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Factors Affecting Students' Attitudes Toward Toads

Iztok Tomažič
University of Ljubljana, SLOVENIA
Andrej Šorgo
University of Maribor, SLOVENIA

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ABSTRACT
Amphibians are one of the most threatened animal groups; however, attitudes and emotions toward them are mostly negative. One of the efforts, as a part of the cognitive dimension of nature protection, should be in the shifting of negative attitudes toward amphibians to positive ones. The purpose of this study was reevaluation of the Toad Attitude Questionnaire (TAQ), as well as assessment of lower and upper secondary school students' attitudes towards toads. The moderating role of grade, gender, reported direct experiences, their experiences with nature, or whether they live in rural or urban areas on student attitudes toward toads was assessed. The results show that the level of education, gender, and reported direct experiences with toads, influence student attitudes more than place of residence and reported number of visits to natural surroundings. The implications for school work based on our study are numerous, some of them opposing recent trends in replacement of real hands-on activities with virtual ones in zoology education. There is no reason that animals in a classroom should be regarded mainly as objects of dissection. Giving them the status of ambassadors representing billions of similar or different organisms from nature is a better approach.
Keywords: amphibians, toads, attitude, students

INTRODUCTION

"The best sound you can hear
is the one from a toad that
you ran over with a bicycle."
Unnamed: upper secondary school student

Amphibians are one of the most endangered taxa in the world, so they need protection by all means possible. Reports show (IUCN, 2016) that over one third of the world's amphibian species have experienced severe decline, or are even facing extinction. Amphibians are vulnerable animals due to their aquatic and terrestrial life (Hussain & Pandit, 2012), and their permeable skin is very sensitive to environmental conditions (Collins & Storfer, 2003). The

Correspondence: Iztok Tomažič, *Department of Biology, University of Ljubljana, Biotechnical Faculty, Večna pot 111, 1000 Ljubljana, Slovenia.*
Iztok.tomazic@bf.uni-lj.si

State of the literature

- Positive attitudes toward animal species are a necessary prerequisite for successful application of conservation actions.
- Toads are generally animals that people perceive as disgusting, and are prone to harming or even killing them.
- Instruction with live animals can lower disgust toward certain animals.

Contribution of this paper to the literature

- TAQ questionnaire (Tomažič, 2011a) was reevaluated on a larger sample of students and broader age spectrum.
- Lower and upper secondary school students were included in the study (age 11 - 18).
- In addition to gender, reported experiences, and education level, student attitudes toward toads were also assessed according to their experiences with nature (i.e. "How often do you take trips into nature?"), or whether they live in rural or urban areas.

worldwide decline of amphibians can be contributed to habitat destruction, alternation, and fragmentation (Stuart et al., 2004; Cushman, 2006; Ferreira & Beja, 2013; Cosentino et al., 2014), over-exploitation (Jensen & Camp, 2003), UVB radiation (Blaustein et al., 2003), chemical contaminants (Blaustein et al., 2003; Pezdirc et al., 2011), disease (Hussain & Pandit, 2012), competition with introduced species (Vredenburg, 2004), and most probably to other, yet unidentified factors, as well. For a detailed review, see also Beebee & Griffith (2005) and Blaustein & Kiesecker (2002). It is therefore of great concern of conservation biologists that education should play an important role in informing general public not only about the amphibian crisis, but about actions to overcome it as well. On the practical level, we should recognize that according to the Haberlein (2012) solutions to the environmental problems, such as decline of amphibian populations (Stuart et al, 2004), are cognitive (e.g. education), technological (e.g. building artificial habitats, captive breeding, and reintroduction), and structural (e.g. protection by legislation). Conservation measures cannot rely only on one of these components to be effective (e.g. Griffiths & Pavajeau, 2008). However, education, even if it is not a final goal of conservation efforts, can be recognized as a basis for other measures because it can influence attitudes as a prerequisite for informed actions (Ajzen, 1991). There are several references on the connections between attitudes toward amphibians, and the will to preserve, or to at least not harm them (e.g. Ceríaco, 2012; Kalnicky et al., 2014; Perry-Hill et al., 2014; Reimer et al., 2014; Jimenez & Lindemann-Matthies, 2015b).

The importance of education for conservation and protection of species and habitats can be recognized as common knowledge. As an example, the Society for Conservation Biology published the Conservation Literacy Guidelines (Trombulak et al., 2004), where it is proposed that conservation biology education should represent one of the most important goals for every society. World educational practices and opinions on "what works the best in

conservation (environmental) education" are diverse (e.g. Neal & Palmer, 2003; Ratcliffe & Grace, 2003; Dillon, 2012), and the same is true for amphibians, respectively.

In recent decades, research about attitudes toward animals has been gaining attention. Researchers are dealing with the notion of how to implement the findings in order to raise awareness about endangered species, and the importance of animal conservation. Species that are usually used in attitude research are either charismatic or flagship species such as dolphins (Barney et al., 2005), primates (Lukas & Ross, 2005), or large carnivores (Majic & Bath, 2010; Prokop, Usak & Erdogan, 2011). One branch of research is about attitudes toward animals that people dislike or fear, like sharks (Thompson & Mintzes, 2002), crows (Špur, Pokorny & Šorgo, 2016), snakes, spiders, and bats (Prokop & Tunnicliffe, 2008, 2010; Prokop et al., 2009) was conducted. However, attitudes toward amphibians had been, with few exceptions, scarcely researched (Randler et al., 2005; Tomažič, 2008; Tomažič, 2011a; Prokop & Fančovičová, 2012; Reimer et al., 2014; Jimenez & Lindemann-Matthies, 2015a; Jimenez & Lindemann-Matthies, 2015b).

For example, the general public can be ambivalent, or even not tolerant to toads living near their homes (Schlegel & Rupf, 2010; Tomažič, 2008). Prokop and Fančovičová (2012) found that 26% of pond owners kill amphibians that inhabit their ponds, and even 31% of non-owners reported that they would kill them. Tolerance of amphibians in that study was positively correlated with the perceived importance of amphibians, and negatively correlated with a disgust reaction toward them. In the study of Jimenez and Lindemann-Matthies (2015b) that was conducted in Colombia, the authors found that the more strongly participants agreed that frogs are useful, of medicinal value, and beautiful, the more strongly they agreed that they should be conserved. In their study, the public's attitude to, and knowledge of frogs was poor. A study of Ceriaco (2012), conducted in Portugal, also found that the presence of wrong perceptions and negative values about amphibians and reptiles predicts persecution and anti-conservation attitudes. The presence of folklore was related to the presence of negative attitudes. On the other hand, results from China indicate that toads and frogs are considered to be beautiful and important for pest control, medicinal purposes, and as food (Jimenez & Lindemann-Matthies, 2015a).

References on strategies to be followed toward amphibian conservation in schools are scarce (Randler et al., 2005; Tomažič, 2008), and advice addressed to educators is mostly generic. Some propose that curriculum materials for school children must be developed, outings to enhance appreciation for amphibians should be sponsored, and cultural and media events centered on amphibian themes and actions – such as construction of ponds to attract and conserve amphibians – should be organized (Young et al., 2004). The study by Genovart et al., (2013) documented that children are more familiar with exotic species than they are with local ones, which was not the case for amphibians and reptiles. Children find pets and exotic animal species most attractive, and if they have the opportunity to observe local species, their appreciation of them increases (Lindemann-Matthies, 2005). However, examples of using live animals for educational purposes within regular instruction or within instruction in informal

learning environments, there are some beneficial outcomes to be found. For example, some studies have found that even brief exposure of participants to live animals reduces the level of fear and disgust they might have felt before that exposure, or raises their fondness for animals (e.g. Killermann, 1996 [spiders]; Tomažič, 2008 [amphibians]; Randler et al., 2012 [mouse, snail, woodlouse]; Klingenberg, 2014 [backswimmer, water louse, dragonfly larvae, flatworm, leech]). Reported direct experiences turn out to contribute to more positive attitudes of participants toward animals (Tomažič, 2011a, b, c). Even better, if students participate in an environmental education program, their ecological knowledge improves considerably (Bogner, 1999; Randler & Bogner, 2002, 2006, 2009; Randler et al., 2005). The duration of such activities have influence on students' knowledge, attitudes, and reported pro-environmental behavior (Bogner, 1998). The main reason for using animals from the local environment is that students gain direct experiences with animals, gain firsthand knowledge about them, and form positive attitudes toward them (Lindemann-Matthies, 2005). That was also evaluated in Tomažič's (2008) study, where students, who directly experienced live animals formed more positive and firm attitudes toward animals, and were more knowledgeable about them.

