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PRIMARY SCHOOL STUDENTS' CONCEPTIONS ABOUT OWLS, EXPERIENCES WITH OWLS AND THEIR SOURCES OF INFORMATION

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Abstract. *The present research explores benefits of using young students' drawings in combination with written responses for gathering information about science concepts. Younger students are still very limited in their verbal expression and less biologically literate than older students. The aim was to determine primary school students' conceptions about owls, experiences with owls and their sources of information, and to then determine how beneficial it is to combine information gathered from drawings and written responses in comparison to previous research done with lower secondary school students. Altogether, 280 students attending fourth and fifth grades from schools in Slovenia participated in the research. Students knew well the specific features of owls. Drawings provided more clear information about body parts and proportions, while owls' specific habitats, behaviours and diet were more thoroughly described in their written responses. Students without experiences with living owls represented owls less thoroughly. Comparison of frequencies of responses in main categories of conceptions about owls showed that using drawings and written responses is equally beneficial for younger and older students. Gathering primary school students' conceptions about science concepts with both drawings and written responses enables better assessment of a student's knowledge than using just drawings or written responses.*

Keywords: *primary school student, conceptions about owls, experiences with owls, student's drawing, student's written response.*

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Introduction

A significant number of animal species are in danger of extinction. There are multiple causes for this threat to biodiversity, but human indifference to the situation and negative attitudes towards at least some species are undoubtedly among them (Wilson, 2017). Examining how students gain their knowledge is important from educational (Palmer & Suggate, 2004) and conservational points of view (Barney, Mintzes, & Yen, 2005). Environmental knowledge, cognitive development, affective and motivational factors and, last but not least, behaviour of students are important for the success of environmental education (Clayton & Myers, 2009). The more knowledgeable a student is about a science concept the more competent he or she will be at applying it (Liversidge, Cochrane, Kerfoot, & Thomas, 2009). The present research worked from the assumption that participating students have developed an understanding of a particular biological concept, i.e. the owl.

Owls (Strigiformes) are an avian order of nocturnal birds with several endangered species. They are subdivided into the families Tytonidae (barn owls) and Strigidae (true or typical owls) (Bruun, Delin, & Svensson, 2013). Ten species of owls can be observed in Slovenia: the barn owl (*Tyto alba*), the Eurasian eagle-owl (*Bubo bubo*), the long-eared owl (*Asio otus*), the Ural owl (*Strix uralensis*), the short-eared owl (*Asio flammeus*), the tawny owl (*Strix aluco*), the little owl (*Athene noctua*), the Scops owl (*Otus scopus*), the boreal owl (*Aegolius funereus*), and the Eurasian pygmy owl (*Glaucidium passerinum*). All of these species are on the Red list of endangered species in Slovenia (Red list, 2002).

There is a growing number of studies that explore students' conceptions of birds (e.g. Hummel, Fančovičová, Randler, Ozel, Usak, Medina-Jerez, & Prokop, 2015; Kubiatko, Usak, & Pecušová, 2011; Kubiatko & Balatova, 2017; Prokop, Kubiatko, & Fančovičová, 2007a, 2008; Prokop & Rodak, 2009; Torkar & Bajd, 2006; Torkar, Gnidovec, Tunnicliffe, & Tomažič, 2019; Tunnicliffe, 2011). They report many misconceptions (Prokop et al., 2007a; Kubiatko et

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al., 2011) and cross-cultural differences between student's knowledge of and attitudes towards birds (Prokop et al., 2008; Hummel et al., 2015). Kubiatko and Balatova (2017) and Kubiatko et al. (2011) report that female students achieved higher scores in knowledge tests about birds than male students. Students learn about animals from different sources, such as in the real world, documentaries, films, fairytales, picture books, children's songs, commercials and representations in the forms of soft toys and wallpaper (Bjerke, Kaltenborn, & Ødegårdstuen 2001; Strouse, Nyhout, & Ganea, 2018; Torkar & Bajd, 2006; Tunnicliffe, 2011; Tunnicliffe, Gatt, Agius, & Pizzuto, 2008). Based on aforementioned studies, students' mental models about owls could be influenced by several factors, and they obtain their ideas about birds from various sources.

