Eurasia Journal of Mathematics, Science & Technology Education, 2012, **8**(3), 257-267

The Impact of a Short Conservation Education Workshop on Argentinean Students' Knowledge about and Attitudes towards Species

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Received 23 April 2012; accepted 1 August 2012

This study investigated the impact of a one-day conservation education workshop on knowledge about and attitudes towards species of 88 students from Valle Fértil, Argentina. Immediately before and after the workshop and one year later, students (aged 12 to 16) had to identify native and introduced exotic plant and animal species as well as artificial ones ("Simpsons") on flashcards, to point out those "species" they considered most beautiful and useful, and to name adaptations of local species to arid conditions. Immediately after the workshop, students strongly increased their knowledge about plants and adaptations. One year later, this was still the case for those plant species students had been already somewhat familiar with in the pretest. The workshop hardly changed attitudes.

Keywords: conservation education, exotic species, native species, pretest, posttest, students, workshop

INTRODUCTION

Human alterations of the environment have resulted in the loss of biodiversity on a global scale (Millennium Ecosystem Assessment, 2003). Important determinants of changes in biodiversity are changes in land use, atmospheric CO2 concentration, nitrogen deposition and acid rain, climate change, and the deliberate or accidental introduction of plants and animals to ecosystems (Sala et al., 2000). In arid and semi-arid biomes of Argentina, biodiversity is especially threatened by rapid habitat conversion due to overgrazing by goats, sheep and cattle, clear cutting for fuel, uncontrolled hunting, and the introduction of exotic species (Ojeda, Campos, Gonnet, Borghi, & Roig, 1998). For the conservation of local biodiversity, proactive measures such as the establishment of ecological reserves, the restoration of ecosystems and the control of exotic species are thus required, but also the dissemination of public information and education about native organisms, their ecological importance and the consequences of species introductions (Colton & Alpert, 1998; Trombulak et al., 2004). Conservation education programs are strongly needed, especially in parts of the world such as Latin America where ecology and environmental education is still not sufficiently implemented in official school curricula (González-Gaudiano, 2007; Borgerhoff Mulder, Schacht, Carob, Schacht, & Caro, 2009). Recently, conservation education programs have been launched in Latin America that aim to sensitize schoolchildren for the conservation and sustainable management of local species and their diversity (Rozzi, Silander, Armesto, Feinsinger, & Massardo, 2000; Ruiz-Mallen, Barranza, Bodenhorn, & Reyes-García, 2009; Borgerhoff Mulder et al., 2009). They are often supported by international organizations and foundations such as the WWF or

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ISSN: 1305-8223

State of the literature

- Effective conservation education programs are vital in key areas such as Latin America as they are a tool for environmental conservation and a way to protect and value biodiversity.
- The implementation of conservation education programs is relatively new in Latin America and respective programs often consist of only short interventions. Moreover, little is known about the outcomes of such programs. In order to tailor conservation education programs effectively, such knowledge is invaluable, especially in countries where conservation curricula are still being developed.

Contribution of this paper to the literature

- A single short intervention (one-day workshop) can be effective both in the short and the long term, but only if the information provided is simple and already somewhat familiar to students.
- The additional knowledge did not influence the way students value or perceive nature and its elements.
- There is a need for structured State driven conservation education programs in Latin America. Conservation organizations might enhance the dissemination of their messages by making more frequent visits to schools and, at the same time, reduce the passive dissemination of cognitive information about species and ecological concepts.

UNESCO (Ruiz-Mallen et al., 2009). However, little is known about the outcomes of such programs. In order to tailor conservation education programs effectively, such knowledge is invaluable, especially in countries where conservation curricula are still being developed. School visits of conservation organizations are often short (a single one-day visit per school or class) and costly (especially for developing countries), and the question arises whether they will actually influence biodiversity knowledge and attitudes. A recent study from Guyana has shown that such visits hardly affect students' environmental attitudes (Borgerhoff Mulder et al., 2009). However, other studies have shown that activities such as a single field trip or a short visit to an informal learning setting can successfully promote cognitive learning, even in the long term (Falk & Balling, 1982; Bitgood, 1989; Lindemann-Matthies & Kamer, 2006).

The present study was closely linked to the conservation education program "Awareness of local biodiversity in the Ischigualasto Provincial Park", San Juan region, Argentina. The program was carried out by the National University of San Juan in collaboration with rangers from the park. As part of the program, one-day workshops for schools in the area of Valle Fértil were developed and carried out by a group of ecologists from the University of San Juan. Moreover, booklets, posters and educational CDs about local wild species, exotic ones and the consequences of species introductions were designed by the researchers and given to all schools in the area . This was important as hardly any educational material about local wild species and the ecology of the region exists.

