GÜ, Gazi Eğitim Fakültesi Dergisi, Cilt 25, Sayı 1 (2005) 155-168

Lise 1 Biyoloji Dersi Alan Öğrencilerin Canlıların Çeşitliliği ve Sınıflandırılmasıyla ilgili Kavram Yanılgılarının Belirlenmesi ve Kavram Haritası Yardımıyla Değiştirilmesi

Using Concept Maps Changing the Misconceptions of the First Year High School Students in Biology Courses in Classification of Living Things and Their Diversity

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ÖZET

İlk ve orta öğrenim fen bilimleri eğitiminde, öğrencilerin sahip oldukları kavram yanılgılarını değiştirmek için öğretmenler ve fen bilimleri eğitimcileri tarafından farklı öğretim yöntemleri kullanılmaktadır. Kavram yanılgılarını değiştirmek kullanılan en yaygın olan yöntemlerden biri de kavram haritalarıdır.

Bu çalışmanın amacı Lise 1. sınıf biyoloji dersi alan öğrencilerin Canlıların çeşitliliği ve sınıflandırılması hakkındaki kavram yanılgılarını değiştirmektir. Bu çalışma biyoloji dersi alan 92 Lise 1(9. sınıf) öğrencisiyle yapılmıştır. Kavram haritaları ve geleneksel biyoloji öğretimi deney ve kontrol gruplarına uygulanmıştır. Altı hafta alan bu çalışma sürecinde Canlıların Çeşitliliği ve Sınıflandırılmasıyla ilgili başarı testi ön ve son test olarak her iki

öğretim metodunu karşılaştırmak için kullanılmıştır. Ayrıca Kavram Haritası Tutum Testi sadece deney grubuna ön ve son test olarak verilmiştir.

Verilerin analiz edilmesinden sonra Canlıların Çeşitliliği ve Sınıflandırılması ünitesini kavram haritalarıyla öğrenen grup diğer gruba göre istatistiksel olarak anlamlı bir şekilde daha fazla başarı göstermişlerdir (P<0,05). Sonuçta biyoloji öğretiminde kavram haritalarıyla öğretim ve öğrenme hem öğrencilerin anlamlı bir şekilde başarılarını artırmış hem de tutumlarını olumlu bir şekilde değiştirmiştir.

Anahtar kelimeler: Kavram yanılgıları, Canlıların sınıflandırılması, biyoloji ve fen bilgisi eğitimi

ABSTRACT

Sonuçta biyoloji öğretiminde kavram haritalarıyla öğretim ve öğrenme hem öğrencilerin anlamlı bir şekilde başarılarını artırmış hem de tutumlarını olumlu bir şekilde değiştirmiştir.

In the elementary and secondary science education, different instruction methods are used by science teachers in order to change misconceptions held by students. One of the common methods used to change misconceptions is the concept maps.

The purpose of this study is to change the misconceptions in diversity of living organisms and their classification held by the 9^{th} year high school students in biology courses. This study has been carried out by in two 92 students of 9^{th} year high school biology classes. The concept maps and traditional biology instruction have been applied to the experimental and control groups. Throughout this study which took six weeks to compare the two instruction methods, the achievement test of classification and diversity of living things have been given to both groups as pre and post-tests. Additionally, concept map attitude scale has only been given to the experimental group as pre and post-tests.

After analyzing the data, it is seen that students who learned the classification and diversity of living organisms with the concept maps showed statistically higher achievement than those who learned the same subject with the traditional method (P<.0,05). As a result, this study shows that teaching and learning concepts with the concept maps in biology courses in high schools changed students' attitudes and achievements positively.

Key Words: Misconceptions, Classification of Living Things, Biology and Science Education

1. Introduction

Presently many studies in science education area deal with the misconceptions related to science subjects taught in schools in the world. Students seem to have difficulties to learn conceptions in science courses including biology subject (Ian and Kinchin 2000, Treagust 1988, and Bloom 1990). There would be several reasons that students can hold misconceptions and the beginning of holding misconception could go to the first school years (Bell 1981, and Pines and West, 1986). Misconceptions held by students were not easily changed throughout of the school years and also, stall meaningful learning of new concepts and make connections with other concepts as well as achievement of students in science courses (Strike and Posner 1982). Studies showed that elementary and secondary school students have problems in the classification and diversity of living organisms (Kellert 1985). For example, Trowbridge and Minszes (1985 and 1988) found that students have difficulties on the understanding of diversity of animals. There are several reasons students have misconceptions related to science courses. To solve this problem, there are some ways, one of which is concept maps helping students to make connections with sup-concepts related to the main concept and to find relations with the concepts (Kinchin, David, and Adam, 2000).