Research Focus

There are several different ways of gathering information about a student's perception of biological concepts, ideas or phenomena. Any information is an external representation of mental models that students have acquired up to the point of its expression (Tunnicliffe, 2011). The researcher found that the research of animals based on students' drawings and interviews revealed not only biological knowledge, but also cultural and social beliefs, and understandings. A student's mental model can be revealed through interviews (Endreny, 2006; Bartoszeck, Vandrovieski, Tratch, Czelusniak, & Tunnicliffe, 2018), conducted on the basis of his or her drawing (AHI, 2016; Prokop & Fančovičová, 2006; Prokop, Prokop, Tunnicliffe, & Diran, 2007b; Rybska, 2016; Sampaio, De La Fuente, Albuquerque, da Silva Souto, & Schiel, 2018; Tunnicliffe, 2011; Tunnicliffe & Reiss, 1999b) or written responses in questionnaires and tests (Prokop et al., 2007a; Teixeira, 2000; Torkar & Bajd, 2006; Tunnicliffe, 2011). The research and methods mentioned above do not reveal the whole picture of the students' perception. Expressing through certain presentation can be limited due to a lack of skills in drawing, speaking or writing. Moreover, sometimes it is difficult to express one's knowledge through words or drawing (Prokop & Fančovičová, 2006). Therefore, using only one method to assess knowledge about biological phenomena does not give a reliable projection of children's perception. In this regard, the effort of using more than one method – a combination of them (writing and drawing) – was explored in previous research with lower secondary school students (Torkar et al., 2019). The results showed that differing methods complement each other well.

Two main aims of the present research were to determine primary school students' conceptions about owls and to explore whether there was benefit in gaining students' knowledge about biological concepts using their drawings in combination with written responses. The potential benefit of gathering students' ideas about owls from written responses and drawings was thus explored in students with very limited verbal expression. The assumption was that students' drawings complement the written responses better than in the research with older students (Torkar et al., 2019) because younger children are more limited in their verbal expression while also being less biologically literate (i.e. they possess less knowledge and fewer experiences with owls).

The research questions were:

1. What do primary school students in fourth and fifth grade know about owls?
2. What information about the biological concept "owl" can be collected with drawings and/or written responses?
3. What are the differences in students' knowledge about owls in relation to grade, gender and direct experiences with owls?
4. Which sources of information did students use for developing their knowledge about owls?

Research Methodology

Respondents and Setting

The research included 280 primary school students from four schools in Slovenia, all of whom attended fourth (n=148) and fifth (n=132) grade. The age of the students ranged from 9 to 11 years-old, with the mean age 9.6 (SD=0.82). Preschool education in Slovenia is organized for children aged one to six. Students aged 6 to 14 attend a single-structure nine-year basic school. It is mandatory, 99 percent public and state financed. It is divided into three three-year cycles. The learning objectives related to biology are mainly achieved in the compulsory school subject environmental sciences (first, second and third grade), science and technology (fourth and

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fifth grade), science (sixth and seventh grade), and biology (eighth and ninth grade). Primary school is followed by three-year or four-year secondary school programs (students aged 15 to 18), and then undergraduate and postgraduate programmes. Usually, schools teach reading and writing in the first three years of the nine-year basic school. As a result, students' expression through writing is still relatively limited in fourth and fifth grade.

Instruments and Procedures

Initially, students completed anonymous questionnaires, which were administered in first two months of the school year 2017-18, during regular science classes. In continuation the research involved asking students about owls in semi-structured interviews. Written parental consent was obtained for each student. The questions were repeated from research by Torkar et al. (2019). Students were asked to draw an owl in the provided space of a rectangle (12 x 17 cm) and name the owl's body parts on their drawing. Next, students were asked to describe an owl for someone who has never seen or heard of an owl. Reported experiences with owls and demographic variables were obtained at the end of the test. Students completed the questionnaire in approximately 15 min. In addition, ten students were randomly chosen for interviews. The interviews were led with open questions asking about different associations with owls, about an owl's appearance, students' attitudes towards owls and the symbolic representations owls hold for them. The main aims of the interviews were to identify where and how students gather information about owls and to further explore how some frequently mentioned misconceptions are related to their sources of information. The interviews were recorded with audio recorder.

