PUPILS' UNDERSTANDING OF MAMMALS: AN INVESTIGATION OF THE COGNITIVE DIMENSION OF MISCONCEPTIONS

MILAN KUBIATKO[1], PAVOL PROKOP[2]

[1] Educational Research Centre, Faculty of Education,
Masaryk University, Brno, Czech Republic,
[2] Department of Biology, Faculty of Education,
Trnava University, Trnava, Slovakia

Abstract: *The investigation of misconceptions among children is a favorite kind of investigation among researchers. It is possible to meet with the term "cognitive dimension of preconcept". Misconceptions about animals have been reported in various research reports on pupils of different ages. This cross-age study is focused on finding misconceptions about mammals among elementary-school children of various ages (from 10 to 15). A questionnaire consisting of 35 multiple choice and open-ended questions was used. This questionnaire was administered to 468 children from 6 elementary schools. We divided the questionnaire items into five categories according to their character. We focused on finding the differences in results between the gender and age of the respondents. We found numerous misconceptions across all age groups. Our study provides implications for teaching biology/science especially in the field of zoology.*

Key words*: misconceptions, mammals, pupils, questionnaire*

Introduction

Children come into schools with their own ideas/conceptions about the world. Children have developed conceptions about the natural world about them. They have experiences of what happens when they drop, push, pull or throw an object, and in this way they build up conceptions about the world around them (Driver, Squires, Rushworth, & Wood-Robinson, 2008). Some conceptions are correct and some are incorrect from a scientific point of view. The term "conception" denotes a mental representation of some features of the external world or of theoretical domains.In this paper we will present the results of research which has focused on the investigation of pupils' ideas about mammals. The research was carried out among elementary schools pupils aged between 10 and 15. Some of the children had been taught about animals and some had not. This is the reason why the investigation was of interest; as some children could be influenced by the surrounding world and some by using their knowledge base.

Theoretical background

Definitions of misconception

The conceptions could be divided into two groups: preconceptions and misconceptions. Preconceptions are those conceptions that result from informal experiences in everyday life, whereas misconceptions are misunderstandings that are induced through prior formal teaching (Duit, 1996). Many things play an important role in the preconception's creation, for example social, economic, and religious factors. This group is called exogenous factors. Also, we know of endogenous factors, which come from the individual psychological and biological characteristics of each individual. The preconceptions are structured in a very complex manner; they are not only knowledge and understanding (Richardson, 1999). Preconceptions have one important attribute; they are interactions with other preconceptions (Nicoll, Francisco, & Nakhleh, 2001).

Škoda and Doulík (2007) suggested on the basis of investigations the following characteristics of preconcepts. They used three descriptive categories:

1. cognitive dimension
2. affective dimension
3. conative dimension

For our purposes the most important is the first category, which is characterized by the content and extent. Every pupil has a founded cognitive level of concept, which is defined as the information's quality and quantity.

A very important thing is that children's preconceptions are stable. They persist even after meeting with facts which contradict the children's incorrect preconceptions. They do not start to diminish until after multiple occurrences of the situation in which the incorrect conception was not proved. The change from incorrect conception to correct conception happens very slowly.

Children obtain information through all senses. Every new experience contributes to the concept's creation via some concrete phenomenon or object. Children have the tendency to view objects/phenomena/situations only from their own view. This fact influences children's conceptions, because conceptions are represented by the experiences of children. Gradually children have an interest in the conceptions of other people. They have the need to share their own ideas with other people, mainly with those, who are in the close environment (Wenham, 1995).

Wenham's (1995) definitions of preconceptions are as follows:

- preconceptions working from experiences, not from imagination or fantasy,
- they are connected with a reality which was the basis for their creation, they are less applicable for other situations, but what is interesting is they are used as analogies for explanations of different phenomena
- preconceptions consist of a small amount of information which is necessary for the creation of complex explanations
- they are connected with specific situations and are therefore impossible to apply to similar situations

- preconceptions can be influenced by other information, not only that connected with one's own experiences
- preconceptions are expressed in a scientific way, but whose meaning is incorrect.

