Evidence-based conservation education in Mexican communities: connecting arts and science

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**Full Title:** Evidence-based conservation education in Mexican communities: connecting arts and science

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**Keywords:** Arts for education; Conservation Education; Drawings analysis; Holistic experience; Mexico; Primates

**Abstract:**

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**Question**

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**Response**

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Evidence-based conservation education in Mexican communities: connecting arts and science

Short title: Conservation through arts-and-science-based education in Mexico

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Abstract

Several studies suggest that 63% of primate spp. are currently threatened due to deforestation, pet-trade, and bushmeat hunting. Successful primate conservation strategies require accurate educational programs capable of enhancing new system-thinking and responsible behavior with these species. Arts-based conservation education can inclusively foster cognitive and emotional processes. In this paper, we evaluate an arts-based Primate Conservation Education program conducted in Southern Mexico. A total of 229 children from habitat communities participated in a program for the conservation of black howler monkeys (*Alouatta pigra*). Different teaching methods were tested (storytelling, theater and shadow puppets), contrasted with a control group, and evaluated through a drawings analysis. Our results showed that children’s knowledge score was predicted by the technique used and the residence within or outside of Protected Areas (PAs). Conversely, gender and context (urban or rural) did not. Overall, indicators revealed an increase of knowledge and a decrease of misconceptions between Pre-Post evaluations. Finally, a satisfaction survey about the program showed a high positive feedback. The study highlights the value of designing multidisciplinary projects based on holistic experiences, where the arts-based education program (grounded in previous scientific studies) has shown to be a successful way to conduct a Primate Conservation Education program.

Key words: Arts for education, Conservation Education, Drawings analysis, Holistic experience, Mexico, Primates
**Introduction**

Science and Art are not opposed activities, they are human concepts related to the creativity processes that are required to generate them. The ability to imagine the unimaginable is a prized attribute for both artists and scientists. *Education on arts* is an education focused on professional and vocational guidance for a specific art [1], while *education through arts* considers art as a learning vehicle for other subjects and as a means to achieve more general educational outcomes [2]. Research advocates that integrating Art and Science education could engage learners in creating ingenious projects and inspire them to articulate science in different ways [3]. Nevertheless, the integration of arts in everyday science teaching is little known, especially in the field of biodiversity conservation [4]. Here, we present a case study of primate conservation at formal schooling in Southeastern Mexico from the approach of education through arts.

**Primate conservation**

Primates play an important role in structuring tropical forests, and accordingly, are often described as ecosystem engineers [5]. Frugivorous species are particularly important for maintaining ecosystems through ecological networks such as seed dispersal [6] alternatively, folivorous species make up most of the primate biomass in tropical forests [7]. Nevertheless, 63% of all primates are threatened with extinction [8], with the primary threats being tropical forest destruction, capture for the pet-trade, bushmeat hunting, pest control, injury due to infrastructure expansion, pollution, and disease [9]. For these reasons, primate conservation has become a prior concern for biological conservation [10].

In general, primates are important in many aspects of human societies, playing significant roles in cultures, religions, and even livelihoods; as well as being essential in human evolution, biology and ethology research [10]. Additionally, these animals are charismatic species, which
facilitates the implementation of conservation strategies by the local communities, and the
general population [11, 12, 4], helping to reach further and wider goals in species conservation.
However, the strategy of charismatic and flagship species will be more effective if local
knowledge and perceptions are considered, and if the target species have links to their cultural
identity [11]. Primates are particularly attractive to children; albeit unintentionally, children
prefer animals with anthropomorphic features [13].

Mexico is the northernmost distribution for New World Primates with two of their native
species *Alouatta pigra* and *Ateles geofroyi* categorized as ‘Endangered’ by IUCN [14]. The
principal threats to these animals are deforestation and hunting for either food or pet trade [10].
Additionally, primate conservation programs take place under different socio-economic
conditions such as high poverty rates, limited funding resources, some negative cultural
stereotypes, and political instability and corruption [15]. In the face of these challenges,
successful primate conservation requires a multidisciplinary approach that needs to be nourished
by theory and practice from, at least, the fields of biology, anthropology, psychology,
economics, and education [16]. Integrating the natural and social sciences will guarantee that
decision-making during planning, implementation and management are guided by the best
available information [17]. Conservation efforts should also encourage local participation and
incorporate local knowledge systems to inform culturally-relevant educational programs that
instill respect for primates and their habitats in culturally-relevant ways [18,19]. Furthermore, as
a component of multidisciplinary conservation efforts, appropriate education and outreach
programs can promote sustainable behavior, decline poaching levels, and guide the decision and
policy making that impact the biodiversity and natural resources [20].
Conservation Education and Arts

