Are Animals 'More Alive' than Plants? Animistic-Anthropocentric Construction of Life Concept

Nurettin Yorek, Mehmet Şahin, and Halil Aydın
Dokuz Eylul University, Izmir, TURKIYE

This study investigated the characteristics students use in attributing value to and classifying the living things; the relational construction of the life concepts and the living things and the place of human in this construction. Participants were first-year high school students from seven schools in Izmir (a large western city in Turkey). An open-ended conceptual understanding test was developed and administered to students. Semi-structured interview forms were applied to students and biology teachers, one from each school; and this provided additional data to clarify ambiguous points in students' responses to the conceptual test. Results revealed that students constructed the life concept by associating it predominantly with 'human'. The most frequently associated concept to the life concept was found to be motion. Students tended to use their own classification criteria instead of biological classification. Generally, we noticed classifications in the form of 'human-animal-plant'

Keywords: Life Concept; Living Things; Classification; Anthropocentrism; Animism.

INTRODUCTION

There are some concepts in science which are hard to define clearly. For instance, although biology is generally named as a life science discipline investigating the living things, a clear definition of the life concept can not be made. Because of scientific uncertainty as well as moral, legal, and theological aspects of this concept it is difficult to propose a clear scientific definition (Franklin, 2004).

Bardel (1997) suggested various conceptual models in a comprehensive study on the life concept. Among these, 'animistic model' is one which is related to the living things most. According to this model, students associate the life concept with the concept of motion. Bardel, using automobile and such vehicles as examples, argues that motion is not specific to the living things only and according to this model, animals would be regarded as 'more alive' than plants. In addition, she

emphasizes that 'animistic misconceptions' could arise as a result of this model.

The idea that associating the life with motion is brought about by the animistic thinking during early childhood, was first suggested by Piaget (1929). Although there were studies which suggested that individual differences could exist related to animism (Berzonsky, 1974, 1987; Klingensmith, 1953), the results indicated that moving nonliving objects could be regarded as alive (Dolgin & Behrend, 1984; Lucas et al., 1979) and in fact the idea of all the moving things were alive existed (Elkind, 1991). Watts and Bentley (1991) arguing that science teachers use animistic and anthropomorphic explanations in describing some topics, refer to the possible reasons of observing such ideas in students. Several studies carried out at different age levels showed that the main reason for subjects' interest in animals rather than plants was movement (Kinchin, 1999; Wandersee, 1986). Prokop et al. (2007a) have found that the most liked subject among biology concepts was zoology and that females showed more interested toward biology (particularly botany) than males. Caravita and Falchetti (2005) reported that students characterized a piece of bone taken from a

Correspondence to: Nurettin Yörek, Ph.D in Biology Education, Dokuz Eylul Universitesi, Buca Egitim Fakultesi, 35100, Izmir, TURKEY
E -mail: nurettin.yorek@deu.edu.tr

living body as "alive." Students often referred to movement, structure, and function in their reasoning.

Research studies which investigate students' view of animals argue that students mostly interested in vertebrates, pets (dogs, cats, horses, etc.), and exotic species (e.g., dolphins, tigers, and lions) (Braund, 1991, 1998; Lindemann-Matthies, 2005). In addition, in animal classification, students were reported to use non-scientific 'individual classification criteria,' and consider mostly outlook instead of a biological classification, and classify animals in terms of their habitat and type of movement (flying, swimming, etc.) used for the purpose of displacement (Kattmann, 2001; Lucas et al., 1979; Tunnicliffe & Reis, 1999). In this context, some students were found to classify penguin as a bird, some as a fish, and others as a mammalian (Braund, 1991). Studies involving Maltese Children reported similar results (Tunnicliffe et al., 2008).

Few studies have investigated students' ideas about plants and reported that students while grouping plants were seen to value them mostly in terms of their anatomic features and outlook (Gatt et al., 2007; Tunnicliffe & Reis, 2000). A study investigating students' ideas about plants reported that while grouping plants students were seen to value them mostly in terms of their anatomic features and outlook (Tunnicliffe & Reis, 2000). A botanist and a biology educator respectively, Wandersee and Schussler (1999, 2001) discussed the reasons why people interested in animals more than they do in plants. After several years of discussions, library searches, and small-scale investigations they introduced a new term, plant blindness. Plant blindness was defined as failing to see or notice the plants in the environment. According to Wandersee and Schussler, plant blindness causes the inability to conceive the significance of plants for the atmosphere and human life; to recognize the special aesthetics and biological features in the Plant Kingdom. In addition, it leads to misleading, anthropocentric judgment of plants as inferior to animals that may result in erroneous conclusions such as plants are not valued by humans.

