

Full Length Research Paper

Science students' misconceptions about birds

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The aim of this study was to determine the misconceptions of science students attending the university on the classification and behaviour of birds, and their interaction with people. For this purpose, open questions, interviews and drawing methods were directed at 110 university science students. As a result of the analysis of data obtained, it was determined that the science students surveyed had various misconceptions with regard to the classification and behaviour of birds, and their interaction with people. Some of these misconceptions are described for the first time (the gizzard in their maw provides the digestion). Some suggestions have been put forward in light of findings both in the literature and the findings of this study.

Key words: Misconceptions, bird, science student.

INTRODUCTION

Misconceptions of students in the field of science education have become a focal point for researchers in recent years. The latest studies have revealed that students have difficulties in understanding many scientific subjects, and the subjects that the students have difficulty in understanding create considerable obstacles to learning in later years of study (Bahar, 2003; Ozay and Oztas, 2003; Yip, 1998).

Various conceptions developed by the students themselves, which are far from scientific facts and called naïve theories, preconceptions, misconceptions or alternative conceptions, create serious obstacles for later years of learning. According to the results from previous research, students develop these false concepts from their own interpretations during the first years at school, or from some inconsistent explanations either at school or outside the classroom (Bell, 1981; Gilbert et al., 1982; Yip, 1998; Bahar, 2003). In addition, it is also important to note that textbooks do not utilize scientific technology appropriately and contain alternative conceptions (Coll and Treagust, 2001; Dikmenli and Cardak, 2004; Schussler, 2008).

Studies related to animals show that students have many alternative interpretations of these concepts. Bell (1981) and Braund (1991) have disclosed that students confuse animals with other living organisms, and their knowledge of the diversity of animal species is limited by domestic animals. For example, students tend to classify

some vertebrates that have no visible limbs as invertebrate, and some invertebrates that have large exoskeletons as vertebrate. Hatano and Inagaki (2002) argue that skeletal principles are combined with (a) a mode of explanation of living things in terms of their similarity to human beings and (b) the idea that living phenomena are produced by a vital principle, as distinct from a purely chemical or physical force (vitalism). It has been determined that these misconceptions can be seen among primary and secondary education students as well as university students (Trowbridge and Mintzes, 1985, 1988; Dikmenli et al., 2002; Bahar, 2003). Studies related to birds that students have many different interpretations (Kiziroglu, 2001; Turan, 1990). Prokop et al. (2008b) found that factual knowledge about birds was positively related to students' attitudes toward birds. Interestingly, younger students had better knowledge of birds than older students. Prokop et al. (2007a) found several misconceptions, some of them with both anthropomorphical and teleological reasoning of the children about birds within each dimension.

Various different methods may be used to determine the perception status of the students. Interpretive and quantitative methodologies, in combination with open questions (Dikmenli, 2010), pre- and post-test techniques (Haslam and Treagust, 1987), concept mapping (Novak and Gowin, 1984; Novak, 1990), interview together with drawings (Teixeira, 2000), drawings (Reis and Tunnicliffe,

2001; Reiss et al., 2002; Prokop and Fancovicova, 2006; Erdogan and Erentay, 2007; Bahar et al., 2008; Kose, 2008; Prokop et al., 2009 b) and a word association questionnaire based on keywords (Sato and James, 1999; Torkar and Bajd, 2006; Cardak and Dikmenli, 2009) are the principal tools used by today's investigators in order to carry out the recording, categorization, and interpretation of students' and teachers' ideas and conceptions.

Purpose of the study

The purpose of this study is to determine the misconceptions science students have in relation to birds, their classification, characteristics, behaviour and interaction with people. It searches for an answer to the issue of the misconceptions associated with birds (classification, characteristics, behaviour, interaction with people) held by university science students.

MATERIAL AND METHODS

This research was carried out during February and March of the 2008 - 2009 academic year among 110 science students (teacher candidates) attending Selcuk University in Turkey. The youngest student in the research sampling was 19, the oldest was 23. The average age was approximately 21 years. Of the participants, were 58 female and 52 male. In the literature (Prokop et al., 2007a; Bahar et al., 2008) no high gender differences are found in this field. Thus, the gender difference is not examined in this study. The students in the sample have already taken general biology courses regarding vertebrate zoology topics. Because of the laws, students can only experience with vertebrate dissections virtually. The science students were given 20 min to answer the questions. The students participating in the study were given a form containing one open-ended question - which was "write down the characteristics and behaviour of birds" - to be filled in. Later, after an analysis of the answers to the open question, interviews lasting about 20 min (Abdullah and Scaife, 1997) were held in an empty room with the 10 students (teacher candidates) that had the most misconceptions. During the interview, questions parallel with the misconceptions, such as why and how were directed at the students. These questions included, for example: "you state that birds migrate south to avoid freezing; why? and "you state that a bat is a bird; why? Furthermore, during the interviews, the students were asked to draw the picture of a bird on a blank sheet of A4 paper. This data collection method made it possible to monitor the thoughts of the participants (Dove et al., 1999; White and Gunstone, 2000; Reiss and Tunnicliffe, 2001; Ozay and Oztas, 2003; Bahar et al., 2008; Kose, 2008; Cardak, 2009).