The workshops took place in the schoolyards or near vicinity of the schools, i.e. familiar learning settings in which students feel comfortable and are not distracted from learning by too much novelty of the location (Anderson & Lucas, 1997; Falk & Dierking, 2000). Each workshop had the same course schedule and content. However, the lecturers were not always the same (always two per workshop; eight overall). The workshops were divided in two parts. In the first part, students were introduced to native and exotic plant and animal species with the help of species expositions, environmental games and species identification tasks. The latter two activities allowed students to move around and actively and playfully learn about species. In the second part, students were introduced to local conservation problems such as uncontrolled logging or hunting, overgrazing, and consequences of the introduction of exotic species. Special importance was placed on the demonstration of how well local wild plant and animal species, in contrast to introduced exotic ones, are adapted to the scarce resources of Valle Fértil and thus contribute to ecosystem functioning. This part of the workshop was mainly done in a lecturer-centered way.

Potential effects of the workshops on students' knowledge about and attitudes towards species were investigated in a controlled pretest/posttest-design. Students were asked to fill-in a questionnaire immediately before and after the workshops and one year later (all schools were visited again). Due to a strong need for conservation education, all schools in the region of Valle Fértil participated in the workshops. It was thus not possible to include an untreated control group in our study. We are aware that without such a control group, at least after a year, changes in knowledge and attitudes might not only be due to the workshops, and acknowledge this as a weakness of our research. The main questions explored in this study were:

- *How many and which species (native and non-native ones shown as photos) can students correctly identify? Can they identify species that occur in Valle Fértil?*
- *Do students know more about artificial ("the Simpsons") than real species, and more about non-native than native ones?*

- *Which of the depicted species do they consider most beautiful and useful?*
- *Which adaptations of plants and animals to the dry conditions of Valle Fértil do they name?*
- *Does a one-day conservation education program influence students' ecological knowledge and attitudes towards species, both in the short and long term?*
- *Is students' knowledge influenced by their age, gender and source of knowledge about species (family, school), and by the school they visit?*

METHODOLOGY

Study design and data collection

The study was carried out in the vicinity of the Valle Fértil reserve in the province of San Juan, Argentina. This region is characterized by Chaco and Monte vegetation, and by a dry desert climate with an annual precipitation of 250 mm (Cabrera, 1994; Pereyra, 2000). The population, a mix of indigenous tribes and white settlers, lives mainly from farming. Extensive grazing is typical for the area, and cattle are competing with native herbivores such as guanaco for the scarce resources (Guevara, Cavagnaro, Estevez, Le Houérou, & Stasi, 1996; Ojeda et al., 1998). This leads to overgrazing in some places and, in consequence, to a loss of local wild plant species. Main predator of both cattle and guanaco is the puma which is heavily hunted in the area of the Valle Fértil (Lucherini & Merino, 2008).

In 2008 and 2009, data were collected in three schools in Valle Fértil. Due to the remote location of the area, many schools were hard to access and had only few students. As we had to visit each school three times, we choose the three largest and most accessible ones which, however, were distributed over the region. The students were asked to complete a picture questionnaire before (pretest) and another one immediately after the workshop (posttest 1). To assess long-term effects of the workshop, a second posttest was conducted one year later (posttest 2). In each test, students had to write down their name, class, the name of their teacher, and the name of their school. It was thus possible to match the three questionnaires on the level of each child. Overall, 117 students were addressed and 88 of them (56 girls) answered all three questionnaires. They were between 12 and 16 years old (mean age = 13 years).

The picture questionnaire

With the help of a set of pictures, students were asked to identify 15 objects and to answer certain questions related to them. The pictures showed native plant and animal species typical for the region of Valle Fértil, but also common introduced ones from other parts of Argentina or other countries. In addition, three cartoon figures (from the "Simpson family") were depicted. Their inclusion allowed a comparison between students' knowledge about real and artificial "species" (see Balmford, Clegg, Coulson, & Taylor, 2002; in that study Pokémon figures were used for comparison). The chosen cartoon figures (Bart Simpson, Mr. Burns, Krusty) are very popular among children and adolescents in the region of Valle Fértil. The chosen plant and animal species are common in the region of Valle Fértil and were selected due to the following criteria:

- *Introduced exotic animal species which are strong competitors for local wild ones or contribute to overgrazing and biodiversity reduction in the region: hare (Lepus europaeus), donkey (Equus asinus), cow (Bos taurus).*
- *Native, endangered animal species which local people regard as competitors or predators for livestock and which, in consequence, are heavily hunted: puma (Puma concolor), guanaco (Lama guanicoe), condor (Vultur gryphus).*
- *Introduced exotic plant species common throughout Argentina which cause ecosystem changes and are strong competitors for local plant species: Eucalyptus (Eucalyptus spec.), Peruvian pepper tree (Schinus molle), tamarisk (Tamarix gallica).*
- *Native, endangered plant species which are vulnerable to ecosystem changes and also (over)used by people of the region: mesquite (Prosopis flexuosa), chica (Ramorinoa girolae), retamo (Bulnesia retama).*

Great care was placed on the selection of suitable pictures (preferably digital photographs). All pictures were of good quality and taken under similar light conditions. They depicted just a single plant or animal with its typical characteristics in close-up. A letter of the alphabet was attached to each picture, the picture printed on photographic paper and the print fixed on a piece of pressboard (15 x 15 cm). At the end of the study, a set of pictures was left in each of the participating schools for further use.