Keogh (1995) argued that the actual reason for biological variety crisis was the extinction of unknown species, which was not classified yet, due to human originated reasons. Therefore, Keogh in this regard, emphasized the importance of teaching the actual meaning of science of systematic to prospective biology teachers. According to Keogh, biology teachers should not regard the systematic only as a scientific field. The number of the living things which have not been classified yet is beyond the number of the known living things and thus, it is very important for the future of biological diversity that biology teachers comprehend the importance of the world of living things for the humans.

A good way of determining how we are doing in biology instruction is to study students' understanding of the basic concepts. Particular attention should be given to students' misunderstanding of these concepts. One such concept which is considered an important ingredient in biology education is the concept of life and the living things.

Purpose of This Study

This study aimed to investigate the construction of the life concept and its effects on Turkish high school students' classification of the living things. For the purpose of this study, following questions were addressed:

1. Which living things and concepts do students choose to associate with first in constructing the life concept?

2. Which criteria students use other than biological classification and which characteristics they take into account in classifying the living things?

3. How do students describe/define the level of importance of the living things?

METHOD

The National Biology Curriculum in Turkey was analyzed to determine the conceptual frame and a written test of 'Conceptual Understanding of the Living Things and the Life Concept' (CULC) was developed. In addition, semi-structured interviews were conducted with seven teachers and 14 students to obtain additional information about the course structure and students' conceptual understanding. The CULC test is presented in Table 1.

Design and description of the conceptual understanding test

At the beginning, twenty open-ended questions were prepared by the researchers considering the findings of previous research and by classifying the concepts chosen in accordance with the national education curriculum in the subject matter. Later on, by taking recommendations of three specialists, namely two faculty members from the science education department of a university and a science teacher, total number of questions was reduced to 8 in order to prevent students from getting confused and bored and to be able to determine adequately students' construction of the life concept. Open-ended questions were then administered to 45 secondary students in a separate school. Data obtained in the pilot test were analyzed by the researchers using open-encoding in which the answers of all students were examined by the researchers. Results of the analysis were shared by the faculty

members and teachers of the pilot sample. In the end, taking into account the experts' opinions, total number of questions was reduced to five.

Our main data collection tool was the first question in the CULC test. Although the first question looks quite simple, it provided with very interesting and informative data for this study. No names of living things were mentioned in this question to prevent any association students could form when they see the names, however, the term 'ten living things' was used to find out students' construction of the 'living thing or alive' concept. Student answers to the first question were collected in a separate page and they were not allowed to see the names of the living things mentioned in the other questions during this time. When the final version of open-ended questions was administered, the researcher (NY) was present in the classroom. Students were given 30 minutes to answer these questions. The other questions in the CULC test were used for interpreting and clarifying the information obtained from the first question.

The second question investigates to what extent the names of the living things students listed in the question one overlap with the groups of living things students mentioned in question two. The third question attempts to reveal whether human would be placed in front of animals. The fourth question explores the role of the concepts 'alive' and 'more alive' in categorizing the living things as significant or insignificant. It is thought that this categorization has an effect on the cognitive construction of the life concept. The fifth question examines the 'significance' criteria used by the students in listing the names of several living things provided to them. It is thought that a living thing would be perceived as important by the students and would be up front because of being alive or students would form the list according to the idea that human is 'the most important' living being.

Validity and reliability of the CULC test

Two in-service biology teachers and two university faculty members, one is expert in ecology and the other in biology education, together discussed and evaluated the CULC test in terms of the content validity. Final version of the test was prepared in the light of expert views.

Using the responses of 50 students drawn randomly among 191 students, analysis categories were determined. Using an analysis rubric constructed from these categories student responses were coded. The researchers and an expert in biology education coded the responses of 50 students using the same rubric. The biology education expert was instructed so that all raters used the same criteria in using the rubric. Comparisons of the coding revealed that there was a general (90%) agreement between the raters in the coding. Some small differences (e.g., a small difference in the coding of students' grouping of animals in the second question) were worked out and all the data were coded using the revised rubric.

