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## Monitoring of environmental education program in urban nature reserve "Bosque Autóctono El Espinal"

Monitoreo de un programa de educación ambiental en la reserva natural urbana "Bosque Autóctono El Espinal"

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**Abstract:** The Urban Natural Reserve "Bosque Autóctono El Espinal" has undertaken the design and implementation of an Environmental Education Program destined to the educational community aiming for the re-signification of the Urban Natural Reserves as complementary areas for learning ("open-air classrooms"). The program is based on the elaboration of activities that help to understand the local natural settings and their main environmental problems in a significant, active and committed manner. All these activities were differentiated according to the potential audience by setting different levels for contents, thinking processes, language and technical vocabulary. To monitor the experience, teachers, students and interpreters were subjected to interviews, and information from field work was registered. All these instruments were implemented before, during and after the visits; 141 cases were analyzed. In general, both the informative materials and the collections and samples were not only easy to comprehend but also attractive for the visitors, and the implemented modality particularly favored interaction, dialog and the spontaneous expression among visitors. The activities provided a good opportunity for the discussion of real problems. Moreover, the post-visit productions allowed us to recognize new learnings in the students, who were able to acknowledge distinctive characters of native biodiversity and the important role of the protected areas. We can assure that these areas complement school learning with life experiences, giving new signification to the official curricula for the local and current environmental problems. The results obtained gave rise to recommendations for the methodological adjustment of new experiences.

**Key words:** protected area, no formal education, open-air classrooms, evaluation

**Resumen:** La Reserva Natural Urbana "Bosque Autóctono el Espinal" (Córdoba) se ha abocado al diseño e implementación de un programa de Educación Ambiental destinado a la comunidad educativa regional. La meta de dicho programa es incluir y resignificar estos espacios como ámbitos complementarios para el aprendizaje ("aulas a cielo abierto") mediante del diseño de materiales y actividades para la comprensión significativa, activa y comprometida del medio natural local y de sus principales problemáticas ambientales. Estas actividades se diferenciaron en función de públicos potenciales, con lo cual se delimitaron los niveles de complejidad en cuanto a contenidos, procesos de pensamiento y vocabulario técnico. Se realizó un monitoreo de la experiencia mediante encuestas y entrevistas a docentes, estudiantes e intérpretes, así como registros a campo. Estos instrumentos de recolección de datos fueron implementados antes, durante y después de las visitas. En total se analizaron 141 casos y en términos generales, tanto los materiales informativos como colecciones y muestras resultaron no solo comprensibles, sino también atractivos para los visitantes, mientras que la modalidad implementada favoreció especialmente la interactividad, el diálogo y la expresión espontánea de los visitantes. Asimismo, las actividades ofrecieron espacios para la discusión de problemas reales, al referir a la interacción de diferentes variables del contexto. Además, las producciones post-visita permitieron reconocer nuevos aprendizajes en los estudiantes, quienes lograron dar cuenta de caracteres propios de la biodiversidad nativa y de la importancia de las áreas protegidas. Finalmente, podemos afirmar que estos espacios complementan los aprendizajes escolares con experiencias vivenciales, con ello se resignifican los contenidos de la curricula oficial en torno a problemáticas ambientales locales y actuales.

**Palabras clave:** áreas protegidas, educación no formal, aulas a cielo abierto, evaluación

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## 1. Introduction

It is well known that the green areas play a very important role in education. They show great potential as a resource where to develop environmental study programs or as centers to promote citizen participation. In this way, the green areas have managed to overcome and complement a simply recreational and therapeutic function hosting, frequently, teachers and students that perform in those spaces their research activities or field work. In the last decades, the educational use of the urban green areas has been followed by the proliferation of different resources that can be classified in two major groups: a) static: imperative signs, paths, observation points, thematic gardens, etc., and b) not static: books, folders, games, brochures, etc. (Benayas, Gutiérrez y Gutiérrez, 1999).

However, most of these educational resources have been characterized by only a descriptive style, missing ideas and pedagogic approaches. In general, they are still mainly based on the typical introduction of the different species present in a reference space, and leave out aspects referring to the ecological processes and the most relevant local environmental problems. Furthermore, the content is presented in a way that shows no connection with the scholar programs, and fails to include the problematization of skills, attitudes or behavior of the public they address (Oggero, Natale y Astudillo, 2013).

From these considerations, it is concluded that in order to draw peoples' attention and to bring them to assume the advocated postulates of the protected green spaces, it is urgent to develop new proposals. These should allow, on the one hand, the fulfillment of the public requirements and motivations, by providing a more coherent and adequate message; and on the other, the offer of educational activities that, in addition to contributing to the description and recognition of the forest species, facilitate the development of the information (deduction, interpretation, estimation, evaluation) and its significant reconstruction (inferring, problem solving, and communication) (Andelman, 2003).

Moreover, international assessment on the present state of scientific education (PISA 2011) points out the students' lack of interest and rejection towards the study of the natural sciences, which relates to the recognition of a scholar science that is obsolete, out of context and distant to the local real problems. In addition, a discipline whose orientation is merely centered on the incorporation of conceptual content offers a deformed and impoverished vision of science (Adúriz-Bravo, 2000; Solbes y Vilches, 1997). The challenge is to open to other *cultural knowledge, contextual, historic and ideological, with a higher incidence of the local*. In this sense, the aim is to overcome a scholar heritage that has driven us to interpret

the reality complexity (natural and social) based on arbitrary clippings (physics, chemistry, history, biology, philosophy, mathematics, sociology), building the kind of knowledge that distorts dangerously the dynamics of the facts and phenomena (Leff, 2004; Morin, 2002). Therefore here lies, the importance of extending the classroom limits considering non formal educational settings, and giving rise to more open and real science (Rivarosa and Perales, 2006; Rivarosa, Astudillo and Astudillo, 2012).

