AN INVESTIGATION ON STUDENTS' PERCEPTIONS OF BIODIVERSITY

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ABSTRACT

In this study, pupils' constructions of some concepts related to biodiversity like classifying living things, variation in living things and ecosystem elements, and the concept of life were investigated in the light of constructivist theory of learning. For this purpose, a biological diversity conceptual understanding test formed by a series of open ended questions was developed and applied to 191 first class high school pupils in seven different high schools in the city of Izmir–Turkey. For the clarification of the responses taken from the test and to follow up some responses a semi–structured interview was developed and applied 14 pupils among the 191. Moreover, to understand the teaching style in seven different schools and to find out the reasons of some responses taken from the pupils a semi–structured teacher interview was developed and applied to seven teachers – one from each school.

The results of the study implicated that although pupils' views towards living things and the nature were similar to holistic understanding, their constructions of the topics of nutrition relationship and energy flow were weak, and the idea of anthropocentric view in which human beings are in the centre of all living things were seem to be widespread among them.

Key Words: Biological Diversity, Environmental Education, Alternative Conceptions, Holism, Anthropocentrism

Introduction

The term "biodiversity" was first used in the Earth Summit held in 1992 in Rio de Jeneiro (KEATING, 1993). In general terms, it means the diversity of living things and their living styles in the earth form the biodiversity.

The sources of many food, drug, industrial products and energy used by humans are gathered from the ecosystem to which all living things are dependent fro survival. More than 25% of medicines used by humans are extracted from tropical plants. According to 1992 UNESCO reports around 40% of medicines in the USA gathered from natural sources (UNESCO, 1992).

Human beings are changing the ecosystems by their daily activities without doing too much extra effort. LINDEMANN–MATTHIES (2002) claimed that these changing are the primary reason for extinction of plant and animal species. The number is frightening; roughly 100 species per day, which is 1000 times bigger than normally accepted numbers. In 20–30 year period more than one million species is estimated to go extinction. 10% of warm zone plants and 11% of 9000 bird species are under the threat of extinction. Just destroying the tropical rain forest put 130000 species in danger (KEATING, 1993). In short it is seen that extinction of living things in other word, the biodiversity now become a global problem. Therefore, the use of the results and suggestions obtained from the studies about environmental protection in environmental education has been increasing its importance (BARKER & ELLIOT, 2000).

Geo–morphological characteristics of land surface in Turkey create many micro–climatic and ecological regions and sub–regions which lead to a very rich diversity of living things. Turkey shows a continental characteristic from the biodiversity point of view (YOREK & al., 2003).

Literature review in the field shows that apart from the studies about the protection of biodiversity and the environment, many environmental education activities about the biodiversity and its protection were held. The activities have been organized in both developed and developing countries (WEMMER & RUDRAN, 1993). Many educational centers were founded for the biodiversity and its protection in many countries around the world. Some of the leading countries were developed new educational programs which increase students' interests towards the environment and help them to develop their environmental protection consciousness (LINDEMANN–MATTHIES, 2002).

Despite the activities organized, especially for the people living in developing countries, KEATING (1993) claimed that their primary agenda is economical and health problems, therefore, they do not spend to much time and effort to protect the environment for their future generations. KEATING (1993) also claimed that today's developed countries were destroyed their biodiversity for the sake of development.

For a sustainable development of Turkey, as a developing country, without losing its rich biodiversity, training of the society, especially the youngsters in a way to improve their environmental protection consciousness is very important.

As a result of local literature review in the field of environmental education in Turkey with a very rich biodiversity showed that no study based on biodiversity is present (YOREK & al., 2003).

Materials and methods

Based on the constructivist approach, the study employed qualitative research methods (YILDIRIM & SIMSEK, 1999; SHEPARDSON, 2005; BOGDAN & BIKLEN, 2007). The National Curriculum in Turkey was analyzed to determine students' conceptual understanding level. According to this analysis, 'Conceptual Understanding of The Living Things and Classification' (CULC) test was developed. In addition, semi–structured interviews were carried out with seven teachers and 14 students to gather information about course structure and students' conceptual understanding. The CULC test is shown below.