There are lots of definitions for what misconceptions are. We refer only to the information about misconceptions which is connected with our study.

Misconceptions refer to ideas formed as a result of the incorrect assimilation of formal models or theories. Misconceptions reflect situations in which students provide mistaken explanations of events on an intuitive basis and according to their daily experience, lacking any informal instruction. On the other hand, a misconceptions can be a situation in which, following formal instruction, students still do not understand a scientific idea and they provide a mistaken explanation (Driver & Easley, 1978).

Misconceptions are created by misunderstanding or wrongly understanding curriculum content. These things happen when a pupil is creating a symbiosis with a new curriculum content. Part of the knowledge from a new curriculum is understood correctly, part is connected to a previous preconception and part of the pupil's knowledge remains unchanged. This last part impedes future learning.

Vosniadou (1991) demonstrated the importance of prior knowledge in the acquisition of new information. The individual's ability to learn something new depends on the interaction between the information that currently exists in the knowledge base and the new information to be acquired. And when there are gaps in the knowledge base or when the prerequisite information has not been activated, the result is failure in communication and in learning.

Also, misconceptions could be created from one's own experience, incorrect articulation or from mistakes in a text (Betkowski, 1995). Through teaching or learning the interesting situation can occur that pupils receive a parallel understanding of phenomena or ideas. One understanding is for school and one is for everyday life (Gilbert, Osborne, & Fensham, 1982).

The next problem is when a pupil still believes their own preconceptions and does not accept the teacher's explanation (Minstrell & Smith, 1983). Similar reasons are denoted by Duit (1996). Firstly, teachers sometimes have inaccurate conceptions because they were not well-trained and are unfamiliar with their subject-matter area. Secondly, inaccurate ideas survived for generations because they were taken for granted and passed on, without any critique, from one generation of teachers to another. Lastly, students interpret what the teacher presents to them in a totally different way from the one the teacher intended.

The probing of misconceptions is not simple. There are two forms of diagnostic. First is the task of teacher. He comes across different forms of the pupils' understanding of the curriculum. The second comes from the pupil. He discovers if his understanding of the curriculum is correct. Teachers can use a pupil's work. A teacher can observe the procedure of a pupil's work. Teachers can investigate a pupil's outlines, drawings, written records, calculations etc.

Hewson (1981) created a set of principles which could be used in the misconceptions' elimination process. The principles are as follow:

1. The teacher must introduce a contradiction with the original idea in the mind of the pupil. The pupil must be made aware that his original idea was wrong.
2. The new theme must be clear and comprehensible for the pupil. The pupil must understand the curriculum in order to be able to think about it.
3. The explanation of the curriculum must be believable, plausible and acceptable for the pupil. When these conditions are fulfilled, there is the presumption that the pupil will start to accept new ideas.
4. The new curriculum must be useful and usable for pupils. The new information must be better for the pupil for problem solution.

Lazarowitz and Lieb (2005) stipulate that meaningful learning will occur when a new concept to be learnt will be integrated with the relevant ideas and concepts which had previously been learned. Students have to integrate new ideas or a new concept into their existing cognitive structure. Without this integration, rote learning will take place, the memory will be short lasting and transfer skills will not be mastered.

Misconceptions have some important characteristics: they are found in males and females of all ages, abilities, social classes and cultures; they are often resistant to conventional teaching approaches; they interact with knowledge presented by teacher; they resemble the ideas of previous generations of natural philosophers; they serve a useful function in the everyday lives of people; they are the product of direct observation, everyday language, the mass media and peer culture and they are found frequently among teachers as well as students (Mintzes, 2003).

Research in the field of misconceptions

Nowadays there is a lot of research connected with misconceptions in zoology. The study which focused on the investigation of misconceptions about mammals was by Kubiatko and Prokop (2007). The authors were focused on finding misconceptions in age related differences in knowledge of mammals. Other studies are oriented towards the classification of animals, a knowledge of the anatomical structure of animals, life cycles of insects etc. For example Shepardson (1997) found problems with the determination of insect life cycles. Similar research by Tamir, Gal-Chappin and Nussnovitz (1981) focused on life cycles, but in this case on butterflies. They found pupils had the correct ideas about life cycles, but pupils believed that a pupa was dead, when it was without any manifestation of movement. Barrow (2002) investigated pupils' ideas about insects. The author found several misconceptions. For example pupils drew an internal skeleton for an insect. Pupils knew only the adult phase of an insect's life cycle.