The sample of the study

The population of this study consisted of all the ninth-grade students attending secondary schools in a large city in western Turkey and the biology teachers employed in the same schools. The sample of the study was 191 ninth-grade students (128 male and 63 female) selected via cluster sampling method from the mentioned population and seven biology teachers teaching in the schools from where the sample was selected. Schools accepted students from different parts of the city and students varied in terms of socioeconomic status.

Interviews with students and teachers

Taking into account students' willingness to participate, 14 students, two (one girl, one boy) from each class, were selected randomly for the interview. Some information, which could not be obtained via conceptual understanding test or by written tests, was obtained through interviews which lasted about 30-40 minutes. The consents of all the students were obtained for the use of a voice recorder during interviews. Seven teachers, one from each class, were selected and interviewed to learn more about their ideas about the

Table 1. Conceptual understanding test of the living things and the life concept

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 into main groups, without leaving anyone out, *at least* how many groups could you form?
3. When all the living things were considered, in terms of biological classification, what do you think is the place of *human*? Explain.
4. When all the living things were considered, are there any, existence of which is(are) not important (to have little or nor use) in your opinion? If yes, which ones? If no, why? Explain your reason.
5. When you rank the following living things according to your criteria of importance from the most to least, which one comes first? How did you determine the degree of importance? Explain.
Mouse, stinging nettle, daisy, mushroom, honeybee.

curriculum and this provided additional data for the study. All interviews were recorded using a digital voice recorder and transcribed later for the analyses.

RESULTS

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.

Construction of the life concept: Animals-Plants-Others

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 mentioned both by males and females were all animals. In the theory of *plant blindness* Wandersee and 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 most frequently ranked names were dogs, cats, human and birds respectively. The position of these names among the 10 living things was found to be in the order of human, dog, cat, and bird. For all groups the most common names the most frequently ranked first were humans, cats, and dogs. Similar findings were reported in Lindemann-Matthies (2005) 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 mentioned and the position of the plants on the lists we notice 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 examined the average position of the plants on the list of the students who included at least one plant name, we found that the plant was ranked sixth.

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 (Kinchin, 1999; Wandersee, 1986). Similarly, according to the results of this study, we may suggest that, since animals are more active than plants in terms of movement they may be constructed first. An excerpt from our interviews is given below to further clarify this point.

Researcher (R): Let's say, if I wanted to ask you to classify animals....
Student (S): Animals...I would classify them with respect to their habitat; living on air, on land...umm, would this be at least also?
R: Tell me whatever your opinion is.
S: And living on sea or as mammals also. I mean...(not sure).
R: Ok, now if I ask you to classify plants.
S: Plants...Plants...(thinking) Plants...(silence)...I can not remember (smiling).

We also asked students about how and according to what criteria they ranked the living things. All students said that they did not use any criteria and they ranked the names as they came to their mind. Following excerpt illustrates this point.

R: You were asked to list the names of the ten living things. How did you do this?
S: Listing?
R: You wrote the names of the 10 living things, I meant that.
S: I have not used any criteria, I wrote whatever came to my mind.

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

As a result, it can be said 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 life concept was associated was human. In this construction, plants and other living things came after animals and human.

Classification of the living things: Student conceptions

Male and female students' answers convened at two main groups namely 'only animals' and 'human, animals, and plants'. We have noticed that approximately half (47.6%) of the males and one fourth of (23.4%) the females considered only animals (and human) while classifying the living things. Percentage of students who grouped the living things as human, animals, and plants were 19 for males and 40 for females.

During our interviews with students, we looked for any clues for reasons why students grouped the living things as human, animals, and plants.

R: If I ask you to classify the living things into some main groups, how many groups can you form?

S: Living things...living things...(thinking)
R: At least in how many groups can you divide them?
S: ... Living on land, on sea, flying, plants, and humans.
R: How did you do this classification?
S: According to their habitat, and I distinguished the plants and humans.
R: Why?
S: Since humans have mind and plants do not move (fixed), I grouped them separately.

It is expressed in the literature that while classifying animals, instead of a biological classification, students often consider appearance of animals and group them according to their habitat and type of movement (flying, swimming, etc.) they use for displacement (Kattmann, 2001; Tunnicliffe & Reis , 1999; Tunnicliffe & Reis , 2000).