Questions asked in Conceptual Understanding (CULC) test

1. Write down the names of *ten* living things that come to your mind first.
2. It is estimated that there are millions of species living on Earth. If you were asked to classify all the living things (species) into main groups, without leaving anyone, *at least* how many groups could you form?
3. When all the living things were considered, what do you think is the place (position) of *human beings*?
4. What kind of feeding relationship can be seen among the following living things which live in a certain area? Grasshopper, weed, hawk, mice.
5. What do you think could be the feeding relationship among these living things if hawk would be removed from the area?

6. In your opinion what are the elements of a forest ecosystem?

7. When an apple fallen from an apple tree to the soil is not taken out, you will see that in a certain period of time it will be rotten and disappear. How do you explain this?

Design of the Conceptual Understanding Test and Validity and Reliability

The content of the (CULC) test was limited to the content of two units included in the high school biology curriculum in Turkey, 'Biodiversity and Classification,' and 'Ecology: Earth Environment and the Living Things.' Two in–service biology teachers and two university lecturers from the educational faculty, one is expert in ecology and the other in biology education, discussed and evaluated the test in terms of the content validity. Final version of the test was prepared in the light of expert views.

It is said that in qualitative studies related to conceptual understanding, preset categories may not be used for the purpose of analyses and categories specific to any research may be determined for this purpose (MARTINEZ & al., 2001; THOMAS, 2002; SHEPARDSON, 2005). In this study, using the responses of 50 students drawn randomly among 191 students, analysis categories were determined. Using analysis rubric constructed from these categories, student responses were coded. An expert in biology education was asked to code the responses of 50 students using the same rubric. Comparisons of coding revealed that there was 80% agreement in the coding. Differences were worked out together and student responses were included in the coding. Responses which were not included in any category were shown as 'not related' in a separate group.

Interviews with students

By students' willingness to participate taking into account, with the help of teachers, 14 students, two (one girl, one boy) from each class, were selected for the interview. Some information, which could not be obtained via conceptual understanding test or by written tests, some points which need to clarify was obtained through interviews. Interviews, lasted about 30–40 minutes, were recorded using a digital voice recorder and then transcribed. The consent of all the students was obtained for the use of a voice recorder during interviews.

Interviews with teachers

Teachers were interviewed to learn more about their ideas about the curriculum and number of hours per week, biodiversity, their method of instruction, and the use of resources, and this provided additional data for the study. Interviews were recorded using a digital voice recorder and transcribed for the later analyses.

The population and the sample

The population of the study was consisted of all the ninth–grade students attending secondary schools in a large province in western Turkey and biology teachers working in the same province. The sample of the study was ninth–grade students (n= 191) selected via cluster sampling method from the mentioned population and seven biology teachers teaching in these students' schools. Distribution of the sample is shown in Table 1. The

same textbook (Ministry of Education Press) was in use in the selected schools. Schools were accepting students from different parts of the province and students varied in terms of socioeconomic status.

Table 1. Distribution of the sample.

| Schools | N | | School type |
	Female	Male	
I	13	14	Traditional High School
II	16	7	Traditional High School
III	17	10	Mainly English Medium
IV	22	4	Mainly English Medium
V	20	9	Mainly English Medium
VI	16	10	Mainly English Medium
VII	24	9	Mainly English Medium

Findings and interpretations

In this section, the results of the CULC test administered to 191 students in seven schools were evaluated and interpreted in the context of research questions and under the following sections.

- Relational construction of the concept of life and the living things
- Student classification of the living things
- Position of human among the living things
- The significance level of the living things.