Other research has been aimed at finding the ability to differentiate between vertebrates and invertebrates. They found that when an animal has a head,

extremities and an external skeleton, it is a vertebrate. An external skeleton was assigned to vertebrates by 7- and 9 year-old pupils. A frequent feature with this group of pupils, which is related to vertebrates, is the occurrence of a carapace. This age group of children classified eels and snakes as invertebrates. The reason is that the body of these animals is able to twist (Braund, 1991; Ryman 1974 a, b; Trowbridge & Mintzes 1985).

Braund (1996) found in his research that pupils do not have a problem with the identification of large mammals like elephants as vertebrates. But pupils in his research have problems with the identification of birds. Many children consider birds to be invertebrates because they have light bodies and are able to fly.

Tunnicliffe et al. (2008) found an ability to classify animals at kindergarten age and the first year of compulsory education for children. The percentage of children able to classify animals corresponded corrrectly with age. Kindergarten children had problems in classifying spiders, dolphins and ladybirds. More than half of the children wrote that they were not animals. It is interesting that the authors discovered that pupils thought that the dolphin was not an animal but a fish. This finding is connected with the work of Carey (1985) that marine life is isolated and distinguished from the other animals because their natural habitat is in the sea.

Similar research was carried out by Braund (1991) into the classification of vertebrates and invertebrates. The highest level of response for "vertebrate" occurs for animals with a well defined head and limbs or having a body that is rigid. This feature of rigidity is also more often referred to by younger pupils. The association with invertebrate is strongest for those instances lacking appendages (snail and earthworm). In Braund's study, penguins are often misclassified as mammals while some pupils identified a penguin as a fish. The justifications used by younger children for classifying the penguin as a mammal are split between body covering, viviparity, and homoithermy.

Kattmann (2001) found that classifying animals by habitat was the most common for pupils from all grades of study. The second significant criterion was the different types of locomotion. Morphological and anatomical criteria played a minor role in the classification of animals.

Randler et al. (2007) found an increase in knowledge about animals with the age of respondents, but in their research there was no significant difference in results between genders.

Yen et al. (2004) showed that pupils and students had problems with amphibians and reptiles in their research. The turtle was classified as an amphibian by a significant percentage of students; the reason was due to its aquatic and terrestrial habits. A crocodile was considered to be an amphibian too by students of all age levels. This misconception was due to students' perceptions of the external morphological features of crocodiles, especially segmentation, body covering and appendages. Some vertebrates were classified as invertebrates because they lack obvious external segmentation and limbs.

Methods

Purpose of study

This study investigates of pupils' misconceptions about mammals. In the strict meaning our investigation could be classified as an investigation of the cognitive dimension of preconceptions according to Škoda and Doulík (2007), but we were inspired by science articles focused on this area of research which were written in English. The pupil verifies a cognitive level of the preconcept with their own view and with the adjusted level of a pupil's knowledge and understanding. It means that the cognitive dimension of preconcepts can include incorrect information. Diagnostic tools have to be able to discover these incorrect ideas. A similar study focusing on the influence of age on pupils' knowledge about mammals has already been published (Kubiatko & Prokop, 2007), so the main aim is to focus on finding differences between gender in pupils' knowledge of mammals. The aims of our study were as follows: What are pupils' ideas about mammals in elementary school[18]? How much do children's ideas about mammals change from fifth to ninth grade? Are there any gender differences in ideas about mammals?