1.1 Purpose of the study

The purpose of the study is to reveal 9^{th} grade high school freshman students' misconceptions pertinent to the classifications and diversity of living things, and to change these misconceptions with the concept maps and conceptual changing texts.

1.2 Hypotheses to be tested

1. There is no statistically difference between experimental (taught by concept maps and conceptual changing texts method) and control (taught by traditional method)

groups' pre and post test achievement scores on the classifications and diversity of living things.

2. There is no statistically difference between pre and post attitudinal scores of students toward the concept maps and conceptual changing texts method after taking the classifications and diversity of living things.
3. There is no statistically difference between genders of experimental (taught by concept maps and conceptual changing texts method) and of control (taught by traditional method) groups' pre and post test achievement scores on the classifications and diversity of living things.

1.3 Assumptions

The following situations were assumed as true;

1. Students responded the questions honestly and seriously.
2. There was no interaction between experimental and control groups of students.

1.4 Limitations and Delimitations

This study was only limited to the 9^{th} grade Turkish students in a province (Konya) center high school and the unit of the classifications and diversity of living things in high school biology course.

2. Material and Methods

This study was designed as a cross-sectional experimental model (2X2) in order to find out the effect of the concept maps and conceptual changing texts method on the classifications and diversity of living things by comparing with the control group taught by traditional biology teaching method.

2.1 Population and sample

The sample of study was selected from randomly selected high school 9^{th} grade students whose school was located in the province center of Konya, a big size city at the Central Anatolian Region of Turkey. The total number of students was 92 as two equal class sizes.

Experimental and control groups took biology achievement test on the classifications and diversity of living things as pre-tests to compare their achievements on the same subject.

2.2 Dependent and Independent Variables

Independent variables were genders of students and experimental group taught by concept maps and conceptual changing texts and control group taught by traditional biology teaching method. Dependent variables were the scores of biology achievement test on the classifications and diversity of living things and the attitudinal scores of students toward concept maps.

2.3 Data Collecting Processes

In this study, there were two instruments to collect data which were biology achievement test and concept map attitudinal scale. Biology achievement test were developed by the researchers and it was a multiple choice test covering the diversity and classification of living things on the high school biology course. There was only one right choice and the remaining four choices mostly related to misconceptions on the same subject. Conducting interviews with the students who took the same subject one-year ago revealed the misconceptions. The panel judges who were from the same discipline controlled the biology achievement test for its content validity. Before conducting interviews and the study, reviewing literatures pertinent to misconceptions on the classification and diversity of living things help to develop questions about the biology achievement test. After that, to measure the reliability of the biology achievement test, a pilot study was conducted on the freshman college students whose majors were biology and 10^{th} grade high school students. The pilot study showed that the test was reliable as 0.89 (with cronbach alfa). Finally, the biology

achievement test was ready to be used on the research, after testing its reliability and controlling its validity with some revising.

Concept map attitudinal scale was originally developed by Arnaudin and Mintzes (1985) and translated to Turkish by Uzuntiryaki and Geban (1999). The reliability of the scale was found as 0.92. It is a kind of likert scale. This scale was only given to the experimental group before and after taking the treatment.

2.4 Time Frame and Application

The study took six weeks in a high school in the province center of Konya, located in the Central Anatolian Region of Turkey. There were two groups, as experimental and control groups. Before the beginning of class applications, the biology achievement tests were given to both groups. Each group had 46 students. In the experimental group, the researcher explained how to make concept maps and gave conceptual changing texts to change their misconceptions in each class. Also, there were some meaningful conservation related to misconceptions between students and the researcher. In the control group, the researcher applied traditional biology teaching method at the same time period. At the end of total class sessions, the experimental and control groups took the biology achievement tests. Also, concept map attitudinal scale was given to the experimental group before and after the class sessions.

2.5 Analyzing of Data

T-test and two-way analyze of variance (ANOVA) were used to test the hypotheses at the 0.05 α level. Also, percentages, frequencies, and central tendency measures, e.g. means and standard deviations.

3. Findings

Before applying concept maps and conceptual changing texts to the experimental group and traditional biology teaching method to the control group, there were interviews as a journal entry to figure out the misconceptions held by the students (10^{th} grade high school students) to whom the classification and diversity of living things had been already taught one year ago. These interviews revealed some misconceptions held by students. Some of the questions and the responses related to the classification and diversity of living things were given below.