Excerpts from the interviews of 14 students and seven teachers are used to explain the data obtained from written conceptual understanding test or to clarify ambiguous points in the written data. In addition, excerpts can be used for clarifying or supporting students' ideas revealed in the conceptual understanding test.

Construction of the life concept

The first question was analyzed to determine the living things students associated with in constructing the concept of life.

Upon examination of the names in the CULC test we noticed that there were not any plant names among the common names of the living things students mentioned. Common names of the living things stated both by male and female students were all animals. In the theory of *plant blindness,* WANDERSEE & SCHUSSLER (2001) argued that two possible symptoms of plant blindness might be (1) the idea of thinking plants as just the backdrop for animal life and (2) failing to see or notice the plants in the environment. In the present study, we can argue that Turkish students (both males and females) may have *plant blindness* considering the approaches they showed toward plants.

The frequency rank of the names were dogs, cats, human, and birds from the most to the least. The position of these names among 10 living things was found to be in the order

of human, dog, cat, and bird. For all groups the most common names written on top of the list most frequently were humans, cats, and dogs. Similar findings were reported in LINDEMANN–MATTHIES (2002) where most frequently appreciated living things by students were animals such as pets (like cats, dogs, and horses) and exotic species (like dolphins, tigers, and lions).

The most frequently written first living thing among the 10 living things by all the students was 'human'. When we consider the proportion of all the living things stated and the position of the plant's name on their list for the students who included at least one plant name we see interesting results. Among all types of the living things, proportions of animals, plants, and the other living things were 80%, 13.4%, and 6.6% respectively. When we have examined the average position of the plant names on the list of the students who included at least one plant name, we have found that they stated the plant name on the $6,4^{th}$ position from the top.

BARDEL (1997) suggested that students construct the concept of life mostly via associating it with the concept of 'movement' and argued that this was an animistic (movement related) misconception. It has been suggested that the concept of motion (movement) was among the most important reasons for why people show more interest in animals than they do in plants (WANDERSEE, 1986; KINCHIN, 2000). Similarly, according to the results of this study, we may suggest that, since in terms of movement animals are more active than plants they may be constructed first.

Which living things students associate with and which living things they start from in constructing the concept of life are related to the list they formed in question one as can be understood from an answer like "I wrote whatever came to my mind." In other words, the name they expressed most frequently on top of the list should be the name of the living things they relate to the concept of life.

In summary, we may suggest that cognitive construction of the life concept occurs mostly by associating it with animals. In addition, according to our results, the first living thing with which the concept of life was associated was human. In this construction, plants came after animals and humans in terms of the concept life.

Student classifications of the living things

Responses to the second research question were analyzed to shed light on how students classified the living things. Male and female students' answers convened at two main groups namely 'only animals' and 'human, animals, and plants.'

It is thought that students consider mostly appearance and physical characteristics of the living things in classification; and they do not change their classification criteria even after they were taught biological classification. In addition, as reported by SHEPARDSON (2005), students perceive humans not as a part of the nature but as 'distinct' from the nature and as we emphasized, when asked to "classify the living things", students, with an anthropocentric approach, were seen to treat humans in a separate group.

The place of human among the living things

Responses to the third question were analyzed for the purpose of determining how or where students placed human among all the living things. Four out of five students for both males and females indicated that human was the most advanced among all the living things. The responses of this question can help us understand why it was human that was the most frequently written first name out of 10 living things in the first research question, and the reason why human was considered in a separate category apart from other living things in the third question.

The placement of human at the centre of nature and the idea of all the living things exist for human may be explained by the possibility of choosing a categorization according to harm or benefit humans will get from the living things. Questions four and five have assumed the role of determining the priority human give himself /herself among all the living things.

The importance of the living things

Analyses of the fourth and fifth questions were conducted to determine the criteria used by the students in characterizing the living things as 'important', 'more important', or 'not important.' From the analyses of the questions one, two, and three, we have seen that human concept was emphasized and placed at the centre of the nature. Based on our analyses, we can say that when attributing importance to the living things students respond by approaching from a self/own centre.