Data Analysis

In order to identify and consequently analyse the features portrayed in the drawings a 'look re-look' process was used (see Tunnicliffe, 1996, 2011; Torkar et al., 2019). Students' written descriptions of owls were categorized, and frequencies within categories and subcategories were calculated. To explore whether written responses provided additional information which was not expressed through drawings, unified classification categories for written descriptions were used. Details defining particular categories are represented in the findings below (Tables 1 and 2). The Mann-Whitney and Kruskal-Wallis tests were used to analyse the differences between students' drawings and written responses and different variables (gender, grade, experiences with living owls).

The purpose of the semi-structured interviews was to collect detailed qualitative data from students. Data gathered from the interviews were analysed for identification of data that could support or explain answers noticed in the first part of the study (questionnaire). A coding scheme was derived through 'open coding'. Meaningful categories, their properties and dimensions were defined (Cohen, Manion, & Morrison, 2007). The coding was performed by both researchers. A series of data-driven categories were created by reading students' responses to questions. Coding was matched with students' explanations of sources of information about owls. Within those codes, the sources of misconceptions were highlighted.

Research Results

Students' Conceptions about Owls

Analysing students' drawings can give deep insight into their mental models of the real world around them. Therefore, students' conceptions about owls with both drawings and written responses were collected. The majority of students drew black-and-white drawings, and the remaining 21.1 percent of students drew an owl in colour. A minority of students (12.1%) formed an outline of a bird that did not bear resemblance to an owl (i.e. drawing 1 in Figure 1). These representations mostly showed basic features of birds such as a head, a body, wing(s), legs and a beak. The majority of students (90.5% of answers in the category physical characteristics of owls) drew an owl representing features specific for this group of birds (e.g. big eyes, round facial disks, ear tufts) (e.g. drawing 2 in Figure 1). Only an exception (1.8%) of students created artistic drawings including distinctive details of a recognisable owl species, its specific features and body proportions (e.g. drawing 3 in Figure 1).

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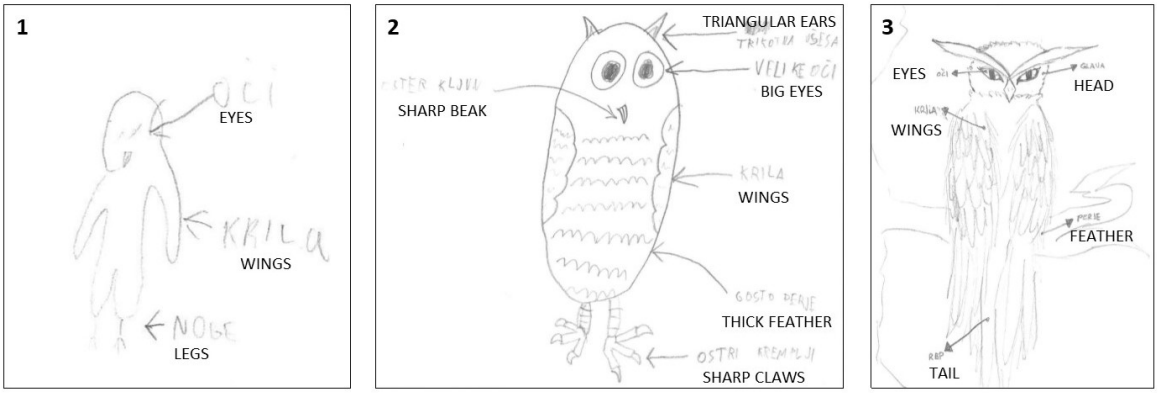

Figure 1. Three categories of students' drawings: (1) outline of a bird, (2) outline of an owl and its basic features, (3) realistic.