The instrument

The measurement tool consists of 35 open-ended and multiple-choice items. In open-ended items we expected one word answer or short sentences. Only in the question "Why do beavers gnaw trees?" did we expect a relatively longer answer in comparison with the others. Not all of the multiple-choice questions had the same number of possibilities. The number of possibilities were from two to five. Only one possibility was correct. Before the administration of the questionnaire, it was checked by experts in zoology (two professors of zoology from different universities) and two biology teachers. Questions in the questionnaire were divided into five categories, namely: 1. Animal classification and phylogeny; 2. Food; 3. Foraging strategies; 4. Parental care; 5. Senses, morphology and anatomy. The answers were binary coded. Incorrect answers were marked by the number 0 and correct answers by the number 1. The questionnaire included demographic variables like gender, class and age. The time for filling in the questionnaire was no longer than 30 minutes. The full version of the questionnaire can be provided by the authors on demand.

Participants

We obtained 468 completely filled questionnaires from pupils of six typical elementary schools in Slovakia. All grades were included in the investigation. The numbers of grades were as followes 5th grade (n = 83), 6th grade (n = 86), 7th grade (n = 112), 8th grade (n = 86) and 9th grade (n = 101). The age of pupils varied

18 According to ISCED – lower secondary education.

from 10 to 15 (n = 468; X = 12.62; SD = 1.47).

The number of boys (n = 229) and number of girls (n = 239) was similar.

Statistical procedure

After recoding the obtained data, we evaluated the items of the questionnaire by percentage. Then we calculated the average and standard deviation and summary score for each dimension. For finding the differences in results between genders we used the Pearson chi-square test (χ^2) and the MANCOVA test. We presented the differences among grades in our previous study, and therefore, did not explore this in this study. Our focus was on presenting pupils' interesting ideas about mammals and showing the results between genders. On the measure of reliability of the questionnaire, Cronbach's alpha calculation was used. The values of Cronbach's alpha close around 0.7 or higher, which generally indicate that results are consistent (Nunnaly 1978).

Results

Statistical evaluation of categories

Based on the distribution of correct and incorrect responses, we found out the maximum number of points acquired from the questionnaire was 34 and the minimum was 8. The average score was 22.84 (n = 468; SD = 4.22). The value of Cronbach's alpha was $\alpha = 0.67$. This value indicates that the questionnaire marginally reaches the appropriate reliability.

The descriptive statistic for the mean success that pupils acquired from the questionnaire is shown in Table 1.

Table 1: Basic statistics of questionnaire categories

Categories	**Number of questions**	**N**	**X**	**%**	**SD**
Animal classification and phylogeny	9	468	5.66	62.89	1.64
Food	9	468	6.46	71.78	1.45
Foraging strategies	3	468	2.01	67.00	0.77
Parental care	4	468	2.49	62.25	1.01
Senses, morphology and anatomy	10	468	6.61	66.10	1.44

N – number of respondents
X – average number of points
SD – standard deviation

The highest average score was found for the category "Food". Only in this category was there found a percentage success higher than 70 %. The lowest score achieved was in the category "Parental care", where the percentage success was 62.25 %.

We found pupils of the 8th grade achieved the highest average score in animal classification and phylogeny; parental care and foraging strategies dimensions. Pupils of the 7th grade achieved the highest average score in the two remaining categories. A statistically significant difference in the results between the ages of students was found in the following categories: Animal classification and phylogeny; Food and Parental care. More detailed information about the influence of age on misconceptions about mammals is in our previous study (Kubiatko & Prokop, 2007).

We focused on the differences in results between genders. For this we used the MANCOVA test. Gender was used as an independent variable, the category results as dependent variables and age as a covariate. The total influence of age on results was not statistically significant ($F = 1.54$; $p = 0.17$; Wilks' $\lambda = 0.98$) and we found out statistically significant differences in results between gender ($F = 7.41$; $p < 0.001$; Wilks' $\lambda = 0.93$). A more detailed view of results shows that in some categories there was no statistically significant difference in results (foraging strategies and senses, morphology and anatomy) between genders and in one category the influence of age on results was significant, specifically in parental care (table 2).