In Slovenian school science and biology curricula, topics such as biodiversity, value of and threats to biodiversity, species and ecosystems conservation, and sustainable development are included throughout elementary and secondary education. The environmental component of schoolwork more or less strictly follows the compulsory curricula for environmental education as education for sustainable development (Šorgo & Kamenšek, 2012; Vavdi & Šorgo, 2015). In Slovenian schools, teachers are autonomous in choosing teaching methods, but not in topics, which are mostly prescribed by syllabi approved by governmental bodies. Additional topics not included in a syllabus of a particular subject can be added over to the compulsory topics, if time allows. Textbooks strictly follows objectives from syllabi. That forms one of the reasons why teacher education, both as pre-service and in-service trainings, is extremely important. Education about amphibians in Slovenian schools is mostly attributed to elementary school and biology teachers. However, objectives in syllabi on amphibians are more or less in the domain of taxonomy, ecology, anatomy, and physiology, and there are no specific objectives addressing their conservation.

There are 19 species of amphibians, rather harmless to humans, present in Slovenia. Among them are two species of toads: the common toad (Bufo bufo), and the green toad (Bufo viridis), the former as an animal of interest in this paper. Students are generally familiar with the common toad, while this species is widespread throughout Slovenia; however, they are regularly unable to distinguish between common and green toads (Kos, 2009). Also, they do not fear toads as much as they are disgusted by them (Tomažič, 2011c).

All species of amphibians are listed on the Slovenian red list of endangered species (Ur. l. RS, n. 82/2002), and are protected by law. Nevertheless, teachers are allowed to take less endangered species from local environments and use them for educational purposes. For their instruction, teachers are allowed to take as many as 10 subjects of an individual species from the local environment and release them no later than in three months after capture. In this

process, animals must not be harmed. Vivisection or dissection of such animals is forbidden in our schools. In Slovenia, the highest media coverage of conservationists' work is focused on species such as large carnivores, birds, amphibians, and reptiles. One amphibian species, the Olm or cave salamander (Proteus anguinus), is of great interest even for media coverage, because it's anatomy and habitat is quite extraordinary. As a result of its popularity, and in combination with the school work, this is the best known amphibian species among lower secondary school students (Kos, 2009). Toads and frogs are most commonly covered in news stories about their transportation over roads by volunteers.

The purpose of the study

Studies about the attitudes of students toward amphibians are rare and could represent a baseline data for conservation education activities. Such knowledge can be used not only to feed teachers' curiosity about students' attitudes, but are a necessary prerequisite to prepare effective educational activities that will serve in a classroom or for outdoor education e.g. in national parks (Jimenez & Lindemann-Matthies, 2015b).

In this study, the research of Tomažič (2011a) was extended to assess the validity of the Toad Attitude Questionnaire (TAQ) with lower and upper secondary school students.

We set out to:

(1) Reevaluate the TAQ on a larger sample of students,
(2) Find if there are differences between lower and upper secondary school student attitude ratings toward toads,
(3) Assess if the reported direct experiences with toads, influence student ratings,
(4) Find if students' attitude ratings are influenced by gender, number of visits in nature, and place of residency,
(5) Find correlations between different attitudinal dimensions separately for students with or without reported direct experiences, and separately for lower and upper secondary school students.

METHODS

Study design and participant information

The present study took place in April and May 2010. In-service teachers who participated in the project were in regular meetings and asked to participate in different project activities. For the purpose of our study, we invited teachers from five lower and upper secondary schools to deliver the Toad Attitude Questionnaires (TAQ) (Tomažič, 2011a) to their students. Teachers were instructed on how to deliver the questionnaires to the students. A total of 539 students participated in the study. The age of the students ranged from 11 to 18 years.

Table 1. Distribution of students (N = 539) according to selected independent variables

Variable		N	N (%)
Gender	Male	253	46.9
	Female	286	53.1
Reported direct experience with toads	Yes	267	49.5
	No	272	50.5
Place of residence	Urban	378	70.1
	Rural	117	29.9
Visits in nature	Once a day	218	40.4
	Weakly	239	44.3
	Once a month or rarely	82	15.2

Lower secondary school students were from sixth (N = 200, 37.1%; age: M = 11.0, SD = 0.38) and eighth grades (N = 171, 31.7%; age: M = 12.9, SD = 0.37). Upper secondary school students were from second (N = 124, 23.0%; age: M = 16.1, SD = 0.43) and third (N = 44, 8.2%; age: M = 16.9, SD=0.45) year of upper (general) secondary school (Gimnazija). The detailed description of independent variables is presented in **Table 1**.

A series of Chi-square tests were calculated in order to find if there were any statistically significant differences in the distribution of the sample. We found statistically significant differences in the distribution for gender vs. reported direct contact with animals ($p < 0.001$), where 58% of male and 42% female students reported having direct contact with animals. Also, there were differences in place of residence (urban/rural) vs. number of visits in nature ($p < 0.001$), where 63% of rural residents visit nature once a day, 32% once a week, and 5% once a month or rarely in contrast to urban residents, where 31% of students visit nature once a day, 50% once a week, and 20% once a month or rarely. However, there was no difference in reported direct experiences with toads and place of residence ($p > 0.05$), or reported direct experiences with toads and number of visits in nature ($p > 0.05$). A higher number of lower secondary school students (53%) reported having direct contact with toads than upper secondary school students (43%), ($p < 0.05$). Also, lower secondary school students (46% once a day, 41% one a week, and 13% rarely) visit nature more often that upper secondary school students (28% once a day, 52% one a week, and 20% rarely); ($p < 0.001$). In upper secondary school, there was a greater population of girls ($p < 0.01$). All other comparisons yielded no statistically significant differences (all $p > 0.05$).

Instrument

The reason for a single animal species selection for measuring attitude was that presumably measuring a generalized attitude toward amphibians would not yield concrete or valid results (for a discussion see Prokop & Tunnicliffe, 2010). If students were to rate their attitude toward amphibians, they could be wrongly thinking about turtles – reptiles or only frogs – the prototypical species for amphibians (Yen et al., 2004).

The instrument was in a form of a questionnaire and consisted of two parts. The first part included questions about the respondent's sociodemographics: age, gender, education level, reported direct contact with animals, and the place of residence (rural or urban) (**Table 1**). The second part of the questionnaire measures the attitude toward toads and was adopted after Tomažič (2011a). Students completed a TAQ that consisted of 27 items. The 27 statements used in this study were based on 5-point Likert type scale (1 – strongly disagree to 5 – strongly agree). Prior to statistical analysis, negative statements were reversely coded.

Statistical analysis

The data were transferred to the SPSS statistical program for Windows (SPSS Inc., 2006), and attitude statements were submitted to a principal component analysis (PCA) with Varimax rotation. After the principal components (attitudinal dimensions) were extracted and Cronbach's alphas calculated, a series of GLM univariate and multivariate tests were applied. We tried to find the effect of independent variables on individual attitudinal dimension, extracted with PCA. A multivariate test was conducted in order to find joined effect of independent variables on all attitudinal dimensions.

Then, descriptive and inferential statistics was used, where medians were obtained for each attitudinal dimension and evaluated according to independent variables. As the data was generally not normally distributed, the most appropriate statistical test was Mann-Whitney U with calculated effect sizes (formula: $r = -z/\sqrt{N}$), when comparing the influence of the individual independent variable on student ratings. In the case of analyzing student ratings according to reported number of visits in nature, that variable contained three independent groups. For that reason, the Kruskall-Wallis test was used, followed by a series of Mann-Whitney U tests as post-hoc comparisons to assess effect sizes. The data is presented in a form of box-plot charts, stating the medians and sample distributions.

Also, Spearman's rho correlations were calculated separately for lower and upper secondary school student ratings and for reported direct experience with toads.

RESULTS

The results are presented in four parts. In the first part, the results of the PCA are presented. In the second part, results of multivariate and univariate statistics are shown. In the third part, student ratings on an individual dependent variable according to independent variables are presented. The fourth part of the results includes Spearman's rho correlations presented separately for education level and reported direct experiences.