In this study, we have seen that students while classifying animals, used expressions as living in water (swimmers), flyers, and terrestrials. Braund (1991) suggested that this and similar methods used by students, were a kind of 'alternative classification' (alternative concept) they developed against biological classification. Kattmann (2001) reported that students' methods of animal classification remained unchanged even after they had been taught biological classification.

As a result, it is thought that students consider mostly appearance and physical characteristics of the living things in classification; and they do not change their classification method even after they were taught biological classification. In addition, as expressed by Shepardson (2005), students perceive human not as a part of the nature but as 'distinct' from the nature; and when asked to "classify the living things" they were seen to treat human in a separate group which indicates an anthropocentric approach.

The place of human among the living things

Analysis of the third question revealed how human was positioned within all the living things. Four out of five students for both males and females stated that human was the most advanced among all the living things. By examining the results of the third question, we can better understand the reason why it was human that was the most frequently ranked first among the 10 living things in the first question, and the reason why human was considered in a separate category apart from the other living things in the third question.

In student interviews, we have seen that they had a common thought form which places human at the center and believes that all the other living things exist for human. Related to this idea, responses of three students are given below.

R: In terms of biological classification, what do think about the place of human among all the other living things?
S-II: Human is at the top position...As if we are not revolving with the earth, but the earth is revolving for us...Like all natural phenomenon are occurring for us. Since human can think and has skills, he is at the top.
S-VII: Human is the most important living being who leads and develops the natural cycle...The most important distinction of human from animals and plants is his ability to think. Besides, everything in nature is created for humans.
S-XI: I think everything in nature is an established mechanism for humans to live comfortably. You know, from plants…we benefit from animals (meat and milk). There are much more for humans to benefit from.

Placement of human at the centre of nature, and the idea of existence of all the living beings for him may be interpreted as a result of choosing a categorization according to the harm or benefit he will get from the living beings. Questions 4 and 5 were asked to determine the level of priority given to human among all the living things.

The importance and the degree of importance of the living things

Student responses to the fourth and fifth questions were analyzed to find out the criteria they used in characterizing the living things as 'important', 'more important', or 'not important'.

The importance of the living things

Two main categories were determined in the analysis of the fourth question. Four fifth of both male and female students said that there were not any living things that could be identified as 'unimportant' in nature. Reasons they had for being important were mostly related to roles the living things have in ecologic balance and that unimportant living things could not be existed in nature anyway. Another reason stated was the dependence of living things on each other in terms of nutrition. When we looked at the living things that were regarded as unimportant, they were ones people generally dislike or were scared of such as insects, snake, and rat.

While explaining the importance of the living things almost one third of students, used statements such as "if it was not useful it would not be existed in nature" or "if it exists, it certainly has a role" rather than emphasizing the reasons of their responses. These types of

statements have been considered to be examples of teleology (purposefulness). Some researchers reported the widespread existence of teleological thinking in students' interpretations (Barrow, 1990; Giordan & De Vecchi, 1994; Lemmer et al., 2003).

In our interviews with students and teachers it was stated that there could not be /were not any living things that were regarded as unimportant. Even if the 'importance' was interpreted in terms of benefit-harm to the nature, when interview transcripts were examined closely, it was realized that the importance criteria in students' and teachers' subconscious 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 (Ashworth et al., 1995; Kellert, 1993). These concepts comprise anthropocentric features. An excerpt from a student interview supports our idea.

R: In your opinion, are there any living things that are unimportant among so many types?

S: Unimportant...most of them are important actually. I mean, for instance voles are harmful to our fields, and we are scared of snakes but snakes eat voles and kill them. But...in the recent test (pre-test), you know, I do not know much about benefits or harms of jellyfish...I thought, can be unimportant.

R: How do you determine the importance (important or unimportant) of a living thing?

S: In terms of benefits and harms to the nature.

R: Can we say that a living thing is unimportant if it is not beneficial to human?

S: No, we cannot.

R: What is important is its benefit to the nature...

S: Yes, in the end, we benefit from the nature.

An excerpt from a teacher interview is given below.

R: In your opinion, are there any living things that are unimportant among so many types?