Conservation Education (CE) is a crucial component in the process of solving current environmental problems through its role in increasing awareness and modifying attitudes of general population. As well as promoting the gaining of knowledge and skills in conservation researchers and practitioners [21]. Nevertheless, there is a need for seeking an interdisciplinary CE in order to be able to tackle complex, multi-disciplinary environmental challenges. To design a CE program, it is necessary to consider age, different learning strategies, and promote meaningful and transformative learning [22]. In Mexico, CE has been mainly dominated by a traditional education perspective because of the influence of the fields of biology and technology, whereby environmental information is transmitted through teaching methods that generate receptive and passive learning, reinforcing a single area of human development: the cognitive domain [23, 24]. But the emotional domain is needed for the integrated child development (e.g. creativity, critical thinking) and for the harmonious relation with nature [22]. In addition, many children seem to have lost enthusiasm in nature because they perceive it less attractive than social media or electronic games. Hence, we need to seek for innovative habits to (re)awaken and (re)nourish the sensibility of children and re(build) a new relation with outdoors [25].

The emotional perspective on sustainable behavior needs to be included on the level of model design, as well as on the practical level of intervention programs to result in long-term changes in feelings and behaviors [26] For this reason, artistic and creative approaches can facilitate affective knowledge, as well as deepen the emotional connections between people and places [27], thereby maximizing all senses (auditory, visual, kinesthetic, etc.). This is particularly important for biological conservation, because applying these principles to conservation issues can foster both closer relationships with nature, and more creative solutions to certain issues.
Additionally, central components of the decision-making process are the emotions and the conflict that we can experience between the heart and the mind while making the choice. The skill to manage emotions and moral issues is important in the argumentation processes of science emphasized in science topics related to socio-scientific issues, conservation topics and sustainable development [28].

In addition, it is vital to work this topic in formal education, where the school becomes the cornerstone in promoting values about the society-environment relationship and fostering a critical spirit to face the different situations of environmental problems. Besides, in the Mexican and rural context, the school is a central point of connection with the rest of the community where children interact with teachers, maintenance personnel, parents, etc. The future decision-making group is in the classroom today and the current decision-makers have relatives at the school too.

On the other hand, the benefits of arts education in elementary education are numerous, such as strengthening self-esteem, stimulating creativity and learning, and other moral values that are not acquired with traditional subjects. However, in Mexico there is a weak presence of arts at the schools. From the 800 hours of classes that are taught annually in primary school, only 40 hours are dedicated to Arts subject [29,30]. A precise assessment of CE programs outcomes would provide accountability and identify specific the role that arts can play in biodiversity conservation. Conservation issues can only be solved with creative and critical thinkers, different ways of perceiving and caring about the world should help us to conserve it [22].

**Primate conservation education**

CE programs has been reported to change people’s perceptions, knowledge and behaviors; thus, they are considered a key element of primate conservation initiatives [16]. Nonetheless, at
indigenous contexts it is important to consider different approaches from the post-development concepts (e.g. buen vivir, ubuntu) in order to take into account the traditional knowledge and different worldviews and belief-systems [31].

In practice, primate CE programs are varied, facing several difficulties depending on the social and cultural context, encompassing different audiences, having dissimilar lengths of time, and employing a variety of methods including active and passive learning strategies such as nature clubs, documentaries or comic books [32, 33, 34, 35]. Despite there being recent projects incorporating some artistic activities in primate CE, systematic evaluations of effectiveness of these activities remain few or are based mainly in the verbal-domain such as questionnaires as opposed to drawings analysis or photo elicitation [17]. Moreover, in Mexico, there is an overall lack of evaluation of primate CE programs, none of which use artistic approaches. This study seeks to fill this gap by employing an arts-based approach to primate conservation education and systematically evaluating its effectiveness. In this paper, we designed and conducted an arts-and-science based educational program at formal schools from Southern Mexico in order to evaluate the effectiveness of different teaching strategies in conveying the importance of the black howler monkey (A. pigra).