Principal component analysis of the TAQ

After the initial principal component analysis (PCA) with Varimax rotation 25 items were retained. Cronbach's alpha for the total scale of final 25 items was 0.90. The PCA produced four meaningful principal components (PC) that are considered as different attitudinal dimensions (**Table 2**). The KMO of 0.926 and Bartlett's test of sphericity (5761.3, df = 351, $p < 0.001$) supported the use of analysis. The total variance explained by four-principal

Table 2. Distribution of statements on different attitudinal dimensions

ITEM	Principal component			
	1	*2*	*3*	*4*
Cronbach's alpha	***0.90***	***0.88***	***0.68***	***0.51***
SCIENTISTIC				
I would like to learn about different species of toads.	*0.803*			
I would like to know how toads eat, smell and hear.	*0.801*			
I would like to learn about environments where toads live.	*0.787*			
I would like to know how toads developed.	*0.768*			
I like to read about toads.	*0.737*			
I could observe toads for a long time.	*0.638*			
I get bored when biologists are talking about toads. (R)	*0.621*			
NEGATIVISTIC				
I am afraid of toads. (R)		*0.718*		
I would like to hold a toad in my hands.		*0.717*		
Toads are disgusting animals. (R)		*0.709*		
I like toads.		*0.688*		
When I am walking through the woods, I do not have a special wish to meet a toad. (R)		*0.670*		
I would rather see a model of a toad than a live one. (R)		*0.633*		
Toads are ugly. (R)		*0.573*		
I would rather see a movie about toads than watch them in nature. (R)		*0.554*		
I would like to study toads in nature.		*0.529*		
I would like to have a toad at home.		*0.490*		
ECOLOGISTIC				
Toads are very important in nature.			*0.726*	
It would be for the best if all toads were killed. (R)			*0.615*	
Cars kill too many toads each year.			*0.607*	
The construction of the hotel should be prevented if the result would be the local extinction of one species of toads.			*0.462*	
MORALISTIC				
Keeping toads in captivity is cruel.				*0.699*
I wouldn't like to hunt toads.				*0.588*
Toads need to have rights too.				*0.541*
Hunting toads for fun is cruel.				*0.541*
Excluded items				
We don't need to protect rain forests, because toads living there will move elsewhere. (R)				
Toads are of value as they eat mosquitoes and other bugs.				

components (PC) solution was 51.2%. The first extracted PC accounted for 31.0% of the total variance. Cronbach's alpha for the first PC was 0.90 (seven items), second PC 0.88 (ten items), third PC 0.68 (four items), and fourth PC 0.51 (four items). The first PC was named 'Scientistic,' where students rated their interest in the physical attributes and biological functioning of animals and their interest in direct experience of animals. The second PC was named 'Negativistic,' where students expressed an orientation toward active avoidance of animals as a result of disliking, fear, or disgust. Because of the reversed statements in this category, the higher the values are, more positive is the student's attitude. The third PC contained statements describing 'Ecologistic' attitudes, i.e. concern for the environment as a system and for interrelationships of wildlife species and the natural habitats. The fourth PC, termed 'Moralistic,' contained items that described concern about the right or wrong treatment of animals. The fourth component is argued, however it should not be retained without reserves due to the unacceptably low Cronbach's alpha.

Univariate and multivariate analysis of independent variables' effect on attitude dimensions

The independent variables in question differently affected student ratings on each attitudinal dimension. From the multivariate test (**Table 3**), it can be recognized that grade and reported direct experiences influenced student ratings the most, followed by gender. Also, two significant interactions were found between independent variables.

Table 3. GLM multivariate analysis of the effect of independent variables on student attitude ratings

Multivariate Tests	Wilks' Lambda	F	Hypothesis df	Error df	*p*	Partial η^2
Grade	0.930	9.236	4	490	**<0.001**	0.070
Direct contact	0.930	9.176	4	490	**<0.001**	0.070
Gender	0.954	5.951	4	490	**<0.001**	0.046
Visits to the nature	0.978	1.374	8	980	0.204	0.011
Place of residence	0.992	0.952	4	490	0.434	0.008
Gender * visits to the nature	0.965	2.189	8	980	**0.026**	0.018
Gender * visits to the nature * residency * direct contact	0.964	2.282	8	980	**0.020**	0.018

Detailed analysis of the effects of independent variables on individual attitudinal dimension (**Table 4**) revealed that gender significantly influenced student ratings on Negativistic and Moralistic attitude dimensions, with a stronger effect on Negativistic dimension. For the variable 'grade,' there were significant effects found for Scientistic, Negativistic, and Moralistic attitudinal dimensions, with the highest effect on the Scientistic attitudinal dimension. The reported number of visits in nature only significantly influenced

the Scientistic attitudinal dimension. It was revealed that reported direct experiences significantly affect student ratings on Scientistic, Negativistic, and Ecologistic attitudinal dimensions, with the highest effect on the Negativistic attitudinal dimension. Place of residence did not show a statistically significant effect on any of the four dependent variables.

Table 4. GLM univariate analysis of the effect of independent variables on student ratings for an individual attitudinal dimension

ATTITUDE DIMENSION	Type III Sum of Squares	df	Mean Square	F	*p*	Partial η^2
SCIENTISTIC						
Gender	1.443	1	1.443	1.823	0.178	0.004
Grade	27.842	1	27.842	35.177	**<0.001**	0.067
Visits to the nature	6.799	2	3.400	4.295	**0.014**	0.017
Place of residence	0.035	1	0.035	0.044	0.834	0.000
Direct contact	9.838	1	9.838	12.430	**<0.001**	0.025
gender * grade * visits to the nature	4.800	2	2.400	3.032	**0.049**	0.012
gender * visits to the nature * direct contact	6.397	2	3.199	4.041	**0.018**	0.016
gender * visits to the nature * residency * direct contact	7.305	2	3.653	4.615	**0.010**	0.018
NEGATIVISTIC						
Gender	8.543	1	8.543	15.094	**<0.001**	0.030
Grade	6.293	1	6.293	11.118	**0.001**	0.022
Visits to the nature	2.393	2	1.197	2.114	0.122	0.009
Place of residence	0.861	1	0.861	1.521	0.218	0.003
Direct contact	20.486	1	20.486	36.196	**<0.001**	0.068
gender * visits to the nature	4.459	2	2.229	3.939	**0.020**	0.016
gender * visits to the nature * direct contact	4.624	2	2.312	4.085	**0.017**	0.016
gender * residency * direct contact	2.437	1	2.437	4.306	**0.038**	0.009
gender * visits to the nature * residency * direct contact	4.732	2	2.366	4.180	**0.016**	0.017
ECOLOGISTIC						
Gender	0.000	1	0.000	0.000	0.989	0.000
Grade	1.467	1	1.467	2.435	0.119	0.005
Visits to the nature	0.507	2	0.253	0.421	0.657	0.002
Place of residence	0.122	1	0.122	0.203	0.653	0.000
Direct contact	3.494	1	3.494	5.801	**0.016**	0.012
gender * grade	2.337	1	2.337	3.880	**0.049**	0.008
gender * visits to the nature	5.074	2	2.537	4.212	**0.015**	0.017
gender * grade * direct contact	2.382	1	2.382	3.954	**0.047**	0.008
gender * visits to the nature * residency	3.928	2	1.964	3.260	**0.039**	0.013
gender * grade * visits to the nature * residency	3.415	1	3.415	5.670	**0.018**	0.011
MORALISTIC						
Gender	4.013	1	4.013	6.298	**0.012**	0.013
Grade	4.085	1	4.085	6.410	**0.012**	0.013
Visits to the nature	1.142	2	0.571	0.896	0.409	0.004
Place of residence	1.127	1	1.127	1.768	0.184	0.004
direct contact	0.004	1	0.004	0.007	0.934	0.000

For the Scientistic attitudinal dimension, significant interactions between gender*grade*visits in nature ($p < 0.05$), gender*visits in nature*direct contact ($p < 0.05$), and gender*visits in nature*place of residence*direct contact ($p = 0.01$) were found.

For the Negativistic attitudinal dimension, significant interactions between gender*visits in nature ($p < 0.05$), gender*visits in nature*direct contact ($p < 0.05$), gender*place of residence*direct contact ($p < 0.05$), and gender*visits in nature*place of residence*direct contact ($p < 0.05$) were found.

For the Ecologistic attitudinal dimension, significant interactions between independent variables were found. Namely, between gender * grade ($p < 0.05$), gender * visits in nature ($p < 0.05$), gender * grade * direct contact ($p < 0.05$), gender * visits in nature * residency ($p < 0.05$), and gender * grade * visits to the nature * residency ($p < 0.05$).