To investigate knowledge about real and artificial "species" (questions 1 and 2), students were asked to name each object shown to them, and to indicate species that occur in Valle Fértil. To investigate students' attitudes, they were asked to point out each three "species" they considered most beautiful and useful (question 3). Moreover, students were asked to write down five adaptations of plants and five of animals to the dry conditions of Valle Fértil (question 4). We asked for beauty as knowledge and appreciation of organisms were found to be closely linked (Lindemann-Matthies, 2005). More knowledge about (local) plants and animals due to the workshop might thus change perceptions of attractiveness. Moreover, more information about local species might change perceptions of usefulness, but also ecological knowledge (adaptations).

Table 1. Knowledge of organisms prior to the workshop

Categories and objects	Responses (%)	
	Correctly identified	Present in Valle Fértil
Non-native animals common in Argentina		
Donkey (Equus asinus)	100.0	94.3
Cow (Bos taurus)	98.9	96.6
Hare (Lepus europaeus)	94.3	94.3
Native wild animals common in Valle Fértil		
Guanaco (Lama guanicoe)	98.9	88.6
Puma (Puma concolor)	96.6	92.0
Condor (Vultur gryphus)	84.1	85.2
Non-native plants common in Argentina		
Eucalyptus (Eucalyptus spec.)	94.3	97.7
Peruvian pepper tree (Schinus molle)	86.4	81.8
Tamarisk (Tamarix gallica)	5.7	62.5
Native wild plants common in Valle Fértil		
Mesquite (Prosopis flexuosa)	83.0	89.8
Retamo (Bulnesia retama)	21.6	58.0
Chica (Ramorinoa girolae)	3.4	85.2
Comic figures popular in Argentina		
Bart Simpson	98.9	-
Krusty	97.7	-
Mr. Burns	96.6	-

Note. Proportion of students (n = 88) who could correctly identify the objects depicted and considered them to be present in Valle Fértil

Table 2. Attitudes towards organisms prior to the workshop

Categories and objects	Responses (%)	
	Most beautiful	Most useful
Non-native animals common in Argentina		
Donkey (Equus asinus)	20.0	71.3
Cow (Bos taurus)	17.5	51.3
Hare (Lepus europaeus)	43.8	33.8
Native wild animals common in Valle Fértil		
Guanaco (Lama guanicoe)	37.5	11.3
Puma (Puma concolor)	28.8	15.0
Condor (Vultur gryphus)	8.8	5.0
Non-native plants common in Argentina		
Eucalyptus (Eucalyptus spec.)	30.0	17.5
Peruvian pepper tree (Schinus molle)	11.3	18.8
Tamarisk (Tamarix gallica)	21.3	6.3
Native wild plants common in Valle Fértil		
Mesquite (Prosopis flexuosa)	26.3	41.3
Retamo (Bulnesia retama)	10.0	0.0
Chica (Ramorinoa girolae)	12.5	17.5
Comic figures popular in Argentina		
Bart Simpson	8.8	2.5
Krusty	2.5	0.0
Mr. Burns	3.8	0.0

***Note**. Students (n = 88) were shown 15 objects on flashcards and asked to point out each three they thought most beautiful and useful. Some students pointed out less than three objects.*

To investigate the effect of the workshops (question 5), students had to repeat all tasks (see above) immediately after the workshop and one year later. In addition (question 6), all students were asked about their age, sex and main source of taxonomic knowledge (teacher, family, friends, others). Such socio-demographic characteristics were found influential on children's knowledge about species in other studies (e.g. Balmford et al., 2002; Lindemann-Matthies, 2005; Nates, Campos, & Lindemann-Matthies, 2010).

We discussed both study design and questionnaire with the workshop leaders (all conservation experts from the National University of San Juan, Argentina). The picture questionnaire was then pilot tested with 12 children from the city of San Juan. They were asked to comment on the questions and the quality of the pictures. Slight adaptations had to be made, i.e. additional close-up pictures of typical plant characteristics such as leaves, fruits and flowers were added to the images. To thank students and their teachers for participation, a set of picture cards for further use was finally left in each of the participating schools.