T: There are no unimportant living things but I believe there are living things that are ecologically and biologically less important. Like there are species which are very similar to each other. There may be living things that do not affect human life and will not affect nature directly. However, according to my belief every living being has a place in nature. Has a function.

Degree of importance of the living things

Students were given names of five living things, namely one fungus, two plants (stinging nettle and daisy), one insect (honey bee), and a mammalian (mouse) and were asked to rank them according to the degree of importance.

Students who ranked honeybee first, said, 'honeybee makes honey' as the reason for their ranking. Males who ranked 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 ranked nettle first said they chose it since it was a healing plant, or a plant, a producer. A small number of students' rationale for ranking fungus first was that it was a source of food. Students who ranked rat first said they chose it since it was an 'experimental subject'. Examples of student responses that ranked different names as first are given below.

S-I: No living thing in the nature is more important than any other. However, this point of view changes from human to human. Humans regard the ones who are beneficial to them as more important.

S-XII: Daisy-Honeybee-Fungus-Nettle-Rat. Daisy helps us continue our lives by photosynthesis (breathing). Honeybee makes honey (I guess). I like honey very much and eat it. Fungus (mushroom) (though some are poisonous) is tasty and has importance in the nature. I do not like nettle much, it is irritating and thus harmful. I do not like rat too. I am scared of rat and it may be harmful to people's belongings. It may be good for the nature but it is harmful for me.

S-III: Rat-Honeybee-Daisy-Fungus-Nettle. Because rat, although seems to be harmful, helps us by eating harmful plants.

S-VI: Honeybee-Nettle-Fungus-Daisy-Rat: I made this list by thinking in terms of their benefit to humans.

S-VIII: Honeybee-Daisy-Nettle-Fungus-Rat: I determined the degree of importance according to their contribution to human life. Without honeybee, humans would not have honey. To make honey, flowers are required of course.

S-X: Rat, because rat is an animal. Others are plants.

The proportion of both males and females who said 'an importance list cannot be made; all living things are important,' was approximately 5%.

In conclusion, when we look at the reasons for ranking a name first (healing, food, making honey, etc.) they were closely related to their importance for human. Females consider aesthetic features, males consider in terms of their usefulness while attributing significance to the living things. However, whether the gender effect is significant should be investigated in further studies.

DISCUSSION AND CONCLUSION

When the results of the five questions of the CULC test were evaluated on the basis of the first question, it can be argued that most frequently associated living thing (human) with the concept of life was ranked as first. The ranks of 10 living things matches to a large extent with the living things associated first in the construction of the life concept. In general, the most frequently associated group of living things with the

concept of life were animals with 80%. Among the 10 living things ranked, first five ranks were again consisted of animal groups. As we have presented earlier, it has been shown that animistic ideas have been effective in the construction of the life concept. The fact that animals stand out in our results may indicate that animistic processes have effects in the construction of the life concept. In addition, the fact that plants were ranked sixth among the 10 living things seems to support our claim.

Our findings about the relational construction of the concept of life and alive suggest that students associate the concept of life first with human, then animals, after that plants, and finally with the other living things. This finding seems to support that students perceive animals (and human) as more important than the other living things. In addition, depending on the results of Kinchin (1999) and Wandersee (1986), our findings indicate that another component in the construction of the life concept is the concept of "motion."

Some researchers claim that emphasis on human notion was caused by an anthropocentric point of view (Hage & Rauckiene, 2004; Murphy, 1996; Shepardson, 2005). It was determined that besides human, the life concept was associated with animals, then plants, and finally other living things. Motion was the most frequently associated concept with the life concept. As a result, it is thought that the life concept is constructed with the use of animist-anthropocentric cognitive schemes.

In this study students used, especially in grouping animals, statements such as living in water (swimmers), flying (flyers), and living on land, which were similar to empiric method used by Aristotle for the classification of the living things. In this way, students seemingly developed a method of classification for themselves. Prokop *et al.* (2007b) argue that while it may be possible to alter some preconceptions others may remain unchanged and can not be replaced with scientific thinking via traditional instructional approaches. Braund (1991) identified this as an 'alternative classification' (alternative concept) students used against biologic classification. Braund (1991, 1998) and Aydin and Usak (2003) emphasized that these alternative concepts students had were caused mostly by their observations of outside world and do not change even after teaching of the concepts; and it is understood that students in a way internalized these concepts. Kattmann (2001) indicated that methods students used for classifying animals were remained unchanged even after they were taught biologic classification. Tunnicliffe and Reiss (2000) reported that students classified plants by using a grouping method according to their anatomic features.