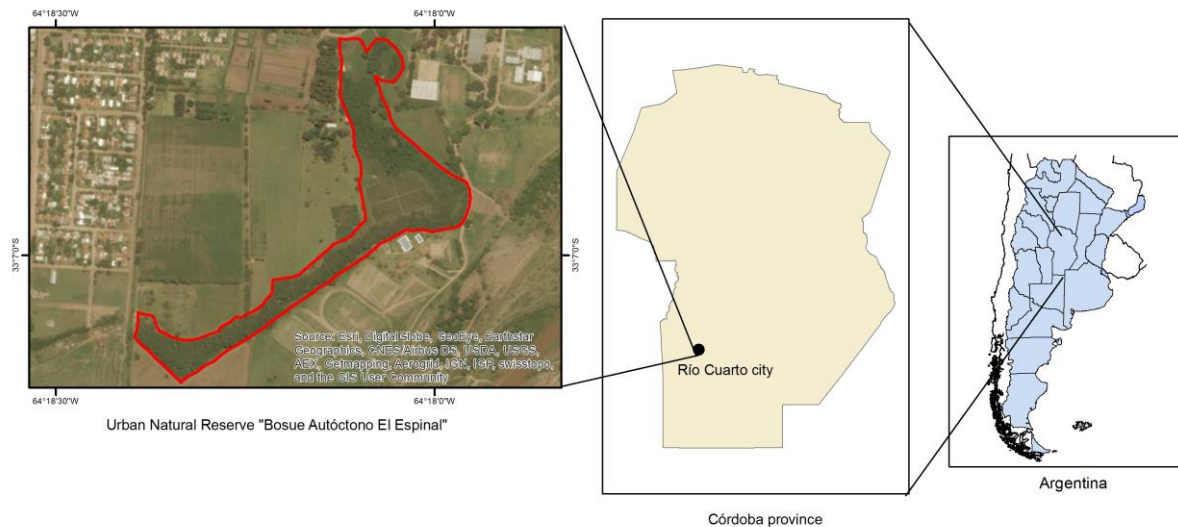
Both arguments led the team of the Natural Reserve "Bosque Autóctono El Espinal" to rethink the reserve educational use and to set up new goals in order to take broader and deeper actions. Thus, a project was designed to strengthen the space of the Reserve as a privileged medium for people to learn about the environmental problem and the importance of conservation, and to raise public awareness on the goods and services provided by natural ecosystems (Kowarik, 2011).

Following a short description of the purpose and characteristics of the designed resources and activities, the implemented monitoring strategy is presented and finally the main results are discussed making useful contributions to the methodological adjustment of new experiences. We strongly believe that documentation and assessment of this kind of educational experiences is important, not only to be able to analyze the results of its implementation but also as a means of disseminating this kind of innovations. In summary, the purpose is to reflect on our own experience addressing its particularities and potentials so that it might inspire new meanings and practices (Suárez, 2007).

## **2. Description of the Environmental Education Program of the Natural Reserve "Bosque Autóctono El Espinal"**

The province of Córdoba (center of Argentina) presents very rich natural vegetation that according to Morrone (2014) is included in the eco-region Espinal (Pampa biogeographic province, Chaco subregion). This region has suffered fragmentation and destruction of the natural habitat due to the intense agricultural and livestock activities, the strong extraction of some species and the propagation of invasive species. Thus, most of the remaining natural environments are in need of protection. In this context, the city of Río Cuarto, located southeast in the Córdoba province, contains, within the homonymous National University Campus, an Urban Natural Reserve called "Bosque Autóctono El Espinal". The main objective of this reserve is to conserve for future generations a fragment of the typical native landscape of the "Espinal" region (Figure 1).

**Figure 1:** Area of study - limits of the Urban Natural Reserve El Bosque El Espinal in the Nacional University of Río Cuarto, within the City of Córdoba (Argentina)



**Source:** Own elaboration based on information taken from Satelital Image of 2012 (sri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community). Software used Q-GIS 2.6 (open source)

The team of the Reserve has recognized the need to include the educational communities and the general population in order to achieve the objective. Therefore, together with the Foundation "Conservation and Development", it has undertaken the design and implementation of an Environmental Education Program destined to the regional educational community aiming for the inclusion and re-signification of the Urban Natural Reserves as complementary areas for learning ("open-air classrooms") (Natale, Oggero, Astudillo y Junquera, 2012).

Likewise, it was hoped to contribute to the articulation of these areas with educational institutions contributing to expand the educational objectives and to promote a significant, active and committed understanding of the local natural environment and its main environmental problems. This way, school learning would be complemented with life experiences that would offer a new way of understanding, analyzing and arguing over real problems referring to the variables of the context in interaction.

The general objective of the Environmental Education Program was to promote, through environmental education, responsible attitudes and behavior towards the environmental problems that affect natural areas and the community. Complementarily, the specific objectives were: a) to design differential environmental education activities according

to the type of public present in the protected area; b) to strengthen bonds between the conservation unit and the educational community, c) to sensitize the educational communities on the value of biodiversity, and d) to train the reserve volunteer workers in the implementation of the different activities.

In order to design environmental education activities that were distinctive for each kind of public visiting the protected area, an opinion survey was conducted, as first instance, among 144 teachers from 35 educational centers from the city of Río Cuarto. The aim of this survey was to identify concerns, interests, perspectives and potential participation groups with respect to the development of educational activities related to the Natural Reserve.

According to the obtained data, the teachers recognized the potential educational value of visiting the protected area to facilitate the contact with nature, to raise awareness on the environmental problems to contribute to the knowledge of species, to train in research protocols, and to deepen the knowledge on the concept of protected area. The teachers also expressed different demands: the incorporation of research activities, recognition of species and the linkage with thematic scholar projects, among others.

In addition, the corresponding bibliographic search was conducted to provide the theoretical bases for the activities, which were differentiated according to the potential participant public, delimiting complexity levels regarding content, thinking processes, language and technical vocabulary. At this instance the work was performed at primary (6-11 years old) and high school (12-18 years old) levels.

The activities design were based on the following criteria: 1) to facilitate the information development (deduce, interpret, estimate, evaluate) and its reconstruction (infer, solve problems, communicate); 2) to direct the assignments of the volunteer guides; 3) to stimulate the observation in different spatial dimensions, and 4) to promote perception by means of all senses. Regarding the addressed content, the activities were organized following four themes that were defined according to the official school programs from educational centers in order to promote the coordination with schools. The themes were:

- Flora and fauna, which refer to the diversity and richness of the protected area, the existing difference between native and exotic species and the impact produced by the latter. Also, aspects related to the value of native species with regard to the environmental services and the option and utility values are addressed among others.

- Ecological interactions, which deepen into the ecosystem concept and the interactions plant-animal (mutualism, parasitism and hemi parasitism) and introduce the topic of trophic webs (predator-prey).
- Biotic and abiotic factors, which present the importance of the abiotic factors for the development of life, their relation with biotic factors and with vital processes such as the water cycle.
- Conservation, where the environmental status of the Eco region of The Espinal and the pressures exerted upon the reserve are discussed; different conservation strategies, such as restoration of degraded areas, are exemplified, and in addition some environmentally- friendly practices that can be implemented at home are transmitted.