Data analysis

To identify possible predictors for students' knowledge about species (number of plant and animal species correctly named) and adaptations (number of plant and animal adaptations correctly named), data were analyzed with general linear models in which the effect of each variable or factor was, as in multiple regressions, adjusted for the effects of all other variables and factors in the model (i.e. type II sums of squares). The final minimum adequate models were then obtained by backward elimination of non-significant ($p > 0.05$) variables (Crawley, 2005). As this type of analysis does not allow strong correlations between the explanatory variables or factors, Pearson correlations were tested first. Only variables with $r < 0.350$ were included in the models (Crawley, 2005).

Initially, age (as variable) and school, sex and source of knowledge about species (teacher and family; the other answer option were not used) as factors were included in the models. To test for influences on students' increase in knowledge due to the workshop, their previous knowledge (as measured in the pretest) was additionally included as a variable in the models.

Chi-square tests were used to analyse differences in knowledge and attitudes between pretest and posttest 1 and between pretest and posttest 2. All analyses were carried out with SPSS for Windows 12.0.1.

RESULTS

Knowledge and perception of species prior to the workshop

Prior to the workshop, non-native animal species and cartoon figures were most often and native wild plant species least often correctly named by the students (Table 1). Only the native mesquite (*Prosopis flexuosa*) was rather well known. However, more than half of the students felt that the native wild plants shown to them actually occurred in Valle Fértil. Especially the native legume *Ramorinoa girolae* seemed to be quite familiar to the students, although they could not name it. Among the native wild animal species, the condor was least well known (or named incorrectly). Members of the "Simpsons" were better known than the condor and better known than almost all of the plants presented (see Table 1). Overall, students could correctly name 8.7 ± 0.10 species prior to the workshop (5.7 ± 0.06 animals and 2.9 ± 0.09 plants, respectively). In the model, none of the tested predictors influenced students' knowledge about species in the pretest.

Attitudes towards species prior to the workshop

The introduced hare and the native guanaco were most often, and the native condor least often selected as beautiful species (Table 2). The introduced eucalyptus tree was also quite often chosen - even more often than the native puma. Although well known to the students, the three cartoon figures were least often chosen as beautiful.

With the exception of the native mesquite plant, non-native animals were clearly most often considered as useful (see Table 2).

Knowledge about adaptations prior to the workshop

In the pretest, 28% of the students were unable to name at least one adaptation of animals or plants to the dry conditions of Valle Fértil, and none of the students could name five animal and five plant adaptations as requested. The ability of animals to hunt desert prey which is often hidden or poisonous and the modification of leaves were mentioned most often (Table 3).

In the model ($R2 = 0.26$), the number of adaptations that students could name correctly was influenced by their source of knowledge about organisms ($F1,84 = 7.19$, $p = 0.009$; family: mean 3.3 ± 0.33 and teacher: mean 1.6 ± 0.21, respectively) and by school ($F2,84 = 12.52$, $p < 0.001$). The number of adaptations students could name correctly was not correlated to their knowledge about species ($p = 0.306$).

Effect of the workshop on students' knowledge

Immediately after the workshop (posttest 1), significantly more students could correctly identify the three local wild plant species presented to them, but also the introduced tamarisk (Tamarix gallica; Figure 1). One year later (posttest 2), this was still the case for retamo (Bulnesia retama) and mesquite (*Prosopis flexuosa*). However, students' knowledge about chica (*Ramorinoa girolae*) was completely eroded (see Figure 1).

The intervention had only a small effect on the identification of animals as most of them were already well known in the pretest (see Figure 1). However, after one year both hare (Lepus europaeus) and condor (Vultur gryphus) were less often correctly named. The hare was confused with the rabbit, and the condor with other vultures and the eagle.

On average, students could identify 10.2 ± 0.20 species directly after the workshop (5.7 ± 0.06 animals and 4.5 ± 0.07 plants, respectively). One year later (posttest 2), fewer species were identified: 8.4 ± 0.14 (5.3 ± 0.09 animals and 3.1 ± 0.10 plants, respectively).

The number of species that students could recall correctly was only influenced by age. The older the students were, the fewer species they could recall in posttest 2 (= -0.23, F1,86 = 4.60, p = 0.035).