The data gleaned from the questions directed at the students was analysed one by one by researcher. The misconceptions gathered from the answers to the open questions were separated into four different categories: characteristics; behaviour; bird and human interaction; and classification.

RESULTS AND DISCUSSION

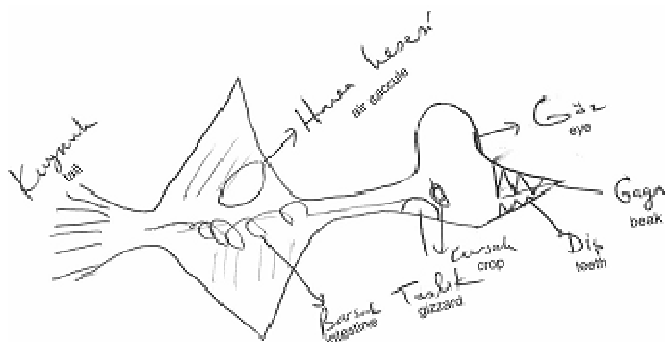
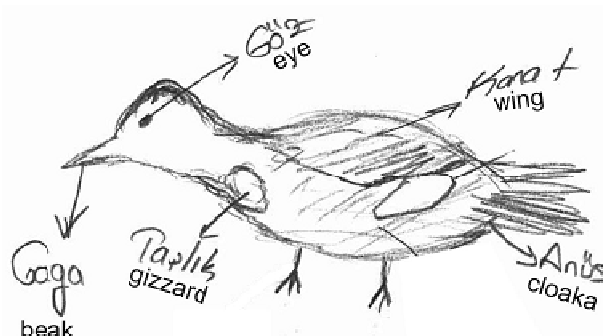
When the answers given by the students to the open question were studied, 26 misconceptions in four different

categories were determined (Table 1). Some of the drawings supporting the misconceptions gleaned from the open question are shown in Figures 1, 2 and 3. The category with the most misconceptions was the characteristics of birds, with 10 misconceptions. In many academic studies, misconceptions about animals and their characteristics have been encountered among students at all levels of education, from primary schools to universities. Data collected during this investigation supports the misconceptions related to animals encountered during various studies (e.g. Bell, 1981; Trowbridge and Mintzes, 1985; Tema, 1989; Braund, 1991; Chen et al., 1994; Chen and Ku, 1998; Katman, 2001; Chiung-Fen et al., 2007; Kubiak and Prokop, 2007; Prokop and Rodák, 2009a; Prokop et al., 2007a, 2009a). Some of misconceptions are reported for the first time. The misconceptions that a bat is a bird, or a penguin is a mammal or fish, have been set forth in other studies as well (Dikmenli et al., 2002; Prokop et al., 2007b; Prokop et al. 2008 a). This is the result of the students' conception that everything that lives in the water is a fish, and everything that flies is a bird (Kattman, 2001). If the students could be informed live of the characteristics of birds in a zoo or a natural environment, this situation could be largely resolved. In addition, students had misconceptions about the behaviour of birds - for instance, birds migrate south to avoid freezing (Prokop et al., 2007a) and the brooding duration of all birds is the same. As a matter of fact, birds migrate due to such needs as genetic factors, hatching environment or warmth. Some birds never migrate. Again, some students believed that all birds were monogamous (Prokop et al., 2007a). However, some birds change partners several times a year. With regard to the interaction between birds and people, many students had misconceptions, such as if a person touches the nest of a bird, birds will never come back to that nest (Fries-Gaiter, 2009), or, all wild birds infect people with bird flu (Prokop et al., 2008b). In fact, birds do not abandon a nest for a long time just because it has been touched by a human. They may stay away for a while for protection. If there are eggs or young birds in the nest, the bird will come straight back to it. Some of the most important misconceptions students have about birds are, "birds have teeth in their beak that help tear food apart"; "birds have eyes in the front of their heads so that they can see ahead" (Fries-Gaiter, 2009); "birds digest their food in their mouths"; "the air sacs that help birds fly are in their feet"; or "birds can fly due to the air spaces between their cells", "only female birds built the bird nests". When misconceptions about the characteristics of birds were considered, it was seen that the students had serious misconceptions about teeth in their beaks, the location of their eyes on their head, the digestion of food, air sacs, the location of the gizzard, and the number of chambers in their hearts.