For the Moralistic attitudinal dimension, no significant interactions between independent variables were found (all $p > 0.05$).

Inferential statistics of the effects of an individual independent variable on student ratings for individual attitudinal dimension

The general results show, that students are ambivalent toward learning about toads, which is true for their negativistic perspective, respectively. They score higher on Ecologistic and Moralistic attitudinal dimensions (**Figures 1–5**).

Effect of gender on student attitude ratings: Statistically significant differences between male and female ratings exists on Negativistic and Moralistic attitudinal dimension (**Figure 1**). Female students expressed more negative attitude toward toads on Negativistic ($p < 0.001$) and more positive attitude on Moralistic ($p < 0.001$) dimensions than boys. The differences between the males and females were small both for Negativistic ($r = 0.19$), and Moralistic ($r = 0.23$) dimensions.

Effect of education level on student attitude ratings: Statistically significant differences between lower and upper secondary school student ratings are present on all four attitudinal dimensions (**Figure 2**). Upper secondary school students expressed more negative attitude toward toads on all four dimensions; Scientistic ($p < 0.001$), Negativistic ($p < 0.001$), Ecologistic ($p < 0.001$), and Moralistic ($p < 0.001$) than lower secondary school students. The differences between the two groups were as follows: Scientistic ($r = 0.38$), Negativistic ($r = 0.27$), Ecologistic ($r = 0.18$), and Moralistic ($r = 0.18$). Only on the Scientistic dimension differences can be considered as medium.

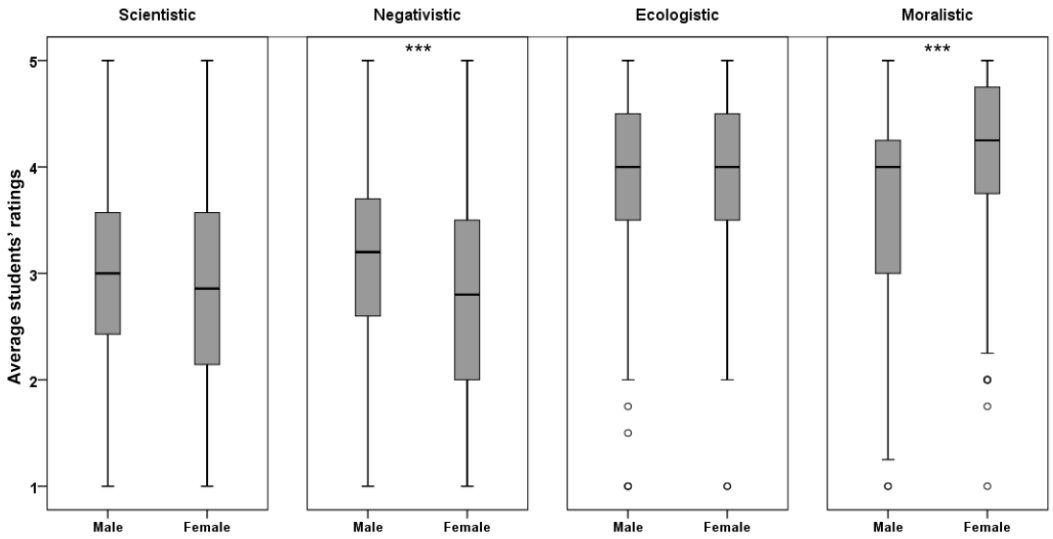

Figure 1. Differences in student ratings according to gender. A lower score on a negativistic scale means a more negative attitude toward toads. Meaning of asterisks: *** $p < 0.001$

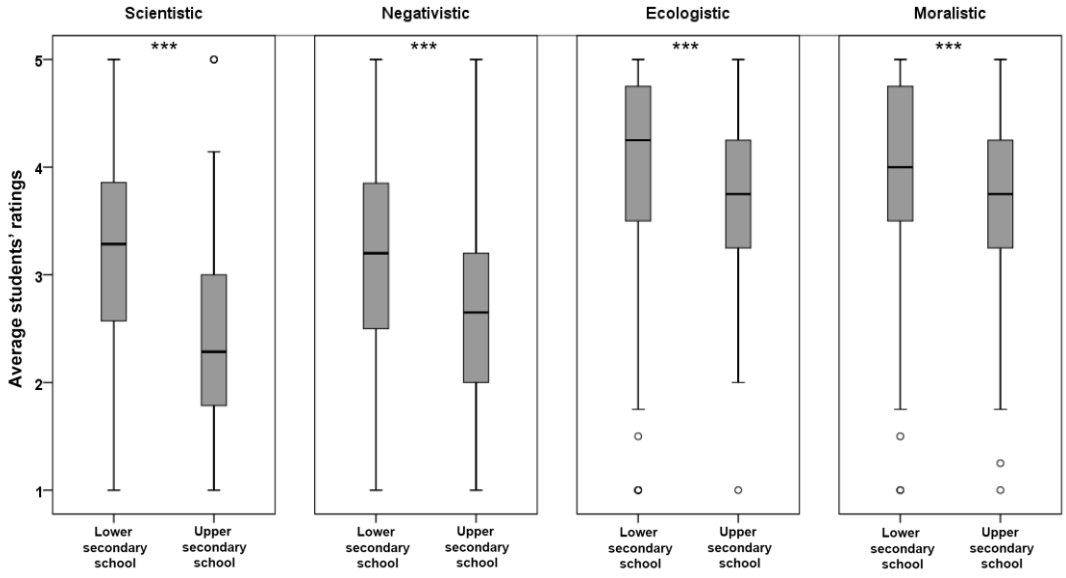

Figure 2. Differences in student ratings according to education level. A lower score on a negativistic scale means more negative attitude toward toads. Meaning of asterisks: *** $p < 0.001$

Effect of direct experience on student attitude ratings: Statistically significant differences in student ratings according to reported direct experiences with animals are present on three of four attitudinal dimensions (**Figure 3**). Students who reported having direct experiences with toads expressed a more positive attitude toward animals than the students who reported not having such experiences; Scientistic ($p < 0.001$), Negativistic ($p < 0.001$), and Ecologistic ($p <$

0.001). The differences between lower secondary and upper secondary school students were as follows: Scientistic (r = 0.27), Negativistic (r = 0.50), and Ecologistic (r = 0.27). Only on the Negativistic dimension differences can be considered as medium.

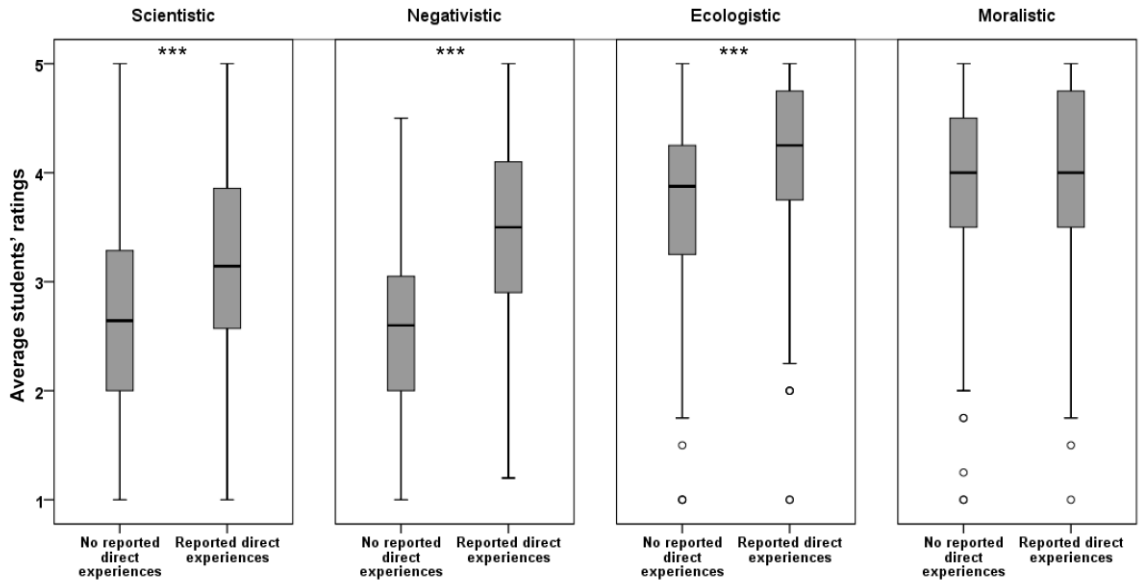

Figure 3. Differences in student ratings according to reported direct experiences with animals. A lower score on a negativistic scale means a more negative attitude toward toads. Meaning of asterisks: *** $p < 0.001$

Effect of place of residence on students' attitude ratings: There were no statistically significant differences in student ratings according to place of residence for all four attitudinal dimensions (**Figure 4**). All the differences between the rural and urban categories were not significant (all $p > 0.05$, all r less than 0.10).