With the aim of correcting those situations that make it impossible for the activities to be performed outdoors, such as adverse weather condition, different kinds of resources and working instructions were designed, which were classified as follows:

## **2.1 Activities to be developed in the interpretative trail of the protected area**

- Observation of mammalian traces: comparison between felids and canids, identification of species, differentiation between wild and domestic animals by observing their footprints and analyzing their habits.
- Recognition of Birds: by means of direct observation and listening bird songs. Interpretation of bird adaptation through the examination of feathers.
- Flora recognition: identification of species highlighting morphologic (dichotomous key) and ecological characteristics.
- Observation and interpretation of clouds: with emphasis on the potentials of predicting weather phenomena and conditions.

## **2.2 Classroom Activities in the didactic classroom of the reserve**

In particular, an interactive DVD was prepared which shows a virtual trail through the protected area that includes:

- Recognition of native and exotic species.
- Analysis of ecological interactions.
- Analysis of abiotic factors.
- Identification of native plants use.
- Recognition of birds and their habitats.



It is important to highlight that the DVD contains also short films that show different aspects of the protected area, referring to the above mentioned themes.

In parallel a course for the reserve volunteers (mostly biology students) was carried out with the aim of training them as environmental interpreters. This course was organized in modules according to main themes identified throughout a survey, and included a progression criteria, adopting methodology based on participative group dynamics.

### **3. Methods for monitoring the environmental education program**

In order to evaluate how effective the didactic activities were, the activities were monitored with the collaboration of three educational centers from Río Cuarto city. The specific objectives were: a) to acknowledge the expectations and perspectives of the participants, b) to characterize the development of the activities regarding difficulties and potentials, c) to acknowledge the possibility of the students to transfer or extrapolate the addressed issues to new situations, and d) to know the evaluations of interpreters and teachers on the visit. For this, we worked with 6 complete classes from the primary and the secondary level, the teachers responsible for these groups and 5 environmental interpreters who were in charge of the activity coordination. To achieve the objectives, different data collection instruments were designed and implemented before, during and after the visits, as shown in table 1.

## **4. Results**

### **4.1 Expectations and perspectives of the participants**

#### *4.1.1. General expectations of the visitors previous to the visit*

We here present the analytical interpretation of pictures drawn (figure 2) by the potential visitors of the protected area, referring to what they expect to see and do during the visit. Six groups took part in this inquiry; three of them included students from primary level, while the rest were high school students. In total, there were 141 cases that were subjected to analysis (tables 2-3).

**Table 1. Data collection instruments used in monitoring each type of actor**

<b>Actors</b>	<b>Visiting students</b>	<b>Teachers</b>	<b>Environmental interpreters</b>
<b>1) General expectations</b>	Expectations urn	On-line inquiry	Initial interview
<b>2) Development of the visit</b>	Field observation register grid.	Interview after each visit	Field observation register grid.
2.1. Adequacy of the activities for the visitors			
2.2. Adequacy of the activities to time-space conditions			Interview after each visit
2.3. Maintenance of students interest and participation			
2.4. Resolution level of activities by students			
<b>3) Transference or continuity</b>		Interview after each visit	
3.1. Articulation with activities and scholar contents			
3.2. Promotion of interdisciplinary or inter-area approaches			
3.3. Promotion of relations between institutions.			
3.4. Interest and motivation promotion in respect to environmental problems and /or science specific concepts	Production and transference activities (brochure elaboration, drawings and messages)		
3.5. Attitude mobilization and representation about the themes			
3.6. Promotion of conceptual and procedural learning			

**Source:** Own elaboration based on information taken from the evaluation project of this program, approved by Fondo para las Américas - Secretariat of the Environment and Sustainable Development of the Nation (Argentina).

In general, the analyzed drawings did not present indications of human intervention, although they were more frequent at the high school level and referred mainly to aspects related to space control (signs, wiring, plantations, constructions, etc.). The dimension of the human impact on the environment (fires, logging, littering, etc.) was almost absent in the drawings in both groups, prevailing, therefore, a natural image of the reserve that leaves out typical anthropic pressures of urban environments.

**Table 2: General expectations of the visitors about what they expect to see (N=141)**

Variables \ Actors		Primary school (n=57)		High school (n=84)		Group total (N=141)	
		%	f	%	F	%	F
Human intervention	Control	10.5	6	44.0	37	30.50	43
	Impact	-	-	2.4	2	1.40	2
	No data available	<b>89.5</b>	<b>51</b>	<b>53.6</b>	<b>45</b>	<b>68.10</b>	<b>96</b>
Flora (physiognomy)	Garden or park	<b>52.6</b>	<b>30</b>	<b>66.7</b>	<b>56</b>	<b>61.0</b>	<b>86</b>
	Wild	12.3	7	33.3	28	24.8	35
	No data available	35.1	20	-	-	14.2	20
Flora (pristine system)	Native	1.8	1	4.8	4	2.5	5
	Exotic	<b>61.4</b>	<b>35</b>	<b>84.5</b>	<b>71</b>	<b>75.2</b>	<b>106</b>
	Hybrid	-	-	10.7	9	6.4	9
	No data available	36.8	21	-	-	14.9	21
Flora (structural diversity)	Homogeneous	<b>43.9</b>	<b>25</b>	21.4	18	30.5	43
	Heterogeneous	21.1	12	<b>78.6</b>	<b>66</b>	<b>55.3</b>	<b>78</b>
	No data available	35.1	20	-	-	14.2	20
Fauna	Farm	7.0	4	3.6	3	5.0	7
	Zoo	5.3	3	1.2	1	2.8	4
	Wild	<b>57.9</b>	<b>33</b>	<b>53.6</b>	<b>45</b>	<b>55.3</b>	<b>78</b>
	Farm/wild	10.5	6	22.6	19	17.7	25
	Farm/zoo	3.5	2	-	-	1.4	2
	Zoo/Wild	3.5	2	-	-	1.4	2
	No data available	12.3	7	19.0	16	16.4	23
Ecological interactions	Yes	26.3	15	20.2	17	22.7	32
	No	<b>73.7</b>	<b>42</b>	<b>79.8</b>	<b>67</b>	<b>77.3</b>	<b>109</b>
Abiotic factors	Yes	24.6	14	<b>81.0</b>	<b>68</b>	<b>58.2</b>	<b>82</b>
	No	<b>75.4</b>	<b>43</b>	19.0	16	41.8	59

**Source:** Own elaboration based on information taken from the 141 cases analyzed in this study

Regarding the flora and despite what was previously highlighted, most productions, from both groups, draw a park or garden-like vegetation profile, judging by the spatial planning of the elements and the choice of shapes which are fixed in the collective imaginary.