When asked to classify all the living things, as appropriate to the above-explained model, some stated only animal groups, some on the other hand, included
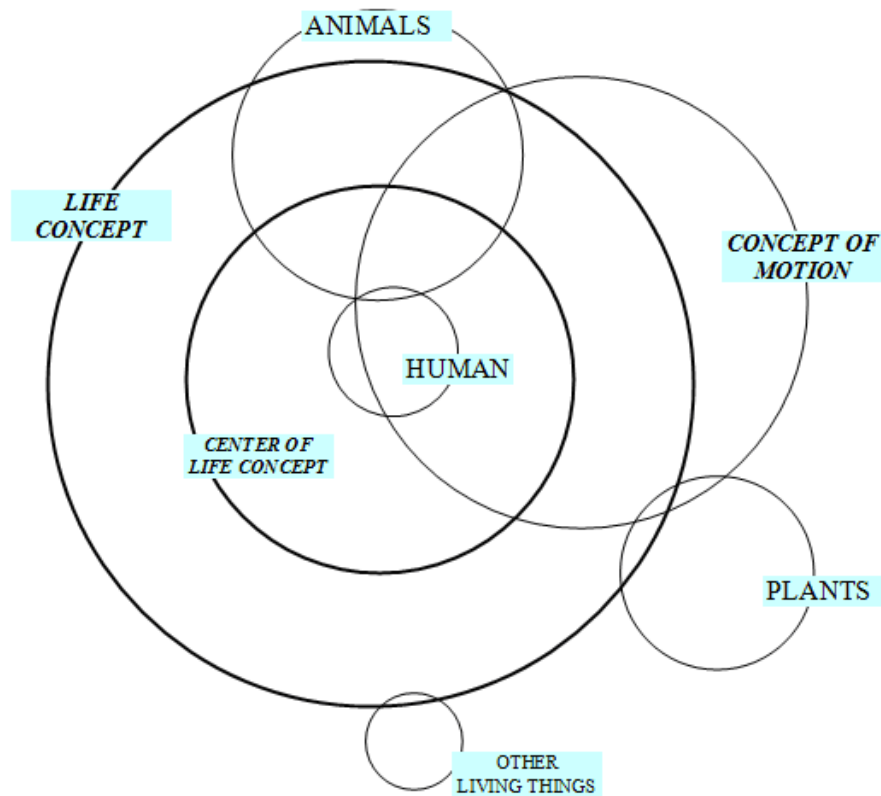

Figure 1. Animistic-anthropocentric construction model of the life concept (Yorek & Narli, 2009)

human in a separate group. Shepardson (2005) specified that students perceived human not as part of the nature, but as 'separate' than the nature. In this study the same approach, which we think was based on anthropocentrism, was seen in classification.

Students ascribed importance to the living things although in terms of their benefit-harm to the nature, it was noticed that in subconscious they used a human-centered judgment. It was seen that students' perception has put human at the center and they considered that all the other living things were exist for human.

Animistic-anthropocentric construction model of the life concept

Starting from the fact that human and animals stand out considerably in this study, we suggest an animistic-anthropocentric conceptual construction model about the life concept (Figure 1). In constructing this model we have represented the life and related concepts and sub-concepts with circles (Yorek & Narli, 2009).

In the model, the circles represent the level of 'significance' of the concepts with respect to each other. In respect to the life concept circle, the sections of other circles which stay inside the life concept circle are directly proportional to their significance level. Proximity to the center of the life concept circle is related to a concept's priority of its association in the construction of the life concept.

When examined closely it can be seen that all the circles which intercept the circle of life concept, do not cover it completely. This is related to the dynamic structure of the model. The results of this study do not describe the construction of the life concept totally. Therefore, further studies about the life concept can be added to this model. In addition, including different age groups, grade levels, and other variables may change the positions and proportions of the circles.

The life concept center is placed at the center of the life concept circle to symbolize the abstract proximity of all the concepts that can possibly be related to the life concept. We assume that in the construction of the life concept, related sub-concepts are cognitively processed in respect to their size and proximity to the center.