Q 1. "Is there any relationship between the number of common features shared by organisms and the number of living organisms?"

R 1. "While the number of organisms increases, the number of common features shared by organisms also increases (Student #4)"

Q 2. "What is the smallest unit in the classification of living organisms"

R 2."the smallest unit is genus (Student #9)"

Q 3. "What is the regnum?"

R 3. "The place where the all living things live (Student #8)

These results showed that students had some misconceptions related to systematical categories, such as species, genus, order, class, regnum, etc. It should be several reasons that students kept these misconceptions. In the experimental group, the concept maps and conceptual changing texts were prepared on the base of these responses and also some questions of biology achievement test.

In this part, to understand what the students know about the methods of systematic nomenclature (naming) were given below.

Q 4. "what do we need to pay attention while systematically writing the name of a species?"

R 4.1. "we look at the ways of their livings and types (Student #3)."

R 4.2. "In the systematical naming, we have paid attention that the human being is the biggest unit and the insects is the smallest unit (Student #6)"

R 4.3. "We look at its name in Latin and if it is commonly found in the world (Student #9)."

…….

These responses revealed that Turkish high school students hold some important misconceptions in Turkish perspective. They could be summarized as the following;

1. The relationship of the number of living organisms and the common features held by the living organisms from species to regnum or from regnum to species.
2. Systematical categories used in the classifications of living organisms.
3. Naming living organisms systematically.
4. The features of natural classification.
5. The order of living organisms evolutionary from simple to advanced forms.
6. The confusions on the classifications of some living organisms, such as; bacteria, protozoa, fungi, some of plants and some of animals (e.g: bats, dolphins, penguins).

3.1 Testing the Hypotheses

In this study, there were three null hypotheses to be tested by using t-tests and two-way ANOVA. To remind the first null hypothesis, it is given at the below.

"There is no statistically difference between experimental (taught by concept maps and conceptual changing texts method) and control (taught by traditional method) groups' pre and post test achievement scores on the classifications and diversity of living things." The t-test results would be seen at the Table 1.

Table 1: *The means and standard deviations of biology achievement tests as pre and post scores and t-tests of results of experimental and control groups.*

Source	**Test**	**Group**	**N**	**X**	**s**	**T value**	**P**
Biology Achievement Test	Pre-test	Experimental	46	9.10	2.02	-0.82	0.41
		Control	46	9.52	2.73		
	Post-test	Experimental	46	24.30	3.21	14.94	0.001**
		Control	46	14.22	3.26		

**P<0.01

T-tests results showed that between experimental and control groups' pre-test scores did not indicate statically significant difference and one part of the null hypotheses is accepted. This result is so important that at the beginning of study, their achievement levels at the classification and diversity of living things seem to be very close and equal. However, after the application of concept maps and conceptual changing texts to the experimental group and following traditional biology teaching at the control group, the scores of biology achievement test as post-test results indicate that there is a statistically significant difference between two groups. In the result, the second part of the first null hypotheses is rejected that teaching and learning with concept maps and conceptual changing texts have a significant impact on the student achievement levels when it is compared with the control group's achievement level on the same content. Additionally, there are statistically significant differences between pre and post test scores of experimental and control groups' biology achievement scores on the classification and diversity of living things. Despite of significant differences between both pre- and post test scores of experimental and control groups, biology achievement scores of the experimental group on the classification and diversity of living things is significantly higher than those of the control group (Table 1).

The second null hypothesis is as the following; "There is no statistically difference between pre and post attitudinal scores of students toward the concept maps and conceptual changing texts method after taking the classifications and diversity of living things."

To test the second null hypothesis, at the beginning and end of the class sessions on the experimental group, was given an attitudinal test related to the using concept maps at the class to the students two times and used paired t-test. The results of attitudinal mean scores and paired t-test could be seen in the table 2 in the following.

Table 2:*The results of attitudinal mean scores and paired t-test.*

Resource	**Test**	**Group**	**N**	**X**	**s**	**T value**	**P**
Attitudinal Test toward to the Concept Maps	Pre-test	Experimental	46	17.48	2.91	-6.89	0.001**
	Post-test	Experimental	46	22.87	2.55		

**P<0.01

With this result, the second null hypothesis was rejected. In the result, concept maps and conceptual changing texts positively and significantly changed students' attitudes toward using this method at the biology class. This should be another way how the concept maps are effective in biology teaching.