The characteristics which appeared in students' drawings of owls are presented in Table 1. Most frequently they represented the owl's rounded head (100.0%), a body (100.0%), large eyes (98.2%), legs (91.1 %), wings (96.1%), a beak (88.2%) and ear tufts (59.6%). These students' drawings indicated some physical characteristics that they typically associate with owls (i.e. rounded head, large eyes). Only one of the included students depicted an owl in relation to other animal species – a mouse was represented as prey. Other students drew only specimens of an owl, including two students who created drawings showing an adult and juveniles. In the drawings of three students, owls were situated in a night-time context and the owl wide awake. 2.6% of students depicted them in their specific habitat. Owls were located in forests, trees and rocks. 4.2% of students represented distinctive behaviours in their drawings, such as sitting in a tree, flying or walking. Represented owls were mostly sitting in a tree, on a bench or in a hole in a tree (19.6%), which is often how they can be observed in nature in Slovenia. Only 7.1% of students depicted them flying. A walking owl was shown in 5.7% drawings.

Additional information about students' representations of owls were gathered with written responses (Table 2). Most frequently, students in their descriptions wrote about physical characteristics (48.8% of responses). Most frequently, they pointed out owls' large eyes (61.4%), wings (39.6%) and sharp claws (26.8%). The majority of students mentioned owls' specific behaviours (32.0% of responses). Altogether, 84.6% of students presented the owl as a nocturnal bird, describing its good night vision (22.9% of students) and hearing (12.1% of students). 19.3% of the students mentioned hooting as a recognisable characteristic of owls, and 15.4% of our sample claimed they twist their heads**.** The diet of owls was the third most commonly described category in written responses (7.5% of descriptions). They listed mice, insects and worms as the prey of owls. 6.4% of students described owls' habitats. They mentioned forest and tree branches, holes in a tree (37.9%) and rocks (0.4%). In the category 'other responses' they also pointed out that an owl is a bird of prey, sits on eggs, has juveniles, and they commented on owls' diversity of species and habitats. They frequently mentioned fairy tales and songs where they had heard about owls.

Students' written responses and drawings also revealed some misconceptions about owls. Long ear tufts were regularly (59.6% of students) confused with external parts of the ears. The owl's mistaken ability of turning its head 360 degrees was exposed by 7.7% of students completing the research tasks. A few (2.1%) mistakenly thought that the word 'owl' represents a female specimen and the species little owl (*Athene noctua*) a male specimen.

All students depicted at least one feature from the category physical characteristic in their drawings. In comparison, in the written responses 48.8% wrote about the owls' appearance, they mentioned large eyes, its claws, beak, wings but also described the purpose of specific features of an owl, such as good vision and hearing, the ability of turning their heads, which could not have been discerned in drawings. Most of the students (90.4%) drew an isolated owl specimen without its typical habitat. In written responses, 6.4% of students pointed out owls live in forests, in a tree or on rocks. Meanwhile only one student in his drawing depicted the prey of owls (a mouse), and in written descriptions 7.5% students described the diet of owls. The depiction of distinctive behaviours of owls, such as sitting in a tree (19.6%) or flying (7.1%) was only noticed in 4.2% of drawings. They exposed behaviours specific for owls more frequently in written responses (32.0% of students); flying (37.1% of students), hooting (19.3%) and turning its head (15.4%). In written responses they also shared other information, such as species diversity of owls,

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habitats in different parts of the world and their lifespan, which was not evidenced through students' drawings.

There were no statistically significant differences in the number of depicted categories through drawings and written descriptions between students in fourth and fifth grade and also between boys and girls. However, the differences between students with or without experiences with living owls were statistically significant in a number of depicted categories through drawings ($\chi^2(1.280)= 6.708$; $p = .035$) and written responses ($\chi^2(1.280)=7.310$; $p = .026$). Students who had seen or heard an owl in nature (76.1%) or in a zoological garden (13.9%) represented owls more thoroughly in their drawings and written responses than those who had never seen an owl (10.0%).

Table 1. Categories and subcategories of students' drawings of owls by grade.