Effect of nature visits on students' attitude ratings: Statistically significant differences between ratings of students according to the number of visits to the nature are present on three dimensions (**Figure 5**); Scientistic ($p < 0.001$), Negativistic ($p < 0.05$), and Ecologistic ($p < 0.05$). Post-hoc comparisons yielded a low effect for the Scientistic dimension. Participants who were visiting nature once a day, differed from those who reported visiting nature once a week (r = 0.23), and those who reported visiting nature rarely (r = 0.24). All other comparisons on other two dimensions yielded r values 0.15 or below.

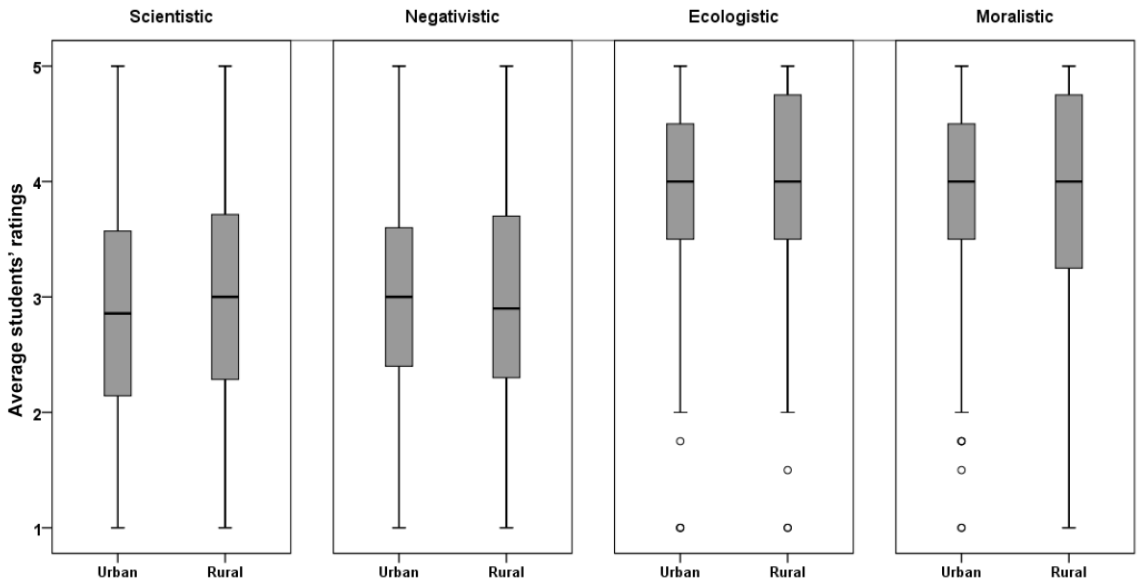

Figure 4. Differences in student ratings according to reported place of residence. A lower score on a negativistic scale means a more negative attitude toward toads

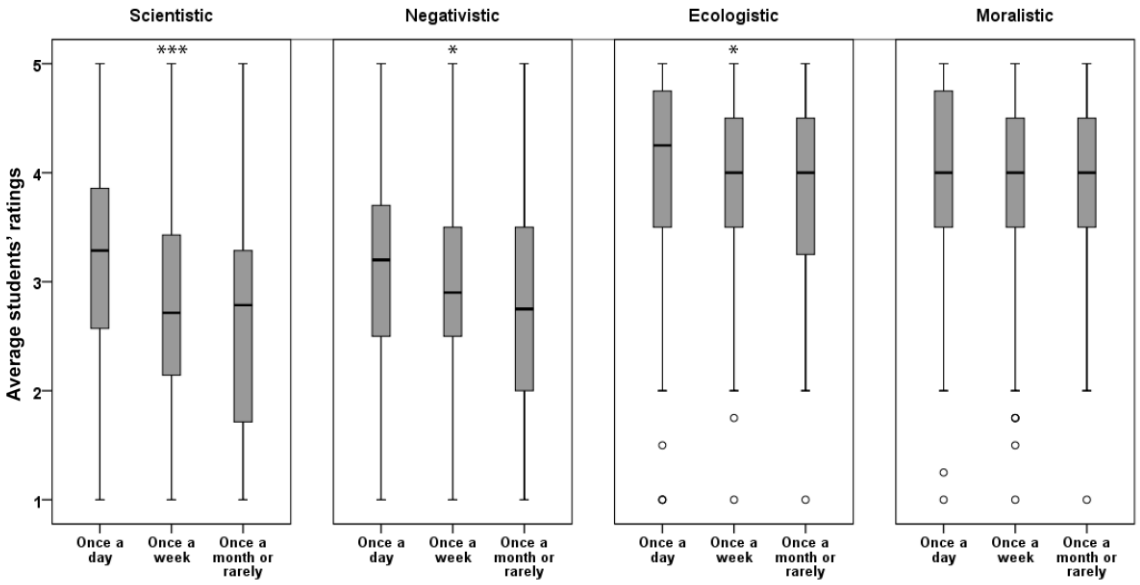

Figure 5. Differences in student ratings according to reported number of visits in nature. A lower score on a negativistic scale means a more negative attitude toward toads. Meaning of asterisks: *** $p < 0.001$, * $p < 0.05$

Non-parametric correlations between dependent variables according to education level and reported direct experiences

In **Table 5**, the results of Spearman's rho statistics are presented. When comparing correlations according to reported direct experiences, it can be revealed that for students who reported direct experiences, the correlations are generally higher than of their counterparts. For both mentioned groups, correlations between Scientistic and Negativistic attitudinal dimensions were high, which means that the more students wanted to learn about toads, the less negative attitude they had toward them. Correlations between Ecologistic/Scientistic and Ecologistic/Negativistic dimensions were moderate to high, depending on the reported direct experiences. Moderate correlations were also found between Ecologistic and Moralistic attitudinal dimensions.

In general, higher correlations between dependent variables exist for lower secondary school students. Only the correlation between Moralistic and Ecologistic attitudinal dimensions, calculated from the sample of upper secondary school students was higher than for lower secondary school students. Again, the highest correlations were revealed between Scientistic and Negativistic attitudinal dimensions.

In both cases, almost no correlation was observed between Moralistic and Negativistic attitudinal dimensions.

Table 5. Spearman's rho correlations between dependent variables sorted by education level and reported direct experiences

Spearman's rho	Direct contact	Scientistic	Negativistic	Ecologistic	Moralistic	Education level
Scientistic			0.570	0.405	0.230	**Lower secondary**
			0.548	0.377	0.184	**Upper secondary**
Negativistic	**NoDe**	0.562		0.480	0.081	**Lower secondary**
	DE	0.592		0.339	0.013	**Upper secondary**
Ecologistic	**NoDe**	0.327	0.311		0.325	**Lower secondary**
	DE	0.466	0.522		0.445	**Upper secondary**
Moralistic	**NoDe**	0.210	0.001	0.396		
	DE	0.334	0.244	0.363		

DISCUSSION

Reevaluation of TAQ

In this study, we have reevaluated the TAQ (Tomažič, 2011a) and concluded that it is appropriate to explain several attitudinal dimensions concerning toads. The PCA from this data sample, in contrast to the analysis of Tomažič (2011a), produced four PC instead of three.

Namely, due to the smaller sample size and lower secondary school students only in the mentioned study, Moralistic and Ecologistic attitudinal dimensions were interlaced. In this study, where there was a larger number of participants included, we decided to retain two separate factors, one that assessed attitudes toward the protection of animals in their ecosystems, Ecologistic, and the last that assessed attitudes toward the mistreatment of animals, Moralistic. The last PC (Moralistic) in our study was the least reliable. For that reason, the results of this PC are interpreted with caution, as the value for this PC is below 0.60 (Leech et al., 2005, p.67).