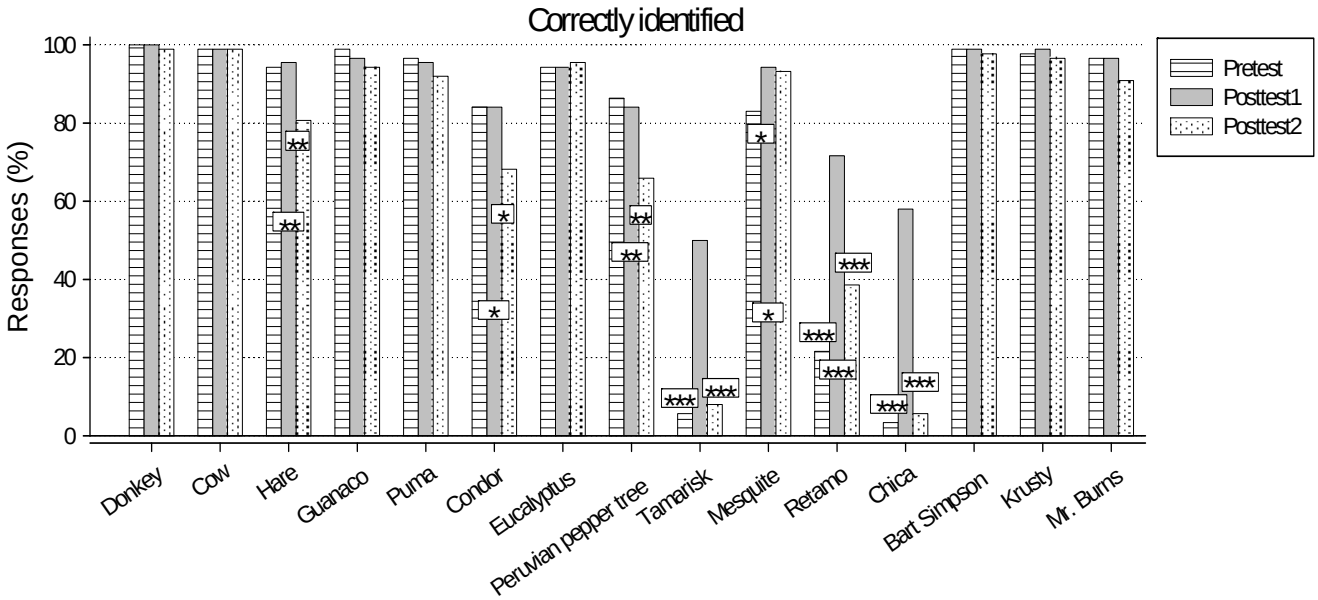

Figure 1. Effect of workshop on knowledge. Short-term and long-term effects of the one-day workshop on students' (n = 88) knowledge of animals and plants as well as cartoon figures. Pretest immediately before, posttest 1 immediately after, and posttest 2 one year after the workshop. Chi-square tests were carried out to test for differences in knowledge between pretest and posttest 1, posttest 1 and posttest 2, and pretest and posttest 2. *: $P < 0.05$; ** $P < 0.01$; ***: $P < 0.001$

Table 3. Knowledge of adaptations prior to the workshop

(a) Animals		(b) Plants	
Adaptations	**Responses (%)**	**Adaptations**	**Responses (%)**
Ability to hunt desert prey which is hidden or poisonous	17.1	Modification of leaves	38.7
Ability to consume spiky plants such as a cactus	15.9	Ability to store water in special organs	38.6
A life in caves, sand or under stones to avoid high temperatures	13.6	Protracted roots	13.6
Ability to store / keep water in body	11.3	Slow growth	8.0
Ability to migrate for food and water during dry season	8.0	No idea	44.3
Nocturnal activity	7.9		
No idea	46.6		

Note. Students (n = 88) were asked to name adaptations of (a) animals and (b) plants to the dry conditions of Valle Fértil. Multiple answers were possible. The answers were sorted into broad categories.

Effect of the workshop on students' attitudes

The intervention had only a small effect on students' attitudes towards organisms. Immediately after the workshop (posttest 1), the condor was chosen more often as beautiful (Figure 2a, compare Table 2). However, one year later students' choices of beautiful organisms were not significantly different from those of the pretest.

Immediately after the workshop and still one year later, significantly more students selected the native retamo (Bulnesia retama) as useful (Figure 2b). Immediately after the workshop, the introduced exotic eucalyptus (Eucalyptus spec.) was also more often selected as useful.

Figure 2. Effect of workshop on attitudes. Short-term and long-term effects of the workshop on students' (n = 88) attitudes about animals, plants and cartoon figures. Pretest immediately before, posttest 1 immediately after, and posttest 2 one year after the workshop. Chi-square tests were carried out to test for differences in attitudes between pretest and posttest 1, posttest 1 and posttest 2, and pretest and posttest 2. *: P < 0.05

Effect of the workshop on students' knowledge about adaptations

Immediately after the workshop, more students could name at least one adaptation of animals or plants