Categories* Subcategories**	4thgrade		5thgrade		Total	
	f	*f%*	*f*	*f%*	*f*	*f%*
Physical characteristic	1056	94.9	977	92.0	2033	93.0
Colour	29	19.6	30	22.7	59	21.1
Head	148	100.0	132	100.0	280	100.0
Body	148	100.0	132	100.0	280	100.0
Tail	15	10.1	8	6.1	23	8.2
Eyes	144	97.3	131	99.2	275	98.2
Ears	94	63.5	73	55.3	167	59.6
Beak	125	84.5	122	92.4	247	88.2
Legs	128	86.5	127	96.2	255	91.1
Claws	34	23.0	47	35.6	81	28.9
Wings	143	96.6	126	95.5	269	96.1
Feathers	48	32.4	49	37.1	97	34.6
Behaviours of owls	46	4.1	45	4.2	91	4.2
Flying	14	9.5	6	4.5	20	7.1
Walking	9	6.1	7	5.3	16	5.7
Sitting in a tree	23	15.5	32	24.2	55	19.6
Habitats of owls	9	0.8	18	1.7	57	2.6
Forest and trees	9	6.1	16	12.1	55	19.6
Rocks	0	0.0	1	0.8	1	0.4
Other	0	0.0	1	0.8	1	0.4
Depiction of more than one owl	0	0.0	2	0.2	2	0.1
Diet	1	0.1	0	0.0	1	0.05
Other species	1	0.1	0	0.0	1	0.05

**Proportion of answers (f %); Proportion of students (f %).*

Table 2. Categories and subcategories of students' written descriptions of owls by grade.

Categories* Subcategories**	4thgrade		5thgrade		Total	
	f	*f%*	*f*	*f%*	*f*	*f%*
Physical characteristic	393	46.3	424	51.3	817	48.8
Size	20	13.5	22	16.7	42	15.0
Colour	30	20.3	37	28.0	67	23.9

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Categories* Subcategories**	4thgrade		5thgrade		Total	
	f	*f%*	*f*	*f%*	*f*	*f%*
Head	25	16.9	27	20.5	52	18.6
Body	9	6.1	10	7.6	19	6.8
Tail	4	2.7	2	1.5	6	2.1
Eyes	82	55.4	90	68.2	172	61.4
Ears	30	20.3	29	22.0	59	21.1
Beak	46	31.1	52	39.4	98	35.0
Legs	35	23.6	28	21.2	63	22.5
Claws	28	18.9	47	35.6	75	26.8
Wings	58	39.2	53	40.2	111	39.6
Feathers	26	17.6	27	20.5	53	18.9
Behaviours of owls	284	33.5	252	30.5	536	32.0
Flying	61	41.2	43	32.6	104	37.1
Active at night	129	87.2	108	81.8	237	84.6
Turning the head	17	11.5	26	19.7	43	15.4
Hooting	26	17.6	28	21.2	54	19.3
Good eyesight	37	25.0	27	20.5	64	22.9
Good hearing	14	9.5	20	15.2	34	12.1
Diet	69	8.1	57	6.9	126	7.5
Habitats of owls	54	6.4	55	6.7	108	6.4
Forest and trees	54	36.5	52	39.4	106	37.9
Rocks	0	0.0	2	1.5	1	0.4
Other	0	0.0	1	0.8	1	0.4
Other species	49	5.8	39	4.7	88	5.3

**Proportion of answers (f %); Proportion of students (f %).*

Students' Sources of Information

The following data-driven categories about students' sources of information were created: *direct experiences with owls, media* and *relatives and others*.

Direct experiences with owls

Regarding students' direct experiences with owls, most of the interviewees had not yet seen an owl in a natural habitat. One who had direct experience in nature described her first experience with an owl:

> *"It happened when we were at the seaside with family. We went for a walk in the evening and suddenly mum showed me an owl sitting in a tree. It was grey and not really so large as I had imagined it before. And it was not moving at all. I asked mum whether it can hurt me, but I was told it is not dangerous if I leave it alone… but that it is dangerous for prey animals."*

Some students explained they had not seen an owl, but they had heard one, when they went on a walk in a forest late in the evening or afternoon. Owls can be found near our houses, revealed one of the boys:

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"Yes, yes, I have seen it many times. I observe an owl regularly through the window at grandmum's home, where I stay after school. It comes so close, right below the window on a big tree."