Level of education and student attitude ratings

In his study, Kellert (1985) found that the best way to focus on the affective realm is with children aged six to nine. In children of that age group, one can mainly build on emotional concern and sympathy for animals. Promotion of cognitive or factual understanding is effective for 10 to 13 year-old children. Finally, after the age of 13, building on ethical concerns for animals and an understanding of ecology is appropriate. For that reason, we have merged all lower secondary school and all upper secondary school students into two separate groups. The differences in student ratings were present on all four attitudinal dimensions (**Figure 2**) with the greatest effect recorded for Scientistic dimension. Tomažič (2011a) has also found that through lower secondary school grades six to nine, students' interest in learning about animal declines. Our study shows that upper secondary school students' interest falls below the ambivalent part of the scale to the more negative side, what could probably be regarded as a result of students' development and/or social preferences by upper secondary school students.

That finding is in line of several previous studies where authors also found that interest in animals decreases over time (Prokop & Tunnicliffe, 2008; Bjerke & Østdahl, 2004, Tomažič, 2011a). Prokop et al. (2007) found that Slovakian students' interest about biology decreases over years and linked their results with the topics that students learn about in different grades. Topics of sixth grade were about animals. For that reason they proposed that "the use of living organisms would be one of the key factors which can increase students' positive attitudes toward biology". We can supplement this notion by confirming that direct experiences with animals significantly influence students' attitudes, and speculate that in general their attitudes toward biology would be more positive if live animals were to be used in instruction. In this study, as opposed to the study of Tomažič (2011a), where there were no differences in student ratings on Negativistic and Moralistic/Ecologistic (in that study, these two factors have been merged) attitudinal dimensions between different class grades of lower secondary school students, we found significant differences between lower and upper secondary school student ratings on all three mentioned factors (**Figure 2**). Of those, the greatest difference was on the Negativistic attitudinal dimension. On Ecologistic and Moralistic dimensions there were statistically significant differences found, but the effect size calculated showed that they were small. Also, the correlations between Scientistic and Negativistic attitudinal dimensions were the highest for lower secondary school, as well as

upper secondary school students. Interest about animals is therefore also governed by a negative view of animals.

Direct experiences and students' attitude ratings

Direct experience with animals has great influence on lowering negative feelings students have toward animals. Therefore, it is of great importance that live animals are included in biology lessons (Tomažič, 2008; Prokop et al., 2009).

This study shows that reported direct experiences lower negative feelings toward animals and heightens interest in studying these animals for lower and upper secondary school students. However, upper secondary school students in general expressed less interest for studying animals and their feelings about animals were more negative than those of lower secondary school students (**Figure 3**). This age related drop in students' interest together with more negative feelings about animals can also be linked to different age related preferences of students.

Reported direct experiences also produce higher concern about animal conservation, which is shown in the Ecologistic attitudinal dimension. Similar results, but for other animals, can be found in the research of Yore & Boyer, (1997) and Prokop et al., (2009). Higher interest in animals could lead to greater acquisition of knowledge and more positive attitudes toward animals, consequently leading to more pro-environmental behavior (Barney et al., 2005). Conversely, negative feelings that students express when working with live animals, can inhibit learning about them. Signals from disgust evoking animals such as toads (Tomažič, 2011c), can disrupt acquisition of new knowledge, if not presented in a way that students are reassured of their well-being. This was found in a case of (reported) dissection activities, where negative attitudes influenced learning outcomes (Randler et al. 2005, Holsterman et al. 2009, 2012).

Some research has found that if students are exposed to disgust-evoking animals like mice or snakes (Ballouard et al. 2012, Randler et al. 2012a), or are participating in dissections activities (Holstermann et al., 2012; Randler et al., 2012b), their disgust sensitivity toward such objects or situations is reduced. Also, their affection toward live animals (toads) rises (Tomažič, 2008).

We found no differences on the Moralistic dimension, according to reported direct experiences with toads (**Figure 3**). Direct experiences with animals therefore do not influence how students perceive cruelty toward animals (see also Tomažič 2011a). Because we did not observe students in a real life situation, we cannot conclude, how they would react if they were to witness cruelty toward animals. If someone is morally sensitive or has positive attitudes toward animals, that does not mean that, that person would behave pro-environmentally (Barney et al., 2005).

Gender and students' attitude ratings

In this study, a significantly greater number of boys reported having direct experiences with toads. This trend didn't change from year 2004, when Tomažič (2011c) assessed levels of fear and disgust that lower secondary school students express toward different animals.

Although differences were found on the Negativistic and Moralistic dimensions (**Figure 1**), the greatest effect was found on the later dimension. Contrary to the study of Tomažič (2011a), here we did not find any differences in ratings between males and females on the Scientistic attitudinal dimension. However, we have found that the upper secondary school girls showed the least willingness to learn about toads as opposed to lower secondary school girls. Not just amphibians, invertebrates are also the animals that females rate as less popular than males (Prokop & Tunnicliffe, 2010). Some studies found that females generally report greater fear of different animals than males (Arrindell et al., 2000; Prokop et al., 2009; Prokop & Tunnicliffe, 2010; Tomažič, 2011c).

The same as in Thompson and Mintzes (2002) study about sharks and Tomažič (2011a) study about toads, girls in this study expressed higher moral objections to the cruelty toward toads than boys.

Visits to the nature and place of residence effects on student ratings

Tomažič (2011a) mentioned that additionally to gender, reported experiences and education level, students should also be asked about their experiences with nature (i.e. "How many times do you take trips in nature?) or whether they live in rural or in an urban area, which we included in this study.

This study in this respect gives us a broader description about how selected independent variables influence student ratings about animals. We found that students who reported visiting nature every day, express more positive attitudes on all except on the Moralistic attitudinal dimension, but we treat differences as significant only for students' interest to learn about animals (**Figure 5**) because the effect size was only greater than 0.20 on the mentioned principal component. These differences can be linked to a higher amount of direct experiences with nature that students who visit nature more frequently gain.

Although more rural residents reported that they visit natural surroundings once a day than urban residents, we found that there were no differences in student ratings on any attitudinal dimension for this independent variable. This results contradict the results of the Jimenez and Lindemann Matthies (2015b) study, who found that farmer and non-farmer populations differ in attitudes toward frogs.

More detailed research about the interplay of direct experiences, the number of visits in nature, and rural/urban places of residence (presence of wetland areas and local amphibian abundance) is needed do draw more accurate conclusions. Also, the level of direct experiences

needs to be researched (i.e. physical/observational direct experiences, participation in pro-environmental actions concerning amphibians).

Outliers explained in a light to animal welfare

Ascione and Shapiro (2009) define animal abuse as non-accidental, socially unacceptable behavior that causes pain, suffering or distress to and/or the death of an animal. It can be seen from **Figures 1–5** that some students (ratings) are placed as outliers on Ecologistic and Moralistic attitudinal dimensions. Statements of those two dimensions ask students how much they agree with the mistreatment of animals as individuals or in nature. At least for the former, some students were either not serious enough when filling out the questionnaire, or they really were rating their statement according to their beliefs? Low Cronbach alpha value for the Moralistic attitudinal dimension could mean that random guessing occurred (Leeming et al., 1995). This is the question for future study, as the statement of one upper secondary school student from the beginning of this article shows (also the author's personal first-hand experience with such actions of children), some students may, when in contact with live animals in nature, behave in a way that they harm or even kill animals. Precisely that was found by Prokop and Fančovičová (2012) in their study about amphibians. For future studies, there is a possibility that through such questionnaires, researchers can find such students, and then conduct additional interviews with them to assess their attitudes and even actions in more detail. Such students may not show such aggressive tendencies only toward animals, but also toward people (in Ascione and Shapiro, 2009).

CONCLUSIONS

In this study, we have reevaluated the TAQ and confirmed that it is appropriate to explain several attitudinal dimensions concerning toads.

Educational level, gender, and reported direct experiences with animals have a significant effect on student ratings. Additionally, students who reported higher contact with nature also displayed more positive attitudes toward toads.