Table 2: Detailed results of a multivariate analysis of covariance (MANCOVA)

Categories	**F(gender)**	**F(age)**
Animal classification and phylogeny	**14.94*** **	1.78
Food	**5.18***	2.42
Foraging strategies	1.68	0.59
Parental care	10.73**	4.64*
Senses, morphology and anatomy	1.78	0.00

* statistically significant difference $p < 0.05$
** statistically significant difference $p < 0.01$
*** statistically significant difference $p < 0.001$

Gender differences

In figure 1 we are able to see that boys achieved higher scores in almost all categories. Only in the last category named "Senses, morphology and anatomy" did girls achieve a higher average score in comparison with boys. A statistically significant difference in results between genders by the use of the Pearson chi-square test in the items was found only in four items. In all four categories girls achieved a higher score than boys. Two of them belong to the category "Food". In

the first we asked pupils what was the dominant component of hedgehogs' food. We found a statistically significant difference in the results between genders (χ^2 = 8.86; $p < 0.01$). The total number of correct answers was relatively high - 81.84 % of all answers were correct, whereby pupils wrote down that a hedgehog's food included worms, snails, etc. In the next question, belonging to the category "Food", we were interested in why beavers gnawed trees. We expected the main reason to be the building of barriers, a source of food, teeth corrosion. We found that 90 % of all answers were correct and we found a statistically significant difference in the results between genders ($\chi^2 = 4.07$; $p < 0.05$). The next statistically significant difference in the results was found in the item relating to the flying squirrel. We wanted to know how well pupils would be able to identify this animal; the possibilities were a mammal, a bird and an amphibian. Only 42.95 % wrote the correct answer that the flying squirrel was a mammal, and the majority of incorrect answers was that a flying squirrel was a bird. A statistically significant difference in the results was with the girls ($\chi^2 = 6.22$; $p < 0.05$). In the item where we asked,which of following animals: a whale; a penguin; a flying squirrel, does not belong among the mammals, we found a statistically significant difference in the results between genders ($\chi^2 = 4.15$; $p < 0.05$). The penguin was correctly identified as the animal which belongs to another group of animals by only 32.91 % of respondents. The majority of incorrect answers were assigned to the flying squirrel. These two items belong to the category "Animal classification and phylogeny".