Zoological gardens are very influential sources of information. Many students mentioned seeing an owl in a zoological garden. One of them explained:

"No, I have never seen an owl in nature… well, except in a ZOO. There I saw a white owl, what is its correctly name? Umm…. snowy owl? Yes, I think it was this one."

Media

While talking about physical characteristic features of owls, they reported learning this at school, from photos and sketches in books, songs, soft toys and from the films Harry Potter, Garfield and in a fairy-tale called Sovica Oka. In students' own words:

"I actually saw it on a schoolmate's school bag, and I have an owl-like keychain and soft stuffed animals… Owls are really popular, you can see them everywhere."

"I was watching a documentary film about owls, how they fly and hunt at night, and there I heard that they produce this sound, uuu-uuu-uuu."

One student learned the most information about owls from the information displays in a zoological garden:

"They have those tables with information about animals… I think I could touch the feathers of an owl represented on a table."

After students explained their experiences with meeting or hearing an owl, we asked them if they knew any other places where owls can be observed. One of the students mentioned the encyclopaedia where he learned that owls' habitats are also rocky areas and tropical forests:

"When I saw an owl, I got interested in learning something more about them, so I surfed on the internet and read about it in that large book of animals…. I think it is called encyclopaedia. There it was written in the section 'habitats' that owls also live on rocks and in tropical forests. So, I could see it there too."

Students were also asked if they are afraid of owls. Some students explained that owls are very dangerous and symbolise death. A student explained his thoughts influenced by watching the popular Slovene youth film:

"Yes, I think it is in this film Kekec, when that boy Kekec imitates an owl to scare the wild man Bedanec… because he was afraid of owls and he believed that hearing an owl brings death, and that is why an owl is dangerous."

The last quotation in this section emphasizes a sticker album collection as a source of information, but at the same time the student's wrong reasoning about ear tufts is presented:

"Yes, those tufts are owls' ears. But I think not all owls have them. When I was collecting pictures for a sticker album collection, there were different owls, but not all of them had those tufts."

Relatives and others

Moving to the last category, where the importance of other people for developing students' conceptions about owls is presented. In students' responses relatives (e.g. grandparent, mother, brother) and others (e.g. guide, teacher) were important as sources of information or facilitators. For example, one mother showed and discussed the owl in a tree with her daughter. When students were asked how they knew it was an owl making the sound, one of them answered she was there with her granddad, who told her. One of the students said she learned about the symbolism of owls (i.e. hearing an owl as a symbol of death) from her grandparents. Students reported that

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language teachers instructed them to read a description about an owl in a book. The following statement presents one student's misconception learned from his brother:

"…also, once my older brother came with me, and I think he told me that an owl can turn its head 360 degrees."

Discussion

The fourth and fifth grade primary school students from Slovenia had considerable knowledge of owls' physical features, their behaviours, habitats, and diet. They were very familiar with those features of owls that differentiate them from other birds. The students' written responses provided more information on their conceptions about owls' specific behaviours, habitats, diet and some interesting facts. Owls' physical characteristics were more clearly depicted with drawings. Information gathered from students' written responses moderately complemented that from their drawings. This is in line with the findings from previous research with Slovene lower secondary students (Torkar et al., 2019) and confirms again that it is beneficial to collect students' information about science concepts with a combination of students' drawings and written responses (Prokop & Fančovičová, 2006). Prokop and Fančovičová (2006) emphasized that it is important to use drawings and written responses when collecting students' conceptions about anatomy. The present research shows that this is also beneficial for other levels of biological organization and for better understanding of their conceptions about organisms' external morphology (i.e. shape, structure, and pattern) and their ecological niche.