Implications for school work based on our study are numerous, some of them opposing recent trends in replacement of real hands-on activities with virtual ones (see Lalley et al., 2010) in zoology education. There is no need that animals in a classroom are regarded mainly as objects of dissection, and due to the wish to protect them by opponents of such practices, dissection is banned from classrooms. Giving them the status of ambassadors representing billions of similar or different organisms from nature will be a better approach. With the inclusion of non-invasive activities, based on ethology (Klokočovnik et al., 2016) rather on physiology and anatomy, we can teach students things above cognitive levels. Offering students direct experiences with live animals is clearly a better approach for fostering more positive attitudes toward animals, especially toward amphibians which students at least in Slovenia perceive mainly as disgusting creatures. In such a way we can hope that school activities are going to become important not only as self-sustaining entities, but as part of

lifelong experiences toward an environmentally friendly future. Also, research should focus on students' attitude and knowledge about different amphibian species, i.e. salamanders and frogs, in order to obtain broader perspective on how mentioned animals are perceived by them.

REFERENCES

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, *50*(2), 179-211.

Arrindell, W. A. (2000). Phobic dimensions: IV. The structure of animal fears. *Behaviour Research and Therapy, 38*(5), 509-530. doi: 10.1016/S0005-7967(99)00097-2.

Ascione, F. R., & Shapiro, K. (2009). People and Animals, Kindness and Cruelty: Research Directions and Policy Implications. *Journal of Social Issues, 65*(3), 569-587. doi:10.1111/j.1540-4560.2009.01614.x

Ballouard, J. M., Provost, G., Barre, D., & Bonnet, X. (2012). Influence of a Field Trip on the Attitude of Schoolchildren toward Unpopular Organisms: An Experience with Snakes. *Journal of Herpetology, 46*(3), 423-428. doi: 10.1670/11-118.

Barney, E. C., Mintzes, J. J., & Yen, C.-F. (2005). Assessing Knowledge, Attitudes, and Behavior toward Charismatic Megafauna: The Case of Dolphins. *Journal of Environmental Education, 36*(2). doi: 10.3200/JOEE.36.2.41-55

Beebee, T. J. C., & Griffiths, R. A. (2005). The amphibian decline crisis: A watershed for conservation biology? *Biological Conservation, 125*(3), 271-285. doi: 10.1016/j.biocon.2005.04.009

Bjerke, T., & Ostdahl, T. (2004). Animal-related attitudes and activities in an urban population. *Anthrozoös, 17*(2), 109-129.

Blaustein, A. R., & Kiesecker, J. M. (2002). Complexity in conservation: lessons from the global decline of amphibian populations. *Ecology Letters, 5*(4), 597-608. doi: 10.1046/j.1461-0248.2002.00352.x

Blaustein, A. R., Romansic, J. M., Kiesecker, J. M., & Hatch, A. C. (2003). Ultraviolet radiation, toxic chemicals and amphibian population declines. *Diversity and Distributions*, *9*(2), 123-140. doi:10.1046/j.1472-4642.2003.00015.x

Bogner, F. X. (1998). The Influence of Short-Term Outdoor Ecology Education on Long-Term Variables of Environmental Perspective. *Journal of Environmental Education, 29*(4), 17. doi:10.1080/00958969809599124

Bogner, F. X. (1999). Empirical evaluation of an educational conservation programme introduced in Swiss secondary schools. *International Journal of Science Education, 21*(11), 1169-1185. doi:10.1080/095006999290138

Ceriaco, L. M. P. (2012). Human attitudes towards herpetofauna: The influence of folklore and negative values on the conservation of amphibians and reptiles in Portugal. *Journal of Ethnobiology and Ethnomedicine, 8*. doi:10.1186/1746-4269-8-8

Collins, J. P., & Storfer, A. (2003). Global amphibian declines: sorting the hypotheses. *Diversity and Distributions, 9*(2), 89-98. doi:10.1046/j.1472-4642.2003.00012.x

Cosentino, B. J., Marsh, D. M., Jones, K. S., Apodaca, J. J., Bates, C., Beach, J., . . . Willey, A. (2014). Citizen science reveals widespread negative effects of roads on amphibian distributions. *Biological Conservation, 180*, 31-38. doi:10.1016/j.biocon.2014.09.027

Cushman, S. A. (2006). Effects of habitat loss and fragmentation on amphibians: A review and prospectus. *Biological Conservation, 128*(2), 231-240. doi:10.1016/j.biocon.2005.09.031

Dillon, J. (2012). Science, the environment and education beyond the classroom. In *Second international handbook of science education* (pp. 1081-1095). Springer Netherlands.

Ferreira, M., & Beja, P. (2013). Mediterranean amphibians and the loss of temporary ponds: Are there alternative breeding habitats? *Biological Conservation, 165*, 179-186. doi:10.1016/j.biocon.2013.05.029

Genovart, M., Tavecchia, G., Ensenat, J. J., & Laiolo, P. (2013). Holding up a mirror to the society: Children recognize exotic species much more than local ones. *Biological Conservation, 159*, 484-489. doi:10.1016/j.biocon.2012.10.028

Griffiths, R. A., & Pavajeau, L. (2008). Captive breeding, reintroduction, and the conservation of amphibians. *Conservation Biology*, *22*(4), 852-861. doi:10.1111/j.1523-1739.2008.00967.x

Heberlein, T. A. (2012). *Navigating environmental attitudes*. Oxford University Press.

Holstermann, N., Grube, D., & Bogeholz, S. (2009). The influence of emotion on students' performance in dissection exercises. *Journal of Biological Education, 43*(4), 164-168. doi:10.1080/00219266.2009.9656177

Holstermann, N., Ainley, M., Grube, D., Roick, T., & Bogeholz, S. (2012). The specific relationship between disgust and interest: Relevance during biology class dissections and gender differences. *Learning and Instruction, 22*(3), 185-192. doi:10.1016/j.learninstruc.2011.10.005

Hussain, Q.A., and Pandit, A.K. (2012). Global amphibian declines: A review. *International Journal of Biodiversity and Conservation, 4*(10), 348–357. doi:10.5897/IJBC12.008

IUCN 2016. The IUCN Red List of Threatened Species. Version 2016-2. <http://www.iucnredlist.org>. Downloaded on 09 October 2016.

Jensen, J. B., and C. D. Camp. 2003. Human exploitation of amphibians: direct and indirect impacts. In Amphibian Conservation, edited by R. D. Semlitsch. Washington, D.C.: Smithsonian Books. pp. 199-213.

Jimenez, J. N., & Lindemann-Matthies, P. (2015a). Public Knowledge and Perception of Toads and Frogs in Three Areas of Subtropical Southeast China. *Society & Animals, 23*(2), 166-192. doi:10.1163/15685306-12341368

Jimenez, J. N., & Lindemann-Matthies, P. (2015b). Public Knowledge of, and Attitudes to, Frogs in Colombia. *Anthrozoös, 28*(2), 319-332. doi:10.2752/089279315x14219211661976

Kalnicky, E. A., Brunson, M. W., & Beard, K. H. (2014). A social-ecological systems approach to non-native species: Habituation and its effect on management of coqui frogs in Hawaii. *Biological Conservation, 180*, 187-195. doi:10.1016/j.biocon.2014.09.044

Kellert, S. R. (1985). Attitudes toward animals: age-related development among children. *Journal of Environmental Education, 16*(3), 29-39.

Killermann, W. (1996). Biology education in Germany: Research into the effectiveness of different teaching methods. *International Journal of Science Education, 18*(3), 333-346.

Klingenberg, K. (2014). 'Primarerfahrung' with living animals in contrast to educational videos: a comparative intervention study. *Journal of Biological Education, 48*(2), 105-112. doi:10.1080/00219266.2013.849285

Klokočovnik, V., Šorgo, A., and Devetak, D. (2016). Hands-on Experiments on Predatory Behaviour with Antlion Larvae. *Journal of Biological Education, 50*(4), 384-394. doi:10.1080/00219266.2015.1117513

Kos, M. (2009). Poznavanje dvoživk v 3. triadi devetletke: undergraduate thesis. Maribor, 102 p. Available at: http://dkum.uni-mb.si/Dokument.php?id=8088.

Lalley, J. P., Piotrowski, P. S., Battaglia, B., Brophy, K., & Chugh, K. (2010). A comparison of V-Frog[C] to physical frog dissection. *International Journal of Environmental and Science Education*, *5*(2), 189-200.

Leech, N. L., Barrett, K. C., Morgan, G. A. (2005). SPSS for Intermediate Statistics: Use and Interpretation. 2. ed. Mahwah: NJ, Lawrence Erlbaum Associates.