However, it should be noted that 24,8% of all drawings included references to wild flora, and managed to show a natural configuration of elements disposition. It is interesting to highlight that in contrast with the high school level, a high percentage of the drawings from the primary level did not introduce any kind of vegetation, focusing their representations on the wild fauna. These differences were also observed in the omission of abiotic factors by the primary level, versus a high appearance of these factors in the high school level drawings.

With respect to the degree of conservation of the native condition of the system, it was observed that most of the drawings alluded to exotic species, which is also related to the use

of common models of representation, as pointed out above. Therefore, only few productions managed to show specific features of the native flora.

**Table 3: General expectations of the visitors about what they expect to do (N=141)**

Variables	Actors	Primary school (n=57)		High school (n=84)		Group total (N=141)	
		%	f	%	F	%	f
Recreational	yes	28.1	16	<b>56.0</b>	<b>47</b>	44.7	63
	No	<b>71.9</b>	<b>41</b>	44.0	37	<b>55.3</b>	<b>78</b>
Register	Photos	-	-	8.3	7	5.0	7
	Notes	-	-	11.9	10	7.1	10
	No data available	<b>100</b>	<b>57</b>	<b>79.8</b>	<b>67</b>	<b>87.9</b>	<b>124</b>
Collection	yes	5.3	3	15.5	13	11.3	16
	No	<b>94.7</b>	<b>54</b>	<b>84.5</b>	<b>71</b>	<b>88.7</b>	<b>125</b>
Observation	binoculars	-	-	1.2	1	0.7	1
	Stereoscopic microscope	-	-	14.3	12	8.5	12
	direct	5.3	3	25.0	21	17.0	24
	No data available	<b>94.7</b>	<b>54</b>	<b>59.5</b>	<b>50</b>	<b>73.8</b>	<b>104</b>
Actors	Oneself	35.1	20	<b>92.9</b>	<b>78</b>	<b>69.5</b>	<b>98</b>
	Pairs	3.5	2	<b>52.4</b>	<b>44</b>	32.6	46
	Teachers	1.8	1	8.3	7	5.7	8
	Environmental interpreter	-	-	8.3	7	5.0	7

**Source:** Own elaboration based on information taken from the 141 cases analyzed in this study

Concerning the category "structural diversity", it is important to highlight that, although the primary level presented a high percentage of drawings offering a homogeneous view of the flora, in the high school level the highest percentage corresponded to a heterogeneous perspective. These mentioned properties strengthen the vision of an artificial space, ordered, static and of pictorial nature; nevertheless, the lack of dynamism was common to both groups since neither of them showed in their drawings interactions between different system components.

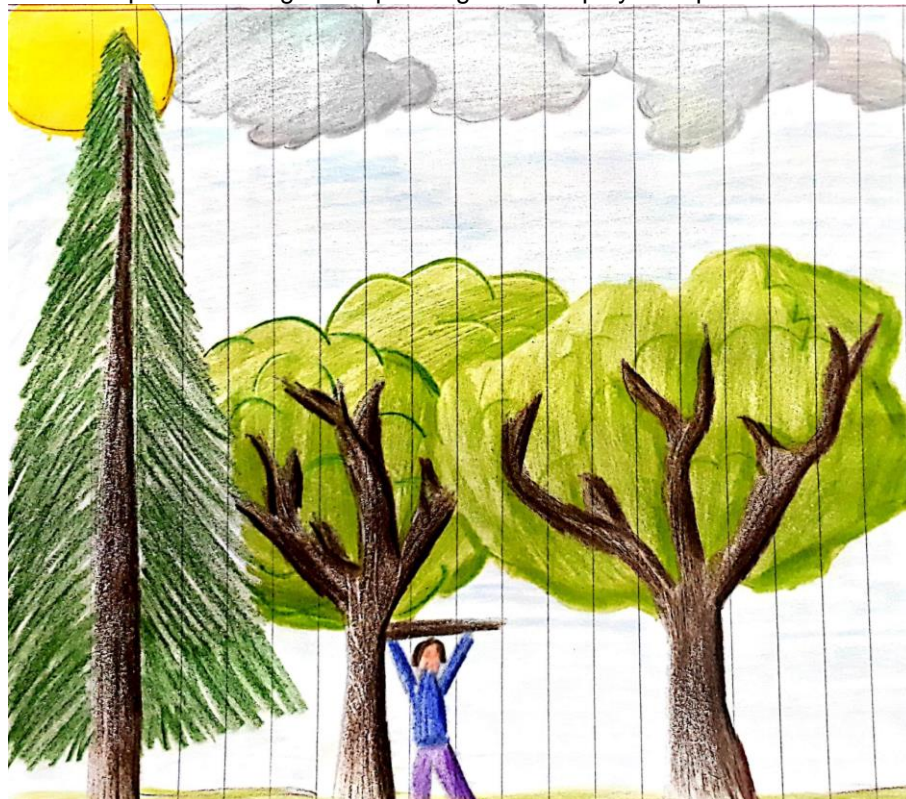
On the other hand, the representation of the fauna was more frequent in the primary level, showing also more diversity in the kind of animals they considered possible to find in the reserve (zoo animals, farm animals, etc.). However, both groups seemed to express the idea that the predominant fauna corresponds to wild animals.

With respect to the potential actions of the participants, the most represented by both groups was recreation or transit during the visit (games or trail representation). In those cases corresponding to the high school level the allusion to the observation action, mainly direct

was also significant. Even though it is a common practice in school, the drawings almost did not show the registration action, collection or manipulation of elements.

Finally, concerning the potential actors, most of the drawings did not include the presence of the teacher or the environmental interpreter as participants in the trail. Furthermore, the primary level often did not register the presence of themselves or other students, which was shown in the drawings from the high school level.