The "why" questions were directed at ten students with misconceptions during one-on-one interviews, and the interviewees were also asked to draw a general bird shape

Table 1. Students' misconceptions about birds.

| Category | Misconceptions (n = 110) | % |
|----------------------------|---|----|
| Characteristics | Birds have teeth in their beaks that help tear food apart. (21) | 19 |
| | Birds have eyes in the front of their heads so that they can see ahead. (20) | 18 |
| | Birds digest their food in their mouths. (18) | 16 |
| | The heart of birds has 2 chambers. (16) | 15 |
| | As birds have no teeth, the gizzard in their maw provides the digestion. (15) | 14 |
| | Birds can fly due to the air spaces between their cells. (15) | 14 |
| | The air sacs that help birds fly are located in their feet. (13) | 12 |
| | Birds can fly because they are light animals. (12) | 11 |
| | Birds have no brain. (3) | 3 |
| | External fertilization may take place in birds. (3) | 3 |
| Behaviour | Birds migrate only to warmer regions in order to avoid freezing. (39) | 35 |
| | Birds fluff their feathers when they are cold. (28) | 25 |
| | Only female birds build the bird nests. (21) | 19 |
| | Only female birds sit on the eggs until they hatch. (20) | 18 |
| | Female birds are responsible for the care of the young. (20) | 18 |
| | During the mating period, the female birds choose the male birds. (18) | 16 |
| | Birds only lay eggs once a year. (17) | 15 |
| | All bird species mate during the same month of a year. (12) | 11 |
| Bird and human interaction | Birds have a family life. Each bird has only one mate. (7) | 6 |
| | If a person touches the nest of a bird, birds will never come back to that nest. (19) | 17 |
| | If a bird calls on the roof of a house, a death will occur in that house. (16) | 15 |
| Classification | Wild birds cause bird flu in humans. (15) | 14 |
| | Bats are birds because they fly. (42) | 38 |
| | Penguins are fish because they live in the water. (29) | 26 |
| | Penguins can live anywhere that is cold. (17) | 15 |
| | Penguins are mammals. (9) | 8 |

**Figure 1.** Examples of misconceptions (eye, teeth, gizzard).**Figure 2.** Examples of misconceptions (gizzard).

and show the various parts. The findings obtained from the answers to the questions were directed at the students, and included, usually, "why is it like this?" and "why do you think so?" These results supported the answers they gave to the open questions. It was again apparent that the students had misconceptions related to the behaviour, various characteristics and classification of birds and also their interaction with humans.

The sketches that the students were asked to draw showed misconceptions, such as teeth on birds' beaks (Figure 1), their eyes are in front so they can see ahead (Figure 1), their gizzards are in their maws (Figures 2 and 3), they have air sacs on their feet (Figure 3). The findings from the open questions conform to a large extent with the results of the interview and the findings from the drawings, as they all gave similar results. In this

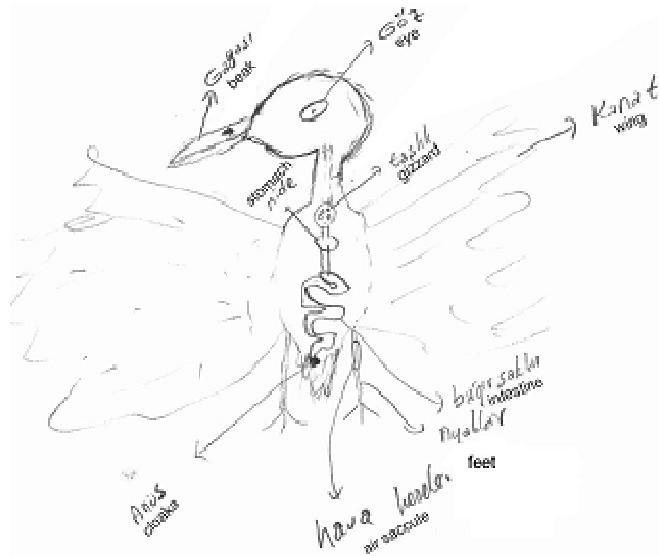


Figure 3. Examples of misconceptions (air sacculae, gizzard).

aspect, the research is similar to that conducted by Teixeira (2000); Bahar et al. (2008); Kose (2008) and Cardak (2009).

The science students (teacher candidates) that were included in the sample had many misconceptions, even though they are the teachers of the future. Until today, they had received many lessons on the diversity of the species and classifications in many phases of their education, in spite of which they still had misconceptions. This situation arises from the fact that science is generally made up of abstract concepts. The students had difficulty in assigning meaning to scientific concepts. The students had many misconceptions about the creatures in the animal kingdom, including birds. Students who lived in city centres, in particular, as they are far from wildlife, were distant from the physical and anatomical structures of the animals. The students could only learn about the creatures of the animal kingdom through such sources as textbooks, magazines and newspapers. Hence, the students had difficulty in understanding, as they could not recognize animals in their natural environment or could not touch or observe them. In short, they could not learn by doing and experiencing. While the students are being given information about the animal kingdom, this information must be concrete. If concrete information cannot be presented, educational techniques, such as models, mock-ups or computer animations, should be used to make the information more concrete in the educational environment. Students should be encouraged to conduct scientific projects with birds in schools. Teachers may obtain multiple advantages from using birds or other animals' model in the classroom.

Further educational implication can be that teachers should plan 1.) More practical works which would eliminate misconceptions and that 2.) Researchers should

should plan investigations to address this question. Real and virtual dissections seem to be also appropriate to say within this context.

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