difference between the experimental and control groups in attitude towards biology at the beginning of instruction ($t= 4.69$, $p > .05$), and no significant difference at the end of instruction ($t= 3.86$, $p > .05$).

4. DISCUSSION

The conceptual change texts oriented instruction accompanied by demonstrations within small groups caused a more significant increase in students' achievement of ecology concepts.

Ecology topics and daily life environmental issues are related to each other closely. Ecology concepts involve some current ecological phenomena and global ecological problems in the world. Furthermore, students are familiar to some ecological events and students experience them. Thus, students can find to grasp some ecological concepts concrete and meaningful in school context. In this study, as conceptual change texts and many questions in the worksheets included some examples of current ecological phenomena and daily life experiences, students could imagine easily the situations and answer them. This situation may have increased students' achievement of ecology concepts.

Students may have alternative ideas or scientifically correct conceptions about the specific situation of the ecological concepts. Conceptual change texts were designed to eliminate students' common misconceptions and improve students' understanding of ecology. Hence, they involved some common misconceptions and correct scientific explanations about ecological concepts in the events. It was expected that presenting some common misconceptions in the conceptual change texts would dissatisfy students with their existing conceptions. In the meantime, worksheets were administered to students. Worksheets would supply to activate students' misconceptions by presenting some demonstrations and questions. Students used worksheets among small groups. After demonstrations, students discussed the questions about ecology in small groups. Discussions were guided by the teacher and they could provide some interactions between teacher-student and among students. This may help students to gain some experience academically and socially. Finally, the teacher made whole class discussion and provided some scientifically correct explanations of the situation. As a result, it was expected that the students would accept the new conceptions instead of the old ones as much as possible.

On the other hand, in this current study there was no significant difference on the students' post-test attitude towards biology. It may be caused by the treatment duration. The treatment period was five weeks. It was probably not a long time period to observe a difference in the students' attitude towards biology. To cause any change in students' attitude towards science, longer time may be needed.

The conceptual change oriented instruction explicitly dealt with students' misconceptions of ecology while the traditional method did not. Student' misconceptions or alternative ideas on ecological concepts found in this study can be taken into consideration by science and biology teachers. The remediation techniques for ecological concepts can be redesigned according to the some factors like class size, class level, and availability of teaching materials. The teachers and the students should be informed about importance and usage of conceptual change texts in science/biology classes. Then, the teachers could plan their instructional activities accordingly.

However, conceptual change approach is a powerful methodology for science classrooms. This methodology can be applied to some other science/biology concepts at different grade levels in order to improve students' understanding of ecology.

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