**Figure 2.** Example of drawing corresponding to the inquiry of expectations of the visitors



**Source:** Taken from information taken from drawings made by children at the primary level of educational institutions that participated in the study

#### *4.1.2. General expectations from the teachers responsible for the groups previous to the visit (on-line survey)*

Previous to the implementation of this proposal on-line surveys were conducted with the teachers that were responsible for the groups in order to learn about their interests and main objectives regarding the future visit to the reserve. In general, the teachers chose to take part in this experience because of the opportunity to explore learning scenarios which favor the direct contact of the student with the environment and allows them to adopt different

positions. Likewise, they recognized the value of the visit as a chance to extend the knowledge about native flora and fauna and to strengthen conservation ideals. Finally, they expressed that a crucial contribution of the experience for the students would be to promote the acknowledgment of the protected area as a valuable space in the city.

#### *4.1.3. General expectations of the environmental interpreters previous to the visit (first interview)*

##### *4.1.3.1. General expectations or appreciations*

In general terms, the environmental interpreters recognized that the new proposal is more dynamic and provides more participation opportunities for the visitors. This would be favored by activities that encourage a closer bonding among the visitors and that generate a relaxed atmosphere suitable for recreation and interaction.

Moreover, they found the new proposal more attractive since it goes beyond describing or enunciating what is observed in a merely informative way. In this sense, the new modality would favor the learning process, while the incorporation of new topics would correlate better with the genuine interests of the visitors.

In addition, the development of the activities would allow the use of different senses and processes: watching, touching, interpreting, listening, reading, etc. Furthermore, it would articulate the conceptual dimension with field observation and the ludic character of the activities. These teaching strategies would contribute to broaden the students' perspective of what is in study, incorporating new points of observation and developing a new perspective about the phenomena that is more systemic and critic.

On the other hand, the interpreters expressed some concern about the need of adequate management of spatial conditions so that all participants have the possibility to perform their observations. They also expressed their uncertainty about the effectiveness of some strategies.

Another concern was the coordination of the time required for each activity and the overall time of the visit. Moreover, they pointed out that the length of the path could be excessive to sustain the visitors' attention and to be able to develop the planned activities in the available time.

Regarding the assessment of the new structure of the visit, some interpreters highlighted two main moments: one initial moment, key for capturing visitors' attention and interest, and a final moment, important for the construction of a global interpretation, a

summary emphasizing the meaning of the experience. In the same way, they recognized the importance of those moments that were specially thought to promote thematic integration recovering the main objectives of the visit.

With respect to the resources employed during the visit (samples, collections, and other informative material) the interpreters qualified them as novel and of high potential to promote greater interest in the visitors. They would also be relatively easy to understand, with the complementary intervention of the interpreters. This accessibility to the resources employed during the visit would be particularly favored by the complementarity existing between the text and the images and by the diversity of formats. Together with these potentials, the interpreters manifested to be concerned about the manipulation and transport of the elements because of the amount of resources that have to be used simultaneously, and about their availability if the size of the group exceeds the expectations. Some concern was also observed regarding the use of some technologic equipment because of lack of training. In spite of all, these limitations were assumed as part of the learning process inherent to the implementation of a new strategy.

#### *4.1.3.2. Themes*

Most of the environmental interpreters agreed that the organization of the themes is positive and well defined, since it allows working in a more coordinate way, optimizing the path and taking advantage of the virtues that each stop along the trail has to offer. On the other hand, some interpreters manifested that the current design of the themes offers the possibility of establishing cross relations between the topics, further contributing to the construction and integration of new knowledge.

In addition, some interpreters identified the theme "flora and fauna" as main topic from which the other thematic axes could be addressed. Similarly, the theme "biotic and abiotic factors" would also include topics that are also related to other thematic axes, although it might be difficult to adapt to different age groups. Finally, it was observed that the anticipation of the themes is convenient, since it allows better preparation previous to the activity. Nevertheless, it was recognized that unexpected events occurring during the visit might require being flexible about how the themes are addressed. This possibility would be regulated by the teachers' expectations and demands.

#### 4.1.3.3. *Target group*

In spite of some adequacy difficulties that might arise, the age diversity present in the new groups was recognized as a potential for the development and evaluation of the new modality. Regarding the concepts the students would incorporate, some interpreters highlighted the following aspects: the acquisition of basic notions about the observation (assuming no previous knowledge), the acquisition of environmental conservation and care values and mainly the acquisition of a systemic view of the environment. Finally, according to the interpreters the participation of the teachers during the visit would depend on the students' behavior and their sense of discipline.

On another level, the interviewed interpreters meditated about the size of the groups pointing out that it might hinder the coordination of the activities and reduce the availability of materials as well as limit the chances of student participation. The groups of younger kids might require selecting those activities that are more pertinent in complexity and adjusting the technical vocabulary to a level they are able to comprehend. These groups would also require more patience given the initial motivation they usually show when they arrive at the visit, and also special potentiality of the perception senses.

Moreover, the previous work carried out with some people of the educational center as well as the first instances of the visit in charge of the interpreters were considered to be very important to establish the meaning and the objectives of the visit, to determine behavior guidelines and to distribute responsibilities among the participants. Similarly, what was highlighted was that the students have a previous introduction to the topics that will be addressed.

#### 4.1.3.4. *The environmental interpreter role*

In general, it was perceived that the innovative nature of the activities constitutes an encouragement factor for the interpreters. Great enthusiasm and interest was observed regarding the new experience. They were also positive about the previous training that was offered to them.

Moreover, they expressed certain concern about the possible questions or answers that might be formulated by the visitors due to the novel activities. In return, other interpreters manifested to be expectant to the doubts and needs of knowledge that may arise.

Finally, they recognized themselves with a new role of scaffolding and mediation as a complement particularly in complex activities. In this regard, they requested more training



about pertinent strategies, which were thought and elaborated especially for the visit contents. Furthermore, they pointed out the need of acquiring more knowledge in some topics to reduce incidents and increase the potential of the activity.

#### *4.1.3.5. Projection of the visit*

Each interpreter made a different observation about how the activities carried out during the visit might project in a new linkage with the visiting educational institutions. In one case, it was considered that the modality of the approach might be recovered during the re-signification of the school assignments that maintain a traditional non-problematic and decontextualized format.

In another case, the proposal was oriented to the replication of the experience considering the seasonal variations to develop a more complex and located perspective of the assessed phenomena. Meanwhile, in the third case the possibility of deepen into teachers and students topics of interest through informative talks was proposed. Furthermore, the incorporation of communication or divulgation scenarios was suggested.

## **4.2 Development of the visits**

A synthesis of the results from the observations made during 6 visits are presented. The register grid oriented non-participant observation of the visit considering three main moments: welcome, development, and farewell.