**Material and methods**

**Study site and subjects**

We conducted the study in different communities selected randomly throughout Southern Mexico (Fig. 1) during an annual elementary school cycle (2015-2016).
Fig 1. The area where black howler monkeys are distributed and the communities that were randomly selected.

The 12 communities (6 rural and 6 urban), within Natural Protected Areas. 1: Celestún, 2: San Francisco Tinum (Yucatán); 3: Dzoyolá, 4: Punta Allen, 5: Bacalar (Quintana Roo); 6: Xpujil, 7: Champotón, 8: Puerto Rico (Campeche); 9 Redención del Campesino, 10: Playas del Rosario (Tabasco); 11: Jerusalen, 12: Nueva Palestina (Chiapas). * Digital cartography used in this Figure is distributed under a Creative Commons Attribution-Noncommercial 2.5 license from Geoportal Conabio.

The three Mexican primates species can be found in this area, study sites were selected based on the geographical distribution of the black howler monkeys (A. pigra) that corresponds to approximately 250,000 km² in the states of Tabasco, Chiapas, Campeche, Yucatan, and Quintana Roo). Communities were randomly chosen from INEGI database [36] with selection criteria being rural or urban (less or more than 2,500 people, respectively) and residence within and outside of protected areas (PAs). This area is characterized by a strong indigenous heritage, there are around seven million Maya people that still live today in Mexico and Guatemala, many of them are native speakers of Mayan and their variations (e.g. Ch’ol, Tzeltal, Tzotzil, Yukatek) rather than Spanish [37]. From this context, a total of 229 students aged 8-10 years from 12 primary schools participated in this study. We considered three variables to analyze in this paper: gender (boys 48.9% vs. girls 51.1%), context (rural 48.9% vs. urban 51.1%), and PAs (inside PAs 43.7% and outside PAs 56.3%). Our educational intervention was done with the official permission of the Secretaría de Educación Pública- Secretariat of Public Education in the Government office of each State, the School Council and the Municipal Comissioner.
**Intervention design**

For conducting and evaluating the arts-and-science based educational program at the selected schools we followed a sequential intervention that consisted in three stages at each school: 1) Rapport building phase (via ice breaker games and creating a climate of trust) as well as pre-evaluation of knowledge and perceptions through content drawing analysis [18], 2) Intervention (four groups at each school participated in arts-based education techniques, three of which were part of the intervention, with the 4th group serving as the control group); 3) Post evaluation of knowledge and perceptions (through drawings analysis), and reinforcement of learning one month after the intervention. In parallel, meetings were held with the parents and teachers to explain the activities that we had planned with kids (see Table 1). Interviews were also conducted in the community to understand the social and environmental context of schools.

**Table 1. Description of all the techniques used detailing the focused sense, previous activities and materials used.**

| Technique and sense | Previous activity | Main activity | Material |
|---------------------|------------------|---------------|----------|
| Storytelling:       | Listening to environmental sounds and recreating them | Storytelling performed by the artistic facilitator, with some sounds through speakers. Students were blindfolded to enhance listening | Speakers and scarfs |
| Auditory            | Guiding dog game and observational games of the natural environment | Vision was the predominant sense in this activity, where the story was told through shadow puppets performed by the artistic facilitator, supported by wooden puppet theatre with wheels, | Homemade wooden puppet theatre |
| Shadow puppets:     | Guiding dog game and observational games of the natural environment | Vision was the predominant sense in this activity, where the story was told through shadow puppets performed by the artistic facilitator, supported by wooden puppet theatre with wheels, | Homemade wooden puppet theatre |
| Visual              | Guiding dog game and observational games of the natural environment | Vision was the predominant sense in this activity, where the story was told through shadow puppets performed by the artistic facilitator, supported by wooden puppet theatre with wheels, | Homemade wooden puppet theatre |
Theatre:  
- Physical and theatre warm-up games  
- Reading the story loud together and ensuring their comprehension.  
- Then, performing the story using only their imagination, body language and props (balls and scarfs)