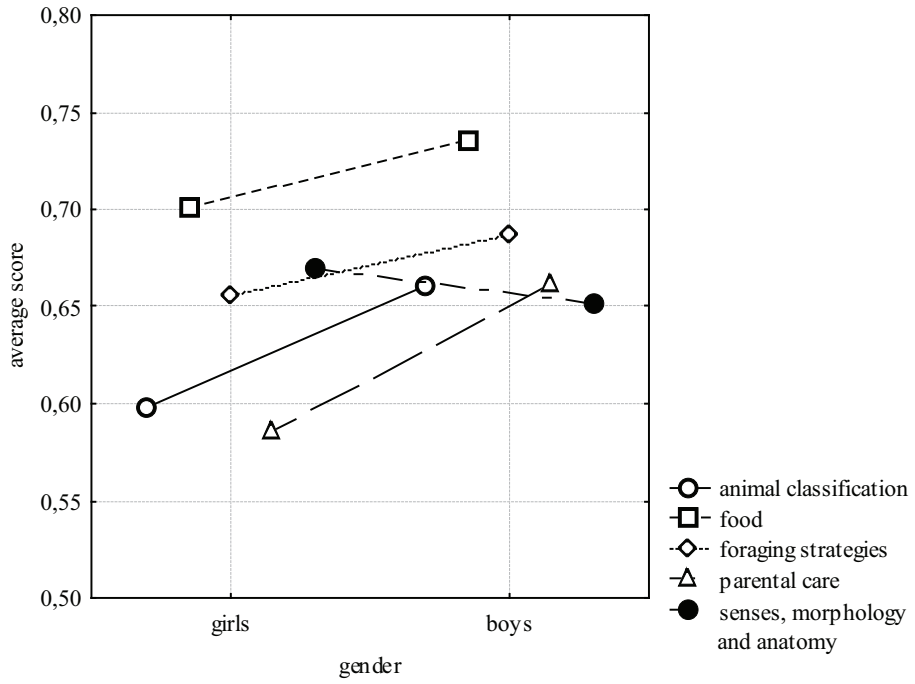

Figure 1: Average score of dimensions

The most problematic questions

When we focused on the responses of some items in the separate categories, we observed some interesting results. In the first category, respondents had problems with the identification of animals relating to dinosaurs. Only 40.69 % of all respondents wrote the correct answer that birds are most closely related to dinosaurs. The majority of pupils (50.85 %) considered mammoths for the animals as being most closely related to dinosaurs. Children had problems with the name of a female deer, 48.93 % of all children named a female deer correctly – a hind. The most quoted incorrect answer was doe (female roe deer) – 42.74 %.

In the category "Food", respondents had considerable problems with the food of wild boars. Only 21.58 % of pupils gave the correct answer that wild boars are omnivores. We found a spectrum of incorrect answers, for example wild boars are herbivore animals or they feed on acorns, potatoes or roots of plants. Pupils had fewer problems with the food of whales' young. Approximately half of respondents answered correctly that the young of whales suckle milk and a similar number of pupils wrote plankton as a source of food.

In the category "Foraging strategies", pupils had problems with how lions hunt. Less than half of respondents wrote that lions hunt in groups, which is the correct answer. The majority of pupils thought that lions hunt prey alone by stalking. The next question, which belongs in this area, was similar to the previous one. We asked about the typical behavior of a lynx when hunting. Approximately 2/3 answered correctly. The lynx grab the prey from behind. According to 1/3 of children, the lynx hunts prey alone by stalking. Pupils did not have problems with identifying animals which hunt in groups. From the following possibilities: a fox, a lynx, a wolf, a bear, 90.60 % correctly marked a wolf.

In the category "Parental care", pupils had the biggest problem with who takes care of a deer's young. More than half of children wrote the female, which is the correct answer. But 41.88 % showed both parents. There were problems with a similar question when we asked about a wolf's parental care, where 56.84 % of children wrote both parents take care of the young. It was the correct answer, but the majority of incorrect (37.61 %) answers attributed this task to the female wolf.

In the last category pupils had problems with the reason for brown bears hibernating. Only approximately half of respondents wrote correctly that it is due to lack of food. Other responses, which were incorrect, of course, were different. Pupils wrote down cold, exhaustion, because it has to, as reasons for brown bears hibernating. The next problem item was to answer how a horse steps when it is walking. The horse steps on the last phalanxes of the hoofs was the answer of 39.10 %, which was correct, but the majority answered incorrectly, that the the horse steps when walking on the whole hoof. Pupils did not have the right idea about how dolphins breathe. Approximately 1/3 showed that dolphins breathe through lungs. The incorrect answers were distributed among branchias, lung sacks and air sacks. The biggest problems pupils had with camels was specifically with the contents of the camel's hump. Only 19.66 % of all pupils wrote that there is fat

in the hump, while others wrote that the hump contains water, which is a typical misconception.

Discussion

This study was concerned with finding misconceptions among pupils about mammals. The term misconception is generally used in scientific literature, but sometimes this term is substituted by the "cognitive dimension of preconcept" (Škoda & Doulík, 2007). And we are able to confirm that elementary pupils had serious problems with several mammals. In our previous study we focused on class differences in results (Kubiatko & Prokop, 2007).

We found that pupils of the 8th grade achieved the highest average score in animal classification and phylogeny; parental care and foraging strategies dimensions. Pupils of the 7th grade achieved the highest average score in the two remaining areas. Young children's biological knowledge is significantly affected by early experiences with live organisms or with themselves (Jaakkola & Slaughter, 2002). A statistically significant difference in the results between ages of students was found in these categories: Animal classification and phylogeny; Food and Parental care. In this study we focused on finding significant differences in results between genders.

We divided the items in the questionnaire into five different categories according to the character of items as follows: 1. Animal classification and phylogeny; 2. Food; 3. Foraging strategies; 4. Parental care; 5. Senses, morphology and anatomy. We found a statistically significant difference in the results between genders without an age influence. In summary, boys achieved higher score than girls. Only in the category Senses, morphology and anatomy did girls achieve higher score than boys.