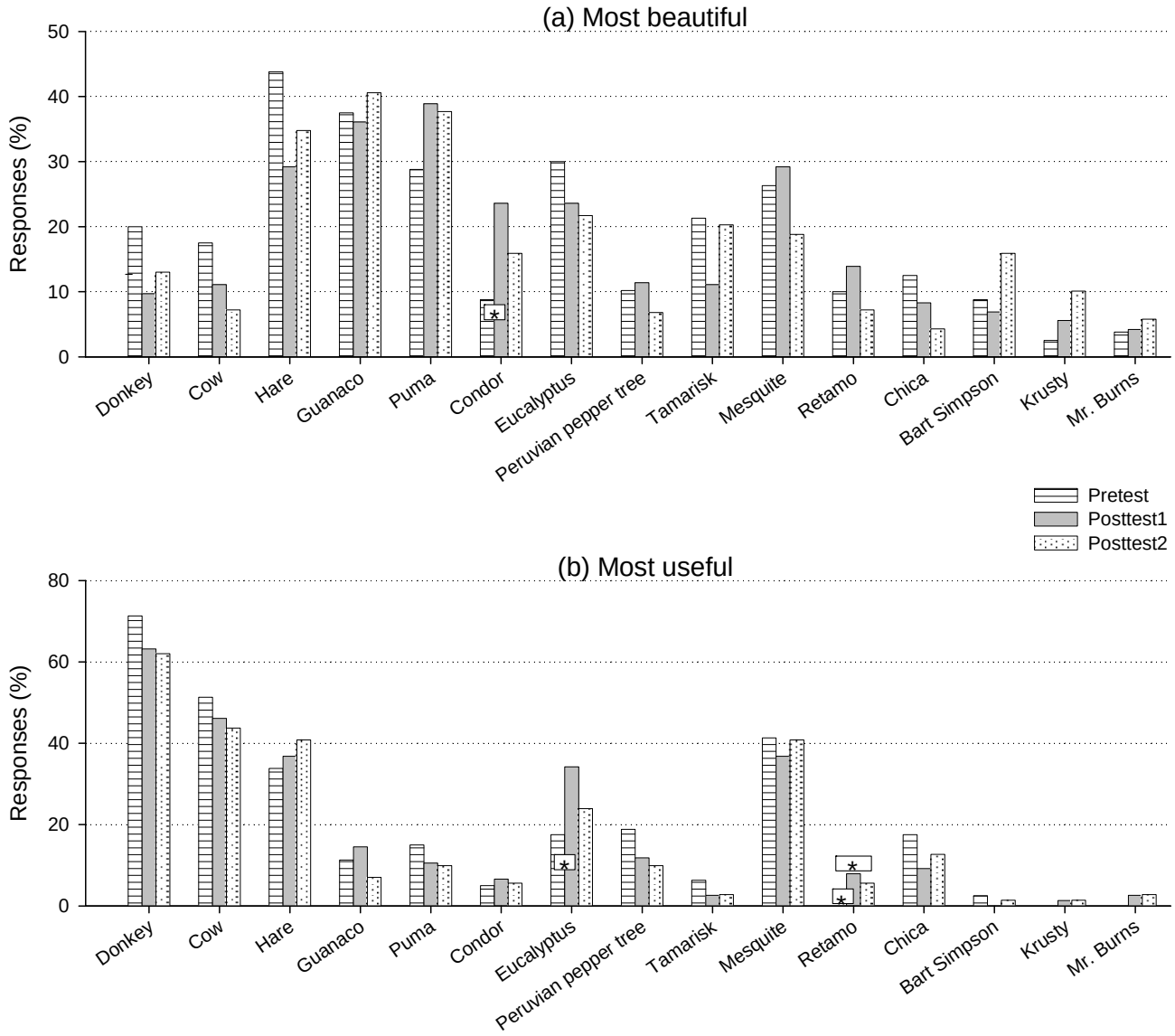

Figure 2. Effect of workshop on attitudes. Short-term and long-term effects of the workshop on students' (n = 88) attitudes about animals, plants and cartoon figures. Pretest immediately before, posttest 1 immediately after, and posttest 2 one year after the workshop. Chi-square tests were carried out to test for differences in attitudes between pretest and posttest 1, posttest 1 and posttest 2, and pretest and posttest 2. *: *P* < 0.05

to the dry conditions of Valle Fértil (Figure 3). Some students could even name the requested number of animal or plant adaptations (five each). Nevertheless, the adaptations mentioned were basically the same as in the pretest (see Table 3). The increase of knowledge (at least one adaptation mentioned) from pretest to posttest 1 was significant for plants ($p = 0.028$). One year later, such knowledge gains were no longer detectable. Students named even less adaptations than in the pretest. This decrease in knowledge was significant for animal adaptations ($p = 0.006$).

On average, students could name 2.4 ± 0.24 adaptations directly after the workshop (1.0 ± 0.12 for animals and 1.4 ± 0.14 for plants, respectively). One year later (posttest 2), even fewer adaptations than in the pretest were named: 1.3 ± 0.18 (0.5 ± 0.09 for animals and 0.8 ± 0.11 for plants, respectively).