The main goal here was to explore primary school students' conceptions about owls using their drawings in combination with written responses and to compare the results with the previous research done with lower secondary school students as reported by Torkar et al. (2019). A comparison of main categories of conceptions depicted from drawings and written responses between primary school and lower secondary school students showed similar frequencies, meaning that using students' drawings in combination with written responses is equally important for younger and older students. Older students drew or wrote slightly less about physical characteristics and more about other categories. Prokop, Kubiatko and Fančovičová (2008) found that students in lower grades had better factual knowledge about birds than older students. Randler (2008) reported that factual knowledge about vertebrates increased until 7th grade and then slightly decreased. Reported stagnation in knowledge about birds might be a result of the increasing number of competing concepts that students acquire over time (Johnson & Anderson, 2004).

Present and previous research (Prokop et al., 2007a, 2008; Torkar et al., 2019) showed that students of all age groups have some misconceptions of owls. However, misconceptions vary in different countries. Prokop, Kubiatko, and Fančovičová (2008) found that many primary school students in Slovakia believed owls' eyes light up at night, or owls see only at night, which was not the case in the Slovene sample. This points to the importance of investigating misconceptions in various sociocultural contexts and that the results are not necessarily always transferable.

Randler (2008) wrote that one central question is whether species knowledge is obtained by directly encountering them in nature or by learning from books. Only ten percent of students did not report seeing or hearing an owl in nature or a zoological garden. In Slovenia, where approximately 60% of the terrestrial ecosystems are forests and potentially ten species of owls can be observed, this result is not very surprising. Some owl species live in urban areas, and some can be observed in zoological gardens. The results show a significant positive relation between students' experiences with living owls and the reported number of ideas about owls in their drawings and written responses. Bjerke et al. (2001) and Randler (2010) reported that animal-related activities are an important source of animal species knowledge.

Ten primary school students were interviewed to explore their sources of information about owls more thoroughly. Results showed that students learned about owls from various sources of information; they learned about owls from their own experiences with living owls, in zoological gardens, in books about animals, documentary films, cartoons, sticker album collection about animals, in children's songs, from their parents, grandparents, relatives and peers and in schools. Responses were categorised into *direct experiences with owls, media,* and *relatives and others*. Similarly, Kellert (2002) divided important children's experiences with animals and nature into direct, indirect and symbolic experiences. The findings are also in line with previous research studying students' sources of information about animals (Bjerke et al., 2001; Strouse et al., 2018; Torkar & Bajd, 2006; Tunnicliffe, 2011). Results revealed that school is not the only source of information about owls and, as could be expected, students do not report getting experiences with living owls in school settings. Already stressed in some of the previous research (e.g. Palmer, Suggate, Robottom, & Heart, 1999) is the importance of different groups of people involved in developing significant

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life experiences of an individual. The present research showed that such people have an important role as sources of information or facilitators of students' experiences.

Conclusions

Slovene primary school students in fourth and fifth grade have considerable knowledge of owls' physical features, their behaviours, habitats and diet, but also some misconceptions about owls. From an educational perspective, owls are one of the groups of animals that cannot be easily observed, but obviously (judging from the results) they are a very attractive study object to students. Owls stand out as a more recognized order of birds.

The present research provides evidence that it is beneficial to collect primary school students' science ideas with more than one research method, i.e. drawings and written responses. Collectively, more information about students' concepts about owls was gathered using drawings and written responses. These findings could help teachers plan instructional strategies for revision of students' previous, and the acquisition of new, knowledge about owls and similar biological concepts. Primary school students' ideas about science concepts depicted with both drawings and written responses enable a teacher to make a better diagnostic, formative or summative assessment than using just drawings or written responses.

Experiences with live animals are an important source of animal species knowledge. Students' experiences with owls significantly influenced their conceptions about owls. However, present-day school settings primarily depend on using secondary (symbolic) sources of information about animals. For the future success of conservation education, it is important that students continue to gain experiences with living organisms in informal settings as well, e.g. visiting zoological gardens, aquariums or hiking in nature parks with their families. Furthermore, the role of relatives and others closely related to individual students should not be neglected, particularly because they are perceived as sources of information and facilitators of their experiences.

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