The last (third) null hypothesis is as the following; "There is no statistically difference between genders of experimental (taught by concept maps and conceptual changing texts method) and of control (taught by traditional method) groups' pre and post test achievement scores on the classifications and diversity of living things." Table 3 gives the means and standard deviations of genders based on the biology achievement scores as pre- and post-test scores

The means scores show some differences between genders as pre and post test scores. Two-factor variance analysis (genders and groups) was used to as pre and post-test scores based on the biology achievement scores as separately and the table 4 and 5 show the two-factor variance analysis results in the following.

Table 3: *The means and standard deviations of genders based on the biology achievement scores*

Source	Test	Group	Gender	N	X	s
Biology Achievement Test	Pre-test	Experimental	Female	11	10.36	1.68
			Male	35	8.71	1.97
		Control	Female	20	10.10	3.05
			Male	26	9.07	2.43
		Total	Female	31	10.19	2.62
			Male	61	8.86	2.17
	Post-test	Experimental	Female	11	26.63	1.91
			Male	35	23.57	3.20
		Control	Female	20	13.75	3.64
			Male	26	14.57	2.96
		Total	Female	31	18.32	6.99
			Male	61	19.73	5.44

Table 4 :*Two-factor variance analysis results of genders and groups based on the biology achievement test as pre-test*

Source	SS	df	MS	F	P
Group (A)	0.0047	1	0.0047	0.00	0.92
Gender (B)	34.34	1	34.34	6.20	0.01*
AXB	1.88	1	1.88	0.34	0.56
Error	487.33	88	5.53		
Total	525.85	91			

*P<0.05

Table 5: *Two-factor variance analysis results of genders and groups based on the biology achievement test as post-test*

Source	SS	df	MS	F	P
Group (A)	2302.43	1	2302.43	236.36	0.001**
Gender (B)	24.08	1	24.08	2.47	0.11
AXB	72.84	1	72.84	7.47	0.01*
Error	857.21	88	9.74		
Total	3283.73	91			

*P<0.05 and **P<0.01

Tables 3, 4 and 5 show that at the beginning of the study there was no significant difference between groups but between genders there was statistically significant difference that the

means of biology achievement level of female students were higher than that of male students. In the result, the first part of third null hypothesis was rejected. In the second part, between groups there was a significant mean difference, also it should be seen the same result at the table 1. However, there was no significant mean difference based on the post-test results of biology achievement tests between genders so that the second part of third null hypothesis is accepted (Table 5). While the total mean score of female student was significantly higher than that of male students at the beginning of study, the total mean score of male students was slightly higher than that of female students at the end of study. That is why, there is a statistically significant interaction between groups and genders. On the other hand, post-test biology achievement mean score of female students is higher that that of male students on the experimental group at the end of study (Table 3, 4 and 5). In addition to results, there was no statistically significant difference found between the groups at the beginning of the study but there was a statistically significant difference between the groups at the end of study (Tables 3, 4, and 5).

4. Discussions

In this study, one of the important ways of forming the biology achievement test was based on the misconceptions related to the classification and diversity of living things already held by the Turkish high school students. Especially, wrong choices of biology achievement test as a multiple-choice test reflect the misconceptions on the same content. Therefore, pre-test results express that Turkish high school students have some significant misconceptions. Some of the reasons of these misconceptions related to the meaning of systematic units in Turkish language should be genus and species almost the same meaning, as “type” or “kind” in Turkish. Turkish high school students seem to have another misconception related to the place of human beings in the classifications of living organisms. Mostly, they put human beings to the different category as a regnum from other living organisms. The other common misconceptions held by the Turkish high school students on the classification and

diversity of living things should be summarized as the following; the relationship of the number of living organisms and the common features held by the living organisms from species to regnum or from regnum to species, the features of natural classification, the confusions on the classifications of some living organisms, such as; bacteria, protozoa, fungi, some of plants and some of animals (e.g: bats, dolphins, penguins).

This study reveals that concept maps and conceptual changing texts successfully and significantly changed students' misconceptions and increased their achievements pertinent to the classification and diversity of living things (Table 1, 3, 4 and 5). Lord (1999), Kinching and David (2000), Amir and Tamir (1995), and Smith and Dwyer (1995) reported the same kinds of results.

Attitudes of students toward concept maps and conceptual changing texts were positively and significantly changed on the classification and diversity of living things (Table 2). It was thought that concept maps and conceptual changing texts help to increase students' achievements and interests on high school biology courses.

The achievements of female students on the experimental groups are significantly higher than those of male students based on the pre and post test scores (Table 3, 4, and 5). The same kinds of results were found by Arnoudin and Mintzes (1985).

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