Control group:  
- Physical warm up games and a dance activity while music was playing  
- Future scenario activity about their community. Children were asked to draw a specific place of their community in the present and 50 years in the future

| Arts-based Intervention |
|--------------------------|
| The intervention was carried out following different artistic languages, in which everyone was focused on a specific sense (Table 1). There was a main activity with three experimental groups: Storytelling (auditory sense), Shadow puppet (visual sense) and Theatre (kinesthetic sense). Each technique had the same duration (20-30 min), and the same content about black howler monkeys (geographical distribution, basic behavior, ecology, conservation, and worldview and traditional knowledge), but varied in the form or style in which it was communicated. Activities held for the control group were not related to black howler monkeys. Instead, a future scenario drawing activity was carried out, where children were asked to draw their community at the present and what it would be like in 50 years. |
Previous activities were done with each group before the main activity, in order to prepare the artistic language that was going to be used (auditory, visual and kinesthetic). After the main activity took place, the facilitator talked to each team about their perceptions, and to find out what they understood about the activity. Finally, we gave the children an opportunity to express one of their favorite’s scenes through a drawing. This activity was optional.

After the all the activities were finished, a satisfaction survey was used to identify children’s perceptions and suggestions about our performance. Each participant was asked to answer eight questions about the program (i.e., What did you learn? Could you give your opinion? Do you think this topic is important? Did you like how we told you the story? Would you repeat the experience? Did you have enough time to learn? Did you have fun? Did you like working as a team?) To answer them we used a dartboard prototype with three different colors of codification: green – very satisfied, yellow – medium, and red – not satisfied. Also, we hung a board on the wall with the title “How did I find the experience” and encouraged the children to express their thoughts and feedback about the activities, our presence, or a special moment they wanted to share (Fig. 2).

![Fig. 2. Left](image-url) A participant assessing our performance through the dartboard of what he likes and does not like. ![Fig. 2. Right](image-url) Space for kids to provide feedback on the activities.
Evaluation technique: drawings

Drawings were used for an evaluation method of children’s knowledge and perceptions about black howler monkeys (Pre and Post) [38, 39,18]. A sheet of paper with a howler monkey silhouette was given to each child, crayons were provided and they were encouraged to draw to answer the following question ‘What does this animal need to live well?’ (Fig. 3). There was no discussion before starting the drawing session, except to introduce the activity. Students were given 50-60 minutes to complete the drawings.

Fig. 3. Some of the children responses through drawings, each drawing is unique to each child.

We asked teachers to not interact with children, discuss their drawings or provide additional explanation during the activity. Also, no books or images were allowed for the activity. After the drawing was completed, we asked a series of questions to clarify the objects and actions depicted and to gain an understanding of the children’s perceptions. To minimize bias in the interpretation, each drawing was analyzed by a pair of researchers from different disciplinary backgrounds (i.e., conservation biology and psychology) but who were familiar with the monkeys and the children’s culture. Both researchers took part in the classroom activities. Strict pre-determined rules of interpretation were followed (see further information about the methodology at Franquesa-Soler et Serio-Silva [18] Inter-rater reliability was measured with a percentage of agreement, which takes into account the chance agreement of two observers. The two evaluators had 83% of agreement rate, and a rate of 80% is considered reliable (40).
Data analysis

Drawing activity was used to evaluate the effectiveness of each method of intervention (storytelling, shadow puppets and theatre) in expanding students’ knowledge about black howler monkey behavior, ecology, and conservation. We assessed students’ knowledge about black howlers in terms of the following categories: 1) howler pelage color – with black being the correct color, 2) tree - at least one tree appears in the drawing, 3) canopy - locating this animal on a tree or branch), 4) food - any type of correct food source they can imagine this animal needs), 5) family - other howlers in the drawing, and 6) other - e.g., representations of other activities such as playing, sophisticated source of food, conservation messages. For each of these categories, we assigned a knowledge score of 0 (absence) or 1 (presence). Pre and Post evaluation were considered to evaluate the effectiveness of each method of intervention. In addition, specific indicators of the change between the Pre and Post were considered. Yellow mombin (*Spondias mombin*) also known locally as *jobo*, is a fruit from the Black howler monkey’s diet and it was included in the content of the stories, so we evaluated the new presence of this element in the Post-drawings. We also assessed whether several assumptions or misconceptions that were detected in the Pre-analysis (*banana* as food source, *brown color* to describe this primate species, and locating the animal on the *forest floor* [18]) persisted following the interventions.