Leeming, F. C., Dwyer, W. O., & Bracken, B. A. (1995). Children's Environmental Attitude and Knowledge Scale: Construction and Validation. *Journal of Environmental Education, 26*(3), 22. doi:10.1080/00958964.1995.9941442

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. doi:10.1080/09500690500038116

Lukas, K. E., & Ross, S. R. (2005). Zoo Visitor Knowledge and Attitudes toward Gorillas and Chimpanzees. *Journal of Environmental Education, 36*(4), 33-48.

Majić, A., & Bath, A. J. (2010). Changes in attitudes toward wolves in Croatia. *Biological Conservation, 143*(1), 255-260. doi:10.1016/j.biocon.2009.09.010

Neal, P., & Palmer, J. (2003). *The handbook of environmental education*. Routledge.

Perry-Hill, R., Smith, J. W., Reimer, A., Mase, A. S., Mullendore, N., Mulvaney, K. K., & Prokopy, L. S. (2014). The influence of basic beliefs and object-specific attitudes on behavioural intentions towards a rare and little-known amphibian. *Wildlife Research, 41*(4), 287-299. doi:10.1071/wr13218

Pezdirc, M., Heath, E., Mali, L. B., & Bulog, B. (2011). PCB accumulation and tissue distribution in cave salamander (*Proteus anguinus anguinus*, Amphibia, Urodela) in the polluted karstic hinterland of the Krupa River, Slovenia. *Chemosphere, 84*(7), 987-993. doi:10.1016/j.chemosphere.2011.05.026

Prokop, P., Tuncer, G., Chudá, J. (2007). Slovakian students' attitude toward biology. *Eurasia Journal of Mathematics, Science & Technology Education*, *3*(4), 287-295.

Prokop, P., & Tunnicliffe, S. D. (2008). "Disgusting" Animals: Primary School Children's Attitudes and Myths of Bats and Spiders. *EURASIA Journal of Mathematics, Science & Technology Education, 4*(2), 87-97.

Prokop, P., Ozel, M., & Usak, M. (2009). Cross-Cultural Comparison of Student Attitudes toward Snakes. *Society & Animals, 17*(3), 224-240. doi:10.1163/156853009x445398

Prokop, P., & Tunnicliffe, S. D. (2010). Effects of Having Pets at Home on Children's Attitudes toward Popular and Unpopular Animals. *Anthrozoös, 23*(1), 21-35. doi:10.2752/175303710x12627079939107

Prokop, P., Usak, M., & Erdogan, M. (2011). Good predators in bad stories: cross-cultural comparison of children's attitudes towards wolves. *Journal of Baltic Science Education, 10*(4), 229-242.

Prokop, P., & Fančovičová, J. (2012). Tolerance of Amphibians in Slovakian People: A Comparison of Pond Owners and Non-Owners. *Anthrozoös, 25*(3), 277-288. doi:10.2752/175303712x13403555186136

Randler, C., & Bogner, F. (2002). Comparing Methods of Instruction Using Bird Species Identification Skills as Indicators. *Journal of Biological Education, 36*(4), 181.

Randler, C., & Bogner, F. X. (2006). Cognitive achievements in identification skills. *Journal of Biological Education, 40*(4), 161-165. doi:10.1080/00219266.2006.9656038

Randler, C., & Bogner, F. X. (2009). Efficacy of two different instructional methods involving complex ecological content. *International Journal of Science and Mathematics Education, 7*(2), 315-337. doi:10.1007/s10763-007-9117-4

Randler, C., Ilg, A., & Kern, J. (2005). Cognitive and Emotional Evaluation of an Amphibian Conservation Program for Elementary School Students. *Journal of Environmental Education, 37*(1), 43-52. doi:10.3200/JOEE.37.1.43-52

Randler, C., Hummel, E., & Prokop, P. (2012a). Practical Work at School Reduces Disgust and Fear of Unpopular Animals. *Society & Animals, 20*(1), 61-74. doi:10.1163/156853012x614369

Randler, C., Wuest-Ackermann, P., Vollmer, C., & Hummel, E. (2012b). The relationship between disgust, state-anxiety and motivation during a dissection task. *Learning and Individual Differences, 22*(3), 419-424. doi:10.1016/j.lindif.2012.01.005

Ratcliffe, M., & Grace, M. (2003). *Science education for citizenship: teaching socio-scientific issues*. McGraw-Hill Education (UK).

Reimer, A., Mase, A., Mulvaney, K., Mullendore, N., Perry-Hill, R., & Prokopy, L. (2014). The impact of information and familiarity on public attitudes toward the eastern hellbender. *Animal Conservation, 17*(3), 235-243. doi:10.1111/acv.12085

Schlegel, J., & Rupf, R. (2010). Attitudes towards potential animal flagship species in nature conservation: A survey among students of different educational institutions. *Journal for Nature Conservation, 18*, 278-290. doi:10.1016/j.jnc.2009.12.002

SPSS Inc. (2006). SPSS for Windows, release 15.0.0. Chicago, IL: SPSS Inc.

Stuart, S. N., Chanson, J. S., Cox, N. A., Young, B. E., Rodrigues, A. S. L., Fischman, D. L., & Waller, R. W. (2004). Status and trends of amphibian declines and extinctions worldwide. *Science, 306*(5702), 1783-1786. doi:10.1126/science.1103538

Šorgo, A., & Kamenšek, A. (2012). Implementation of a curriculum for environmental education as education for sustainable development in Slovenian upper secondary schools. *Ener Educ Sci Tech-B*, *4*, 1067-1076.

Špur, N., Pokorny, B., & Šorgo, A. (2016). Attitudes toward and Acceptability of Management Strategies for a Population of Hooded Crows (Corvus cornix) in Slovenia. *Anthrozoös*, *29*(4), 669-682.

Thompson, T. L. & Mintzes, J. J. (2002). Cognitive structure and the affective domain: on knowing and feeling in biology. *International Journal of Science Education, 24*(6), 645-660. doi:10.1080/09500690110110115

Tomažič, I. (2008). The influence of direct experience on students' attitudes to, and knowledge about amphibians. *Acta Biologica Slovenica*, *51*(1), 39-49.

Tomažič, I. (2011a). Reported Experiences Enhance Favourable Attitudes toward Toads. *EURASIA Journal of Mathematics, Science & Technology Education, 7*(4), 253-262.

Tomažič, I. (2011b). Pre-Service Biology Teachers' and Primary School Students' Attitudes toward and Knowledge about Snakes. *EURASIA Journal of Mathematics, Science & Technology Education, 7*(3), 161-171.

Tomažič, I. (2011c). Seventh Graders' Direct Experience with, and Feelings toward, Amphibians and Some Other Nonhuman Animals. *Society & Animals, 19*(3), 225-247. doi:10.1163/156853011x578901

Trombulak, S. C., Omland, K. S., Robinson, J. A., Lusk, J. J., Fleischner, T. L., Brown, G., & Domroese, M. (2004). Principles of conservation biology: Recommended guidelines for conservation literacy from the Education Committee of the Society for Conservation Biology. *Conservation Biology, 18*(5), 1180-1190. doi:10.1111/j.1523-1739.2004.01851.x

Uradni list RS, št. 82/2002. Pravilnik o uvrstitvi ogroženih rastlinskih in živalskih vrst v rdeči seznam. Available at: http://www.uradni-list.si/ (3.10.2016).

Vavdi, M., & Šorgo, A. (2015). Izvajanje kurikula okoljske vzgoje kot vzgoje in izobraževanja za trajnostni razvoj v zadnjem triletju osnovne šole. [Implementation of a curriculum for environmental education as education for sustainable development in Slovenian lower secondary schools]. *Vzgoja in izobraževanje*, *46*(6), 20-28.

Vredenburg, V. T. (2004). Reversing introduced species effects: Experimental removal of introduced fish leads to rapid recovery of a declining frog. *Proceedings of the National Academy of Sciences of the United States of America, 101*(20), 7646-7650. doi:10.1073/pnas.0402321101

Yen, C.-F., Yao, T.-W., & Chiu, Y.-C. (2004). Alternative Conceptions in Animal Classification Focusing on Amphibians and Reptiles: A Cross-Age Study. *International Journal of Science and Mathematics Education, 2*(2), 159-174.

Yore, L. B., & Boyer, S. (1997). College students' attitudes towards living organisms: The influence of experience & knowledge. *American Biology Teacher, 59*(9), 558-563.

Young BE, Stuart SN, Chanson JS, Cox NA, Boucher TM (2004). Disappearing Jewels: The Status of New World Amphibians. NatureServe, Arlington, Virginia.