In Figure 1 we notice that the closest circle to the center of the life concept is the human circle. However, the human circle does not comprise a large area within the life concept circle. This means that when the concept 'alive' is thought the first living being that comes to one's mind is mostly human but constituting a rather small portion of the whole concept of life. The human circle to a great extent is a member of the animal and motion circles. The symbolic meaning of this can be explained as the concept of human does not regarded as completely animal among the living beings and the fact that human circle is closer to the life concept center

than animal circle may mean that the human concept is thought in prior to animals in the construction of the life concept. In terms of size, the largest area is covered by the motion circle in the construction of the life concept, the second largest area is covered by the animal circle, and the plant circle covers a larger area than the other living things which constitute the smallest area. Interception region of plant circle with the motion circle is smaller than the animal and human circles. The symbolic meaning of this is that, in the construction of the life concept, motion has less importance for plants than it is for human and animals. The circle representing the living things apart from human, animals, and plants has a small area and is not a member of the motion circle. What we understand from this is that the life concept is mostly associated with human, animals, and plants and the other living beings constitute a rather small portion of this relationship.

According to our model, the representations of the living things in the construction of the life concept do not seem to be at the same proportion. In other words, we can say that different groups of living things are associated with the concept of life through varying areas. In this sense, a group of living things (for example mammals) can be expressed 'more alive' than another group (for example plants).

IMPLICATIONS FOR EDUCATION

The following conclusion can be drawn from this study. Students' view of the living things is that human is separate from the nature and all the other living things exist for human. Students can see the parts of the whole living things however; they cannot appreciate the value of the parts within the whole, cannot understand the relationships among the parts, and as a result, cannot comprehend the 'whole'. This is thought to be caused totally by an anthropocentric approach. This approach was also seen to exist in teachers along with students. When the effect of instructional programs added to this, it might reinforce the formation of anthropocentric cognitive structures in students.

It is important to have balance between human and the nature to restructure anthropocentric approach as a new concept, defined as 'Ecocentric (nature centered) conscious'.

The result of this study may have some implications for biology teachers, science educators, and science education as summarized below.

- In curriculum, value of the living things in nature may be evaluated in terms of the harmony among all the living things instead of their benefit-harm to humans.
- In describing groups of the living things, examples emphasizing harmony between human and the nature can be used to ensure understanding.

- Based on students' deficient holistic nature understanding, a new environmental education program may be developed and oriented toward establishment of holistic-ecocentric conscious.

- If any, content of environmental education courses in biology education departments' instructional programs may be revised in terms of new approach. If there are no such courses, new courses may be developed to serve these purposes. In addition, biology teachers may be provided with in-service training about the new approaches.

REFERENCES

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.

Aydin, H., & Usak, M. (2003). Fen derslerinde alternatif kavramların araştırılmasının önemi: Kuramsal bir yaklaşım [The importance of the investigation of alternative conceptions in science classes: A theoretical approach]. *Pamukkale Universitesi Egitim Fakultesi Dergisi, 13*(1), 121-135.

Bardel, C. (1997). *Vivant, Non-vivant, Mort. Ou Sont Les Conceptions Des Eleves* [Alive, Lifeless, Dead. The Origin of Students' Conceptions] Unpublished M.Sc. Thesis, Joseph Fourier University, Grenoble, France.

Barrow, J. D. (1990). *The World within the World.* New York: Oxford University Press.

Berzonsky, M. D. (1974). Reflectivity, internality, and animistic thinking. *Child Development, 45,* 785–789.

Berzonsky, M. D. (1987). Child animism: Situational influences and individual differences. *Journal of Genetic Psychology, 149*(3), 293–303.

Braund, M. (1991). Children's ideas in classifying animals. *Journal of Biological Education, 25*(2), 103-110.

Braund, M. (1998). Trends in children's concepts of vertebrate and invertebrate. Journal *of Biological Education, 32*(2), 112-118.

Caravita, S., & Falchetti, E. (2005). Are bones alive? *Journal of Biological Education, 39*(4), 163-170.

Dolgin, K. G., & Behrend, D. A. (1984). Children's knowledge about animates and inanimates. *Child Development, 55,* 1646–1650.

Elkind, D. (1991). Development in early childhood. *Elementary School Guidance & Counselling, 26*(1), 12-21.