Analysis of the fourth question

Two main categories were determined from the analysis of the responses to the fourth question. First, students who said that there could not be any living things that were not useful in nature were determined. Responses including nutritional relationships, ecologic balance, and usefulness of the living things for humans, and stating that everyone has a role in nature were considered in this category.

Our data suggest that approximately four fifth of both male and female students said that there were not any living things that could be identified as 'unimportant' in nature. In our interviews with students and teachers it was stated that there could not be any living things that were regarded as unimportant. Although the 'importance' was interpreted in terms of benefit–harm relations to the nature, when interview transcripts were examined, it was realized that in students' and teachers' subconscious the importance criteria was actually 'human' and the concept of importance of the living things was again determined according to the anthropocentric cognitive structuring. It has been argued that people attribute value to the living things by judging them in terms of beauty, usefulness, rarity, and visual attractiveness and these characteristics shape their opinion of whether the species should be protected or not (KELLERT, 1993; ASHWORTH & al., 1995). These concepts contain anthropocentric features.

Analysis of the fifth question

Students and teachers, who said there were no unimportant living things, seemed to consider the importance from a human centered point of view.

Students who listed honeybee first said 'honeybee makes honey' as their reason for listing. Male students who listed daisy first, said it was a plant and made photosynthesis, whereas females indicated that they selected daisy since it was a 'flower' and 'beautified the nature'. Students who listed nettle first said they chose it since it was a healing plant, or a producer plant. In conclusion, when we look at the reasons (healing, food, making honey, etc.) for listing a name first we noticed that they were closely related to their importance for human.

Ecosystem and its units: Producers, Consumers, Decomposers

For a meaningful construction of biodiversity, it is thought that there is a need to understand the concept of ecosystem and the relationship among its units which form the ecosystem. 4th, 5th and 6th questions in the CULC were analyzed for this purpose.

In the 4th question, it was aimed to understand the level of students' constructions about possible feeding relationship among living things and their cross relations. In the 5th question, by forest ecosystem, the concept of ecosystem was asked. In the 6th question it was try to identify how students see the decomposers which have a very important place an ecosystem.

The general overview of the results of the 4th question indicates that the feeding relationship among living things is not well understood. The feeding relationship among the given creatures was responded by students as "Grasshopper eats the weed, mice eat the grasshopper, and hawk eats the mice". Other eating behaviors like "mice can eat the weed, hawk can eat the grasshoppers" were rarely mentioned. Moreover, although it is not clear whether the mice eat grasshoppers, they thought to develop a linear reason–result relationship and believe that "the powerful eat the weak".

In the analysis of the 5th question, it was seen that students focused more on the concept of "forest", rather than the concept of "ecosystem". Among the elements of the ecosystem, they counted the animals first then the plants. Other non–mentioned elements lead us to think that students focused on dominant elements in the nature and so possible relationship among them is not understood. Responses reflect that especially boys focused more on animals when they asked to list the living things in a forest ecosystem.

In the results of the 6th question, it is seen that in the pretest some students explained that the apple fallen from the tree, mixed to the soil and disappeared. This response implicate that the students just commented on what they had observed. It is understood from this response that the soil was seen by such students as the main element that wipe everything away. That is, they seemed to develop a mechanism that does not reflect the reality as a whole. Decomposers cannot be seen by naked eyes, therefore it is thought that the students could not understand the real mechanism of a rotten apple, and this led them to give such an explanation to this question.

After the instruction post test results showed that the responses like "the apple was disappeared as a result of the activities of saprophyte living things (decomposers)" increased. It is thought that the instruction made a positive effect for such students to understand the mechanism and changed their responses in the post–test.

Educational implications

In the light of the results obtained and discussed with the related literature in this study, the following recommendations for a better environmental education and for making the next generations to understand the importance of biodiversity for a better future can be listed:

- The concept of biodiversity should be placed comprehensively in biology and environmental education programs in order students to develop the environmental protection consciousness.