At the beginning of the walk through the forest, in general, the environmental interpreters (5) instructed behavior guidelines and their reasons (remain together during the walk, stay inside the established trail, do not litter, do not climb trees, do not mistreat animals or cut plants). In addition they presented a characterization of the protected area focusing mainly on extension and location. Also, the characteristics of an urban natural reserve and of the reference eco-region were defined. Furthermore the organization, duration and objective of the visit were presented and, in some cases, the structure and content of the field guides were explained. Only one interpreter referred to the institutional dependence while others referred to the satellite image of the reserve to locate the visitors in space. In other cases the value of the reserve for ecosystem conservation was highlighted.

#### *4.2.1. Observation of the interpretation trail activities (register grid for field observation)*

A short description of the observations made by the interpreters during the usual stops along the trail is presented here.

##### *4.2.1.1. Our flora: species recognition*

The interventions from the environmental interpreters that are considered to be more interesting to promote understanding and participation from the students were related to: a) inquiring into visitors spontaneous ideas before the exhibition b) continuously strengthening the exhibition with observation, c) encouraging the visitors to point out the prominent characteristics of the observed plants, d) suggesting the consideration of variables to be able to jointly define concepts. The concepts addressed in this stop were, among others: native and exotic species, symbiosis types and plants' life cycle.

##### *4.2.1.2. What do the traces tell us?: between feathers and plumage*

The interpreter's actions that resulted more adequate to favor the activity resolution were: a) the introduction of variables as clues for feathers interpretation, b) the offer of moments for the visitors to investigate the differences and formulate hypothesis, c) the use of visitors' answers to extend some notions, d) the pointing out of contradictions in the visitors' answers.

In this stop, the visitors attempted, in general, to actively respond to the activity, although they manifested some anxiety with respect to sample handling and they mainly guessed the answers using the field guide.

##### *4.2.1.3. What do the traces tell us? Footprints interpretation*

In this activity, the following interventions from the interpreters became relevant: a) suggesting observable features of the footprint shape to deduce to which species it belongs, b) investigating initial ideas c) asking the students how they imagine other animals footprints would look like to then explain some concepts like difference between wild and domestic animals or between felids and canids, among others.

This stop caught the interest of the students who got involved by making comments about the most significant differences present in the samples. It was observed, generally, that

they focused in the comparison of the footprint shape with the pictures in the guides skipping the reading of the informative text.

#### *4.2.1.4. Our flora: What use does it have?*

The most outstanding strategies used in this stop by the interpreters were: a) resorting back to daily experiences that the kids might be familiar with, b) inquiring previous ideas from the students, c) introducing some historic references. In this activity, although the students were anxious to use the perfume samples and the guides, they were disperse.

#### *4.2.1.5. Reading the sky*

In general, the interpreters used the concept of water cycle to introduce the process of clouds formation. The students took part of the activity by reading the field guides, but there were some difficulties in the identification and there was a tendency for guessing the answers. Their spontaneous comments introduced references to weather prediction, to clouds formation process and to the imagination of figures from the clouds' shapes. To complete the previous description, table 4 shows the frequency of the strategies employed by the interpreters at different time points during the visits.

#### *4.2.1.6. Resources, time and space handling*

The collected field data showed that the space was adequate for the activities as well as the given time, allowing a flexible organization and a dynamic degree of participation. The guides were always enough for all visitors (1 guide every 2 persons) and did not present difficulties in understanding or handling.

#### *4.2.2. Observation of the didactic classroom activities (register grid for field observation)*

A short description of the observations made during the course of the most common activities in the didactic classroom is presented here.

##### *4.2.2.1. A large orchestra*

The strategies employed by the environmental interpreters that resulted more interesting in this activity were: a) the recovery of spontaneous comments related to personal experiences, b) the definition of some concepts after investigating the visitors ideas, c) the

transformation of students' questions in new questions that help us deduce the answer, d) the proposal of relations between bird names and some of their characteristics.

The students participated actively contributing with their personal experiences and making questions about the characteristics of the species that caught their attention (i.e.: what is the crest? Why doesn't it eat fish if it lives in the pond?).

#### *4.2.2.2. Age of the trees*

The most important interventions made by the environmental interpreters were: a) relating the addressed issues with instances along the interpretation trail in order to consolidate concepts, b) investigating the students' previous knowledge about the determination of trees age, c) explaining the technique and procedure for age dating and the interpretation of weather conditions during tree growth.

#### *4.2.2.3. Curiosities of the Chañar and utility of the forests plants*

The interventions of the environmental interpreters that resulted interesting were those oriented to: a) the recovery of historic references during the exposition and b) the effort to connect the topics addressed during the path referring to previous explanations that the visitors remembered, c) allowing the students to comment some personal experiences (consumption of tea or sweets).

#### *4.2.2.4. What is the path of a water drop?*

The most significant strategies consisted of: a) investigating previous ideas about the addressed topics, b) requesting arguments with respect to the students' answers, c) introducing references about the water value as activity introduction. To complement the preceding description, table 5 shows the frequency of the employed strategies at different time points of the didactic classroom activities.

### **4.3 Post-visit activities with the visitors (Transference and production activities)**

#### *4.3.1. Primary level students*

The first objective of the post-visit activity was related to promoting the focalization of the students in those visit aspects that, from their perspective, resulted more interesting in the context of an imaginary situation that would help them evoke the lived experience.

The visitors' productions were systematized according to five categories of analysis:

- a) Flora: Presence of native and/or exotic flora.
- b) Fauna: Presence of wild or other kinds of fauna (zoo, domestic or farm animals).
- c) Abiotic Factors: Presence.
- d) Conservation: Ideas about species and environment care or preservation.
- e) Activities: Reference to the activities performed during the visit.

With respect to the first inquiry, it was observed that 51% included the representation of native flora, prevailing as examples the "espinillo", "chañar" and "tala", among others (table 4, figure 3). This high representation is in contrast with the results from the previous inquiry of pre-visit expectations where the representation of the native flora was only 1.8%.