Franklin, S. (2004). Life. In S. G. Post (ed.), *Encyclopedia of Bioethics* (pp. 1381-1387). New York: Thomson Gale, Macmillan Reference.

Gatt, S., Tunnicliffe, S. D., Borg, K., & Lautier K. (2007). Young Maltese children's ideas about plants. *Journal of Biological Education, 41*(3), 117-121.

Giordan, A., & De Vecchi, G. (1994). *Les origines du savoir. Des conceptions des apprenants aux concepts scientifiques* [The origins of knowledge: From the learners' conceptions to scientific conceptions] Geneva: Delachaux et Niéstle.

Hage, R., & Rauckiene, A. (2004). Ecocentric worldview paradigm: The reconstruction of consciousness. *Journal of Baltic Science Education, 2,* 50-58.

Kattmann, U. (2001). Aquatics, flyers, creepers and terrestrials-students' conceptions of animal classifications. *Journal of Biological Education, 35*(3), 141-147.

Keogh, J. S. (1995). The importance of systematic in understanding the biodiversity crisis: The role of biological educators. *Journal of Biological Education, 29*(4), 293-299.

Kellert, S. R. (1993). Attitudes, knowledge, and behavior toward wildlife among the industrial superpowers: United States, Japan, and Germany. *Journal of Social Issues, 49,* 53–69.

Kinchin, I. M. (1999). Investigating secondary-school girls' preferences for animals or plants: A simple 'head-to-head' comparison using two unfamiliar organisms. *Journal of Biological Education, 33,* 95–99.

Klingensmith, S. W. (1953). Child animism: What the child means by "alive", *Child Development, 24*(1), 51-61.

Lemmer, M., Lemmer, T. N., & Smit, J. A. (2003). South African students' views of the universe. *International Journal of Science Education 25*(5), 563- 582.

Lindemann-Matthies, P. (2005). 'Loveable' mammals and 'lifeless' plants: How children's interest in common local organisms can be enhanced through observation of nature. *International Journal of Science Education, 27*(6), 655- 677.

Lucas, A. M., Linke, R. D., & Sedgwick, P. P. (1979). Schoolchildren's criteria for "alive": A content analysis approach. *The Journal of Psychology, 103,* 103–112.

Murphy, T. P. (1996). What value nature? A legal viewpoint. *Journal of Environmental Education, 27*(4), 5-8.

Piaget, J. (1929). *The child's conception of the world.* London, UK: Routledge & Kegan Paul.

Prokop, P., Prokop, M., & Tunnicliffe, S. D. (2007a). Is biology boring? Student attitudes toward biology. *Journal of Biological Education, 42*(1), 36-39.

Prokop, P., Prokop, M., Tunnicliffe, S. D., & Diran, C. (2007b). Children's ideas of animals' internal structures. *Journal of Biological Education, 41*(2), 62-67.

Shepardson, D. P. (2005). Student ideas: What is an environment? *Journal of Environmental Education, 36*(4), 49-58.

Tunnicliffe, S. D., & Reiss, M. J. (1999). Building a model: How do children see animals? *Journal of Biological Education, 33*(3), 142-148.

Tunnicliffe, S. D., & Reiss, M. J. (2000). Building a model: How do children see plants? *Journal of Biological Education, 34*(4), 172-177.

Tunnicliffe, S. D., Gatt, S., Agius, C. & Pizzuto, S. A. (2008). Animals in the lives of young Maltese Children, *Eurasia Journal of Mathematics, Science & Technology Education, 4*(3), 215–221.

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.

Wandersee, J. H., & Schussler, E. E. (1999). Preventing plant blindness. *The American Biology Teacher, 61,* 84–86.

Wandersee, J. H., & Schussler, E. E. (2001). Toward a theory of plant blindness. *Plant Science Bulletin, 47,* 2–9.

Watts, M., & Bentley, D. (1991, April). *An instructional 'Man-Trap': Anthropomorphic thought in constructivist science education.* Paper Presented at the Annual Conference of

the American Educational Research Association, Chicago.

Yorek, N., & Narli, S. (2009). Modeling of cognitive structure of uncertain scientific concepts using fuzzy-rough sets and intuitionistic fuzzy sets: Example of the life concept, *International Journal of Uncertainty Fuzziness and Knowledge-Based Systems, 17*(5), 747–769.

❖ ❖ ❖