We used linear mixed models (LMMs) to analyze children’s knowledge (scored as 0-6), using context (rural and urban), gender (boys and girls), location related to PAs (living inside or outside), state (Tabasco, Chiapas, Campeche, Yucatan and Quintana Roo), time (Pre and Post) as fixed factors and ID (each individual child) as a random factor in our models. For all models, appropriate error distributions were specified following Zuur et al. [41]. To determine the best model to assign to the dependent variable (score of children’s knowledge) we used the Akaike's
information criterion (AIC). We performed LMMs with the R package nlme (Pinheiro et al., 2014) within the statistical program R (version 3.2.0) [43]. We calculated Increase of Learning (IL) representing the difference between the Score of Pre and Post intervention. We used repeated measures ANOVA (Bonferroni adjustment for multiple comparisons), and dependent T-test to make comparisons between pre- and post-evaluations. We also used independent T-tests and Kruskal-Wallis tests to compare between groups [44]. The $\alpha$-level for statistical significance was set at 0.05. Finally, to assess students’ satisfaction with our interventions, we calculated percentages for each level of satisfaction (i.e., green – very satisfied, yellow – medium, and red – not satisfied) from the dartboard exercise.

**Results**

From the LMM analyses, the best model indicated that the score of children’s knowledge was predicted by PAs, Time (Pre and Post intervention), and the interaction between Technique and Time (Table 2); but not by Gender (male/female; LMM: $P=0.0852$) or Context (urban or rural; LMM: $P = 0.1019$).

**Table 2. LMM analysis of factors affecting the Score of children’s knowledge**

| Predictor variables | DF | $F$-VALUE | $P$-VALUE |
|---------------------|----|-----------|-----------|
| Protected Area (PAs) | 1 | 2.85 | 0.0930 |
| Time                | 1 | 80.65 | <0.001 |
| Technique:Time       | 6 | 2.73 | 0.0140 |

**df, degrees of freedom. AIC = 1451.209**
We found differences in children’s knowledge between Pre and Post evaluation for all techniques ($P<0.01$, $P<0.05$, $P=0.01$, respectively; Fig. 4), except for the control group ($P=0.212$; Fig. 4).

Storytelling had the highest score from the Post-evaluation (3.9), followed by Theatre and Shadow Puppets, which shared similar scores (3.8 and 3.5, respectively). The storytelling technique produced a higher Increase of Learning (IL), or the difference between the Score of Pre and Post intervention (See Table A.2).

Fig. 4. Differences of children’s learning between pre-and-post evaluation at each technique expressed in Score’s mean, N= 229.

**Context: Protected Area**

Prior to the science-arts based intervention, children’s knowledge differed significantly depending on whether they were living inside or outside the PA (3.1±0.1 vs. 2.7±0.1, respectively; $t= 24.6$; $df= 1$; $p<0.01$). However, following the intervention, we found no significant differences in children’s knowledge by location (3.8±0.2 vs. 3.6±0.1, in and outside.
the PA, respectively; \( t = 31.6; df = 1; P = 0.181 \). We did detect a higher Increase in Learning (IL) for those children who live outside the PA (0.87 vs. 0.68). For children living inside the PA, we found differences in knowledge in relation to the intervention technique \([X^2(3, N = 89) = 20.39, P < 0.001]\). Namely, the technique that increased knowledge the most was theatre (60.47%), followed by storytelling (54.94%). Knowledge generated from the shadow puppet (39.28%) did not differ from the control (28.48%).