**Table 4: Elements and aspects included by visitors on Post-visit activities** (Primary level students, n=84)

<b>Variables</b>	<b>(n=84)</b>	
<b>Flora</b>	<b>%</b>	<b>f</b>
Native flora	<b>51.19</b>	<b>43</b>
Exotic flora	26.19	22
No data available	22.62	19
<b>Fauna</b>		
Wild fauna	42.86	36
Farm-domestic-zoo	2.38	2
No data available	<b>54.76</b>	<b>46</b>
<b>Abiotic factors</b>		
Presence of Abiotic factors	40.48	34
No data available	<b>59.52</b>	<b>50</b>
<b>Conservation</b>		
Ideas about conservation	21.43	18
No data available	<b>78.57</b>	<b>66</b>
<b>Activities</b>		
Activities representation	32.14	27
no data available	<b>67.86</b>	<b>57</b>
<b>Protected area</b>		
Characterization of the protected area	17.86	15
No data available	<b>82.14</b>	<b>69</b>

**Source:** Own elaboration based on information taken from the 84 (primary level) cases analyzed in this study

Regarding the "Fauna" category, it was observed that a significant number of drawings (42.86%), included images of wild fauna, with prevalence among the referred species of the puma, the hare, the skunk, the wildcat, some reptiles, birds and insects (table 4). Once again,

a significant difference is recognized with respect to the representations collected during the pre-visit inquiry, where although over 50% included references to wild fauna, they consisted mainly of undifferentiated birds. In contrast, in the post-visit activity details from the regional fauna could be observed in the drawings, even when the species were not observed in situ.

In relation with the category "abiotic factors", it was also observed an increment in the representations that included these factors in comparison with the results obtained in the pre-visit inquiry, 40.48% and 24.6% respectively (table 4).

**Figure 3.** Example of drawing corresponding to the post-visit activity with primary level students



**Source:** Taken from drawings made by children at the primary level of educational institutions that participated in the study

The presence of ideas related to the care and preservation of the natural areas was systematized mainly through the analysis of the welcome messages elaborated by the visitors. Although most of the written productions made reference mainly to the opportunity to learn and to enjoy themselves offered by the visit, a not so small a number of representations (21.43%) incorporated ideas related to the value of animal and vegetal species conservation (table 4). Among the most frequent messages were:

"Welcome to the forest Espinal. Do not cut trees, do not litter."

"Welcome, save the animals."

"Save the animals and nature."

"Do not cut trees, do not kill, do not waste water, do not capture, do not hunt, do not pollute, do not litter, do not break, do not hit."

"Do not kill the animals, do not litter."

Regarding the category "activities", although most of the drawings focalized on some observed element that resulted particularly interesting, 32.14% of the drawings showed the representation of the species observation task, the mammalian footprint interpretation and the didactic classroom activities, among others (table 4). In comparison with the results obtained in the pre-visit inquiry, the activities, focused in the classic observation and register tasks, reached only 10.6% of the productions.

Finally, 18% of the drawing included some kind of characterization of the protected area as such, referring to its denomination, functions, location, extension or institutional affiliation (table 4).

#### *4.3.2. High school students*

The post-visit activity with High school students consisted in the design of an informative brochure to promote the visits to the forest. The objective of this proposal was to offer a playful scenario where the students could capture their appreciation of the main potential points of the visit to the protected area. It was expected in this way to encourage representations and attitudes from the students as well as to observe indicators of conceptual learning. The brochures analysis was performed according to the same categories used with primary school students.

Most of the productions from the students (68%), incorporated specific references to the native flora through written text as well as drawings (table 7). Among the recognized species are: algarrobo, chañar, caldén, espinillo, moradillo, tala, peje, zarzamora (blackberry), etc. Once again, this presented a significant contrast with the representations achieved by the same students prior to the visit, where the productions that incorporate native flora were only 4.8%.

With respect to the fauna category, most of the brochures incorporated references to native fauna (table 5). Among the included species are: puma, wild cat, owl, woodpecker,

white heron, guiraca guiraca, fox, ovenbird, skunk, southern lapwing, yellow-billed teal Duck, etc. Also in this case, the specificity and details from the references and the text were remarkable in comparison with the pre-visit inquiry. Nevertheless, there were no references to domestic, zoo or farm fauna in any case, which were present in the pre-visit production (around 30%).

For the category "abiotic factors", 32% of the cases included references to abiotic factors, which is a lower percentage than observed in the initial representations from the same group (81%) (table 5). The students seemed to evoke other aspects of the visit in order to produce a communicative product to promote the protected area.

**Table 5: Elements and aspects included by visitors on Post-visit activities** (High school students,  $n=25$ )

<b>Variables</b>	<b>(<math>n=25</math>)</b>	
<b>Flora</b>	<b>%</b>	<b>F</b>
Native flora	68	17
Exotic flora	8	2
No data available	24	6
<b>Fauna</b>		
Wild fauna	52	13
Farm-domestic-zoo	0	0
No data available	48	12
<b>Abiotic factors</b>		
Presence of Abiotic factors	32	8
No data available	68	17
<b>Conservation</b>		
Ideas about conservation	64	16
No data available	36	9
<b>Activities</b>		
Activities representation	56	14
No data available	44	11
<b>Protected area</b>		
Characterization of the protected area	96	24
No data available	4	1

**Source:** Own elaboration based on information taken from the 25 (high school) cases analyzed in this study

The ideas about environmental care and preservation of the area encompassed by the reserve or even messages related to the conservation of species were very frequent (64%) (table 5). The following are some examples:

"...It is important to preserve natural areas so that different species might develop."



"This forest is not large... due to the expansion of urban zones and human activities such as agriculture, logging and also forest fires started by men and natural phenomena, causing the reduction of these areas."

"Let's help protect our reserves."

"It is important because 'El Espinal' is the only natural reserve that we have in the city of Río Cuarto... the animals present there are protected so that the natural ecosystem cannot be broken."

Regarding the category "activities", a significant recognition (56%) of the new activities proposed by the visit was observed (table 5), in contrast with the initial representations that only projected the classic register, observation and manipulation tasks (25%). Among the most frequently highlighted activities are; feathers and mammalian traces interpretation, identification of different types of clouds, work with birds' songs, games in the didactic classroom, identification of flora and bird watching.

References to the category "protected areas" were also significant among the productions from the students who were able to evoke a proper denomination and characterization. For instance, the students made reference to the institutional affiliation and to the sectors surrounding the area, the extension in hectares covered by the area, its functions and the main value in relation to the province native forest surface, etc. (table 5).

#### **4.4 Valuations of interpreters and teachers on the visit**

##### **4.4.1. Post-visit activities with the environmental interpreters (Questionary)**

In general terms, the feelings expressed by the environmental interpreters are related with an optimistic and confident point of view towards conducting the visits, prevailing positive feelings. This is in agreement with what they expressed in the interviews previous to the pilot.

Moreover, they pointed out that the initial expectations were mostly covered since the visit resulted better organized, interactive and participatory and in most cases were carried out successfully.