By a detailed analyses the influence of age was presented in the category "Parental care" and no statistically significant difference was found in the two categories: "Foraging strategies" and "Senses, morphology and anatomy". Similarly statistically significant results between genders can be observed in studies of a similar nature (Randler, 2008).

A more detailed analyses showed us that pupils have problems in identifying mammals. There were problems with the identification of the flying squirrel. The majority of children mistook this kind of mammal for a bird. This finding confirmed the findings of other authors that use the criterion of locomotion for the classification of animals (Markham, Mintzes, & Jones, 1994).

In the studies which were concerned with the concept of animal the investigators were interested in the scientific meaning of the term. Students developed their own categories. Students' reasons for the classification or characterization of an organism as an animal were found to be that of distinguishing between mammals and other "creatures". Students used criteria like a habitat, or locomotion, or number of legs (Bell, 1981; Tema, 1989). The influence of habitat was presented by the questions about classifying whales, platypus or mammoths.

The children in our research had problems with the dolphin. Only one third of pupils knew that the dolphin breathes through lungs. There is the influence of habitat in identifying animals. Tunnicliffe et al. (2008), have had similar findings – In their investigation a number of children recognized the dolphin as an animal, but many respondents classified the dolphin as a fish, not an animal. This conception may have arisen from the teaching about fish in a separate context from being members of the animal kingdom (Tunnicliffe et al., 2008). Our respondents had problems with the contents of a camel's hump, where only 1/5 answered correctly that it is fat. Other pupils wrote water.

Pupils had problems with the foraging strategies question. The lowest problems they had were with animals which live in Slovakia (wolf, lynx) in comparison to animals which live in another continent (lion). Some pupils had problems with the reason for brown bears hibernating, hedgehogs' food, whales' youngs' food etc.

Many of these misconceptions are created in the preschool age of pupils. These mistakes are often created from pictures in book, from tales which are read by parents to their children. There is no problem to find a picture of fruit on a hedgehog's spines. Or we can read about a camel which crossed the Sahara because it had water in its hump. All tales about brown bears contain information that the brown bear must sleep all winter because it is cold outside with snow and frost, and halfway through winter the brown bear turns its body round on the other side. Children are influenced too much by incorrect information, which can arise from different media.

Tunnicliffe and Reiss (1999) found home to be one of the most important sources of information about animals for elementary aged children. Children interpret the world and physical phenomena for themselves and hold various representations of the world. Sources of animal knowledge apart from previous learning at school are out-of-school activities in terms of informal, free-choice learning which influences learning about animals. Such informal learning takes place in zoos, museums, parks and aquariums (Falk, 2005).

Solomon (1987) points out that a greater amount of information is culled from the media in an incidental, unintentional, casual fashion, where there is exposure to information through watching television programmes. Watching TV programs about animals and nature received almost a similar proportion compared to learning about animals in school (Bjerke, Kaltenborn, & Ødegardstuen, 2001).

Conclusion

In our research we focused on the investigation of pupils' understanding of animals, namely mammals. We found a statistically significant difference in the results between genders and evaluated items focused on finding which questions cause the biggest problems for students. We found several misconceptions in all of the categories. On the basis of these results we could suggest some educational recommendations:

- use more pictures in the teaching process because textbooks are predominately text-based as opposed to having photographs
- focus on atypical kinds of mammals (whales, bats, platypus) and bring attention to their attributes, why these kinds of mammals are classified as mammals
- the visual part of the teaching process is very important, children should be in contact with nature as often as possible.
- teach more about exotic mammals – due to children's better ability to picture mammals, show that in other countries there are mammals which may be different to Slovakian ones
- try to connect the present time with phylogenetic development, not only to teach about animals today, but also about extinct mammals
- since a knowledge deficiency within issues seems to continue throughout various educational levels, it makes good sense to develop appropriate techniques that help the students to improve their understanding of the curriculum (Bozkurt et al., 2005).

We believe that our study gives new information for the investigation of misconceptions and will help pedagogical workers in the teaching process.

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