The number of adaptations that students could name in posttest 1 and posttest 2 were only influenced by their previous knowledge. The more adaptations students already knew, the more could they write down directly after the workshop (= 0.42, $F_{1,86} = 17.97$, $p < 0.001$) and one year later (= 0.46, $F_{1,86} = 23.35$, $p < 0.001$).

DISCUSSION

In the pretest, non-native domestic animals (donkey and cow) and cartoon figures were most often, and local wild plant species least often correctly identified by the study participants. The "Simpsons" were better known than the condor, and clearly better known than most of the plant species depicted. However, all animals and half of the plants were correctly identified by at least 75% of the students. Our results are both in line and in contrast with those of a comparable study from England. In this study, common local wild plant and animal species, but also "species" of Pokémon were shown on flashcards to four- to eleven-year old students (Balmford et al., 2002). As in our study, artificial "species" were well-known to the British students; about 80% of the Pokémon figures were correctly named. However, in contrast to our study, less than 50% of the local wild organisms could be identified. The rather good knowledge of students in Valle Fértil supports the notion that with decreasing developmental status of a country and decreasing household income people's knowledge about organisms increases (Chipeniuk, 1995; Chand & Shulka, 2003; Pilgrim, Cullen, Smith, & Pretty, 2007).

Two native organisms, the guanaco (Lama guanicoe) and the mesquite (*Prosopis flexuosa*), were frequently pointed out as most beautiful. If it is true that children want to conserve most what they like best (Ashworth, Boyes, Paton, & Stanisstreet, 1995), this is a pleasing result for conservation. Both species are sensitive to ecosystem changes and, in consequence, threatened in Valle Fértil (Ojeda et al., 1998; Vilela et al., 2009). However, two exotic organisms, the fast growing eucalyptus and the introduced hare (Lepus europaeus), were even more often pointed out as most beautiful. Commercial plantations of eucalyptus, which are common in many parts of Latin America, often replace old-growth forests and other forms of native vegetation, and result in a severe loss of local biodiversity (Rozzi et al., 2000; Smith-Ramirez, 2004). Hares can be competitors for native animals such as the southern vizcacha (Lagidium viscacia; Galende & Raffaele, 2008). Donkey (Equus asinus) and cow (Bos taurus) were pointed out as the most useful organisms in Valle Fértil. However, both are introduced exotic species which are strong competitors for local grazers and cause overgrazing and biodiversity reduction in the region

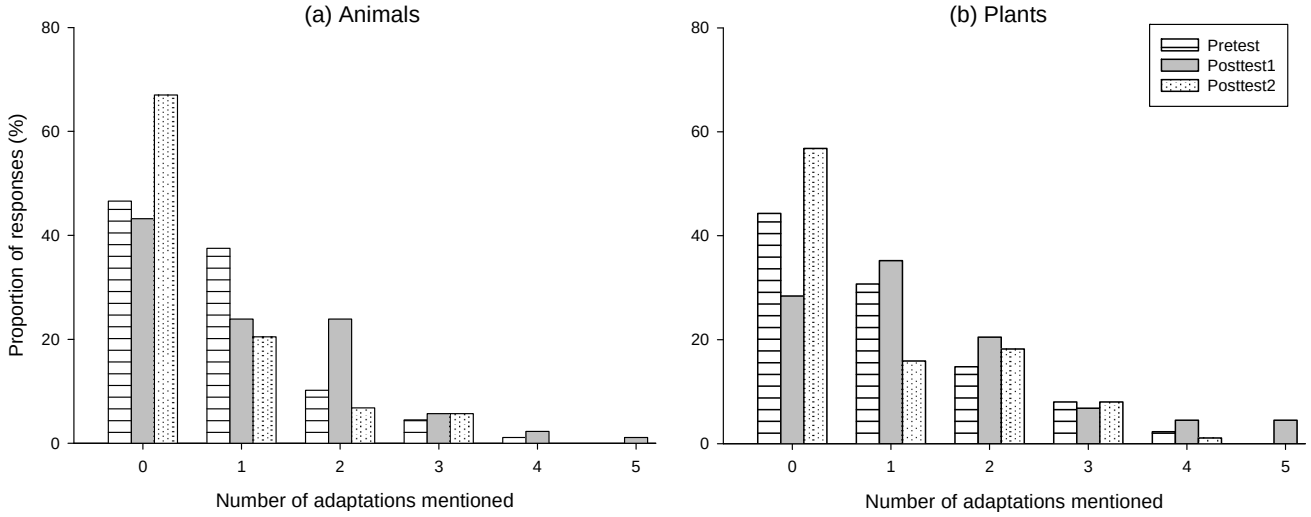

Figure 3. Effect of workshop on number of correct adaptations mentioned. Short-term and long-term effects of the workshop on students' (n = 88) knowledge about adaptations of (a) animals and (b) plants to the dry conditions of Valle Fértil.