- The anthropocentric understanding of nature observed in students should be taken into account and in educational programs dissuasive activities for students to change their minds should be organized.

- The value of living things in the nature should be handled in the light of the harmony among all living things, not because of their harm or benefit to human beings.

- In educational programs, while explaining the group of living things, instead of giving examples like the relationship between the living things and their effects to human health, some other examples like the humans' congruence with the nature should be used.

- Based on the holistic understanding of nature observed in students, a new environmental education program, in which holistic and eco–centric consciousness is developed, should be developed.

- Environmental education courses in educational faculties should be reviewed according to the new understanding. In–service biology and science teachers who are generally responsible for the environmental education should be informed about the new understanding by means of in–service educational courses.

LITERATURE

ASHWORTH, S., BOYES, E., PATON, R. & STANISSTREET, M. 1995: Conservation of Endangered Species: What do Children Think? *Journal of Environmental Education and Information* 14: 229–244.

BARDEL, C. 1997: Vivant, Non–vivant, Mort. Ou Sont Les Conceptions Des Eleves. Memoire de DEA nonpublié, – *Université Joseph Fourier*, Grenoble.

BARKER, S. & ELLIOT, P. 2000: Planning a Skills–Based Resource for Biodiversity Education. *Journal of Biological Education* 34(3): 123–127.

BOGDAN, R.C. & BIKLEN, S.K. 2007: Qualitative research for education: An introduction to theory and methods. – *Pearson/Allyn and Bacon,* Boston.

KEATING, M. 1993: The Earth Summit Agenda for Change A Plain Language Version of Agenda 21 and Other Rio Agreements. – *Center for Our Common Future*, Geneva.

KELLERT, S.R. 1993: Attitudes, Knowledge, and Behavior toward Wildlife among the Industrial Superpowers: United States, Japan, and Germany. *Journal of Social Issues* 4: 53–69.

KINCHIN, I.M. 2000: From Ecologist to Conceptual Ecologist: The Utility of the Conceptual Ecology Analogy for Teachers of Biology. *Journal of Biological Education* 34(4): 178–183.

LINDEMANN–MATTHIES, P. 2002: The influence of an educational program on children's perception of biodiversity. *International Journal of Environmental Education* 33(2): 22–31.

MARTINEZ, N.M., SOLANO, I. & GOMEZ, E.J. 2001: Characteristics of the methodology used to describe students' conceptions. *International Journal of Science Education* 23(7): 663–690.

SHEPARDSON, D.P. 2005: Student Ideas: What Is An Environment? *Journal of Environmental Education* 36(4): 49–58.

THOMAS, G. 2002: Theory's spell—on qualitative inquiry and educational research. *British Educational Research Journal 28*(3): 419–434.

UNESCO 1992: Biodiversity: An increasingly important theme in environmental education. *UNSECO–UNEP Environmental Education Newsletter* 17(4): 1–3.

WANDERSEE, J.H. & SCHUSSLER, E.E. 1999: Preventing Plant Blindness. *The American Biology Teacher* 6: 84–86.

WANDERSEE, J.H. 1986: Plants or animals-which do junior high school students prefer to study? *Journal of Research in Science Teaching* 23: 415–426.

WEMMER, C. & RUDRAN, R. (1993). Training Developing–Country Nationals in the Critical Ingredient in Conserving Global Biodiversity. *Bioscience* 43(11): 672–677.

YILDIRIM, A. & SIMSEK, H. 1999: Sosyal bilimlerde Nitel Arastirma Yontemleri – *Seckin Yayincilik*, Ankara.

YOREK, N., AYDIN, H., BASLAR, S. & DOGAN, Y. 2003: Increasingly Important Topic in Environmental Biology: Biodiversity. In: *International Symposium on Environment and its Education*, 18–23 July 2003, Baku–Azerbaijan.