Some activities and/or moments were more interesting than others. For example, during the real trail the interpreters highlighted the activities: bird calls, what do the tracks tell us? Between "feathers and plumage", "welcome" and "footprints interpretations". In the case of the DVD, they highlighted as more interesting the activities related to: "age of the trees", "a great orchestra" and "native and exotic species".

As strengths of the activities, the interpreters noted the promotion of a wider, systemic and more critic perspective by the students about the addressed issues. Likewise, it was deduced that the integration and articulation of the conceptual dimension with the field observation and the ludic character of the activities allowed the visitors to achieve greater involvement in the experience.

The recovery of personal experiences during the course of the activities and the previous work about the topics from the educational institution would have contributed particularly to maintain the students' interest. Furthermore, the interpreters recognized the interest raised by the unknown and the possibility of observing animals in situ, as well as some contrasts with the expected (burned areas, for example).

As the interpreters announced in the initial interview, the management of time and of the groups during the visit (keeping their attention and achieving their participation) and the conservation of the selected thematic axis were the main difficulties that needed to be overcome. In this sense, they recognized the need to gain access to complementary information and deeper knowledge of the themes so that the visit is more dynamic with respect to the resources, the informative booklets were found attractive and easy to handle as whereas the DVD were found to be a comprehensive and interactive resource.

#### *4.4.2. Post-visit activities with teachers (Questionary)*

Although all teachers expressed that the activities were in agreement with the characteristics of their students (age, interests, time, etc.), they highlighted the following moments of the visit as the most interesting ones: what do the tracks tell us? Between feathers and plumage, foodprints interpretations; making reference to the students' preference to work with real elements and outdoors. On the other hand, the teachers coincided that the visitors participated more and were more interested than in other field trips, since many had with them notes taken previously to the visit about the themes that were to be addressed during the forest trail. That was reflected in the expression of spontaneous questions and comments.

According to the teachers the didactic materials were attractive, comprehensible and easy to handle. Moreover, they observed that the DVD has an adequate time extension and it maintains the students' attention during the course of the activities in the didactic classroom.

Regarding specifically the articulation of curricular contents, the teachers manifested that the learning context of the reserve in general can be integrated in one theme, learning

unit or other disciplinary areas. Finally, the teachers expressed that the main learning promoted by this kind of experiences is related to the fact that the visitors understand the importance of preserving native forest and taking care of nature, and at the same time they are familiarized with the existence of a protected area in the city, its flora and fauna and their importance. Furthermore, they highlighted that this kind of experiences allows greater contact with nature favoring and strengthening the natural science learning process.

## **5. Final considerations**

### **5.1 About the monitoring process**

The monitoring strategy that we have developed had as objectives not only to characterize the experience in terms of participation and knowledge promotion of the visitors, but also to propose some criteria that might be useful to develop or refine this or other educational experiences in protected areas. In this regard, we are in agreement with Collins, Joseph and Bielaczyc (2004) with respect to the value of evaluation designs that contribute to think about particular learning environments focusing on their refinement. In this context, and as Cobbs, Confrey, DiSessa, Lehrer and Schauble (2003), the challenge has been to interpret and to appreciate not only the positive aspects of the proposal but also to recognize and analyze the obstacles that interfered in the experience and meaning given by its protagonists.

On the other hand, to attend the complexity and dynamism that are natural to this kind of educative real scenarios, as the one considered here, has driven us to combine diverse inquiry methodology. In other words, and again in agreement with Collins et al.(2004) the objective of capturing the diversity of refinements, qualities, sensations and life lessons that constituted this experience has required to combine direct methodologies (as interviews or written questionnaires) that allow the analysis of more explicit or declarative aspects from the experience of the different actors, with indirect methodologies (problem solving, ideas projection, etc.) for the inquiry of those implicit or dormant components. In terms of the analysis of the obtained data, the combination of diverse methodology has implied, in turn, qualitative and quantitative approaches.

On another level of discussion, a premise has oriented the design and development of monitoring strategies: the idea that they are the actors involved (teachers, students, interpreters and team responsible for the protected area) the ones who build the educational scenario of the visits to the reserve. Even though the activities and resources that shape the

visit experience have been thought and produced by a technical team specially assembled for this purpose, they only acquire a purpose at the time of their implementation. Therefore, we believe that it was of great importance to be able to overcome the situation of mere external evaluation of the visit, recovering voices and input from the participants. This way, from the initial interview of expectation inquiry we invited them to open a process of critic experimentation and pedagogic evaluation of the experience.

Furthermore, the implementation of three inquiry moments: before, during and after the visit, allowed us not only to consider the objectives raised by the responsible team but also the expectations of the involved actors and the possibilities of continuity of the proposal. This allows highlighting how important it is that the visits to the protected area are not limited to the observation path but that the teachers work with the students about the topics in preparation classes in the educational centers previous to the visit and that they can resume the experience in new activities post visit to expand the addressed issues.

## **5.2 About the Environmental Education Program: positive aspects and recommendations**

- The activities were interesting for the students and in all of them the group participation was significant.
- The Environmental interpreters were able to develop a broad number and diverse strategies appropriate for the kind of activity proposed at different moments.
- The management of time, space and resources allowed completion of the planned activities.
- The interpreters were able to modulate the complexity level of the proposed activities adapting them to the particularities of each group of age, and were flexible at some moments with vocabulary and length of the visit.
- Both the informative material and the collections and samples were not only easy to understand but also attractive for the visitors.
- The implemented modality favored, in particular, the interaction, the dialog and the spontaneous expression of the visitors.
- The post-visit productions allowed us to recognize the new knowledge acquired by the students, who were able to represent, in a significant percentage and in the free expression activities, specific characters from the native biodiversity and the role the protected areas play in conservation.

Some useful recommendations arose from monitoring for the methodological adjustment of the experience regarding content and transference modality:

- To elaborate a series of narrative resources (stories, legends, etc.) and interrogation resources (riddles, puzzles) related to the topics to be addressed, in order to deliver complex concepts to young children and to liven the interpreters' talk promoting a more active participation from the visitors.
- To deepen the presentation of initial problematic situations leading to a more profound interpretation of the information and to argumentation during activity resolution.
- To make the purpose and objectives of the activities always explicit and request the students to explain their answers, pointing out contradictions or presenting new conflicts to mobilize their ideas toward new directions.
- To offer time and space necessary for the handling and observation of the materials and for definition of hypothesis over differences and resemblances, with supportive questions from the interpreters.

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