(Guevara et al., 1996; Ojeda et al., 1998; Malo, Acebes, Gianonni, & Traba, 2011). The observed positive attitudes towards exotic species due to aesthetics and use demonstrate the necessity of local conservation education programs.

Prior to the workshop, almost half of the students had difficulties to name at least one typical adaptation of plants or animals to the arid conditions of Valle Fértil. Most often, they mentioned the ability of animals to hunt certain desert prey and of plants to store water and reduce transpiration which are indeed typical adaptations of species in the region (Campos & De Pedro, 2001; Campos, Borghi, Gianonni, Ortiz, & Pastrán, 2007). Overall, it was much harder for students in Valle Fértil to name adaptations of species than to describe their uses, as asked in a related study (Nates et al., 2010). This reflects the absence of ecology education in school, but also practical everyday-life experiences with useful organisms.

In the short term, the workshop had a positive effect on students' knowledge about plants. One year later, this was still the case for those species (mesquite and retamo) students had already been somewhat familiar with, i.e. correctly identified them in the pretest. In contrast, students' learning gains about rather unfamiliar species were totally eroded. The mere impression that a species was present in Valle Fértil (e.g. *Ramorinoa girolae*) was not enough to contribute to a better remembrance of its name after a year.

Directly after the workshop, more adaptations of organisms to the dry conditions of Valle Fértil were named, and fewer students could name no adaptation at all. However, one year later students could no longer recall what they had heard during the workshop. As in posttest 1, their already existing knowledge about adaptations influenced their performance. This indicates that the one-day workshop failed to install in students a sense for ecological concepts such as adaptations, although they partly contributed to taxonomic knowledge. The workshop hardly affected attitudes. It did increase the attractiveness of the condor in the short term (maybe because its ecological value was pointed out), but not in the long term. To raise the appraisal of "non-loveable" species such as the condor, more species-specific educational efforts have to be made (see Lindemann-Matthies & Kamer, 2006).

Despite its positive effect on students' knowledge about local wild plants, the conservation workshop was most likely too short to deliver meaningful information to the participants. Repeated exposures might be more successful (Ruiz-Mallen et al., 2009). This is especially important as due to the lack of ecology / environmental education in schools in Latin America, it is likely that no further reinforcement of knowledge takes place in the classroom. In contrast, a one-day field trip was found to have long-lasting positive effects on students' environmental knowledge and attitudes (Knapp & Poff, 2001). The authors related the success of their field trip to the rich variety of actions that had been offered such as catching, looking, searching, chasing, and acting. They argued that these experiences had formed a mental foundation where other concepts and information could be placed and recalled later on. It could thus be that the present conservation program, despite the inclusion of activities which were designed to trigger students' curiosity and hold their attention, was still too passive and interpreter-centered.

CONCLUSIONS

Appreciation relates to familiarity, but also to the utility of species. Especially in farming communities such as in Valle Fértil, animal and plant species are valued because of their usefulness as people are dependent on species production. However, many farm animals are exotic species that compete with local wild organisms for the already scarce resources in the Monte biome. Overgrazing and the loss of local biodiversity are the consequences, and the question arises how education can successfully promote the conservation of native wild species, especially plants, which are less known and appreciated than introduced ones, and also economically less important.

Successful education is only achieved when the gulf between the level of knowledge and understanding a student already has and the messages that conservation programs want to convey is bridged (Falk, 2001; Falk & Adelman, 2003). The present study shows that a single short intervention can be effective both in the short and the long term, but only if the information provided is simple and already somewhat familiar to students. Thus, conservation organizations might enhance the dissemination of their messages by making more frequent visits to schools (Borgerhoff Mulder et al., 2009; Ruiz-Mallen et al., 2009) and, at the same time, reduce the passive dissemination of cognitive information about species and ecological concepts (Knapp & Poff, 2001). However, even more important would be the dissemination of ecology / environmental education in school. In line with Dolins et al. (2010) we argue that nongovernmental organizational efforts are important, but that ecology and, more specific biodiversity education needs to be incorporated in school curricula at all levels.

ACKNOWLEDGMENTS

We like to thank all students and teachers for their collaboration, and Manuel Olivarez and Flavio Cappa for support in the field. We also like to thank the National University of San Juan (Project:"Conociendo para conservar la biodiversidad del Parque Provincial

Ischigualasto (Sitio Patrimonio de la Humanidad) y zona de influencia: propuesta educativa para los docentes y la comunidad del Valle"; project no 0401118) and the Institute and Museum of Natural Sciences, San Juan, for logistic support.

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