**Special indicators of the drawings**

a) *Spondias mombin*: specific item from the black howler monkey’s diet

Jobo (*Spondias mombin*) appeared for the first time in the post-intervention evaluation; it was present in 53.7% of the drawings and was influenced by the communicative technique that was used \((X^2 = 32.859; df = 3; p < 0.001)\). More children (67.9%) with the theater technique included the Jobo in their drawings as part of the diet of howler monkeys.

b) *Decrease of Assumptions*:

In addition to the IL produced between the Pre and Post intervention, some assumptions depicted from Pre-analysis [18] have decreased too (Table 3), such as including less bananas for food or drawing less times black howlers at the forest floor. Differences were not found among techniques.

| Assumption          | %Pre | %Post | \( X^2 \) | df | Pvalue  |
|---------------------|------|-------|-----------|----|---------|
| Banana              | 69.1 | 30.9  | 61.72     | 1  | <0.001  |
| Forest Floor        | 59.8 | 40.2  | 34.45     | 1  | <0.001  |
| Brown color         | 57.8 | 42.2  | 15.91     | 1  | <0.001  |
Satisfaction survey

Regarding the evaluation of children’s feedback about the CE program, a majority of positive answers were obtained in all the questions. Broadly, more than 70% of the children answered that they felt very satisfied in six of the eight questions. Questions with the highest percentage of positive answers were about: whether they learnt something new about black howler monkey conservation (72%), the importance of the topic (84%), their enjoyment during the process (88.8%), and the techniques used (86.6%). The questions scored negatively included the duration (8% not satisfied and 24.9% medium) and expression their opinions (15.8% not satisfied and 25.2% medium) (Fig. 5).

Fig. 5. Children’s feedback through answering eight questions about our performance, n=224

In order to obtain a further understanding about children’s perceptions of and reactions to the program, we also took into account the messages from the board (Fig. 2). Most of the messages
(71.3%) were about what they liked more. Particularly, they were referring to some humorous or positive moments of specific activities, including some of the icebreaker games (e.g. “I liked painting, working with you, dancing and singing, I liked everything”; “I liked to perform the theatre, I had a lot of fun and I learnt a lot”; “I liked when we saw the show of the monkey and the boy” or “I liked the shadow puppet”). Generally, most of the messages (65.2%) were related to positive feelings and emotions, and some messages were requests to continue our work with them (“I liked doing activities with you, I hope you come back”). Some sentences (40.6%) were linked to the black howler monkeys and what the children learned about them (“I liked to perform the theatre and to learn about monkeys, and to draw them”).

**Discussion**

**Quality of Education and Conservation programs: the need for innovation with methodologies**

Our study examined the effectiveness of different arts-based pedagogical techniques in improving the message for the conservation of primates and their natural habitat. Our aim was to find the best ways to have a positive educational experience with participatory and inclusive methods, as well as paying special attention to the emotional connection between children and nature or, in this case, the black howler monkeys. In Mexico, Education for Sustainability (EfS) is still relegated in the school curricula [23]. Therefore, our work supports an alternative when implementing EfS projects in formal schooling.

Regarding to the content of these programs, in some Mexican schools there is a good deal of environmental education about recycling and water care, but this is not directly related to how this knowledge can benefit local needs, biological conservation, and land use [32]. There is a
need for holistic approaches, where all environmental contents are linked to individual, collective and global trends and lifestyles.

Hence, from our experience we identified a gap in the teaching field of EfS in Mexico: the species conservation domain. Additionally, it seems that children are only following rules instead of being involved in meaningful projects [38]. With the arts-based education approach we were able to encourage critical thinking, as well as promote responsible actions based on autonomous decisions. Working on Primate Conservation allowed for the establishment of real connections between primate conservation issues and local community issues in ways that are not easy to teach through traditional methods. In Mexico this model is still common, where educators -many times with limited resources for doing their job -simply hand down knowledge and students do not play an active role in the learning process [23,45]. The components of choice, responsibility, simplicity participation in decision-making and feedback with results that are integral to environment-based education have been used in many different fields to empower learners, engage participants, improve training, and create appropriate development projects [46].

**PAs and technique predicted children’s score about the black howler monkeys**

We found that children’s knowledge about black howler monkeys was predicted by the technique used (storytelling, shadow puppet, and theatre) related to the moment of intervention, and PAs [inside or outside the Protected Area (PA)]. In contrast to other studies, children’s knowledge score was not predicted by gender [47, 48, 49] or by context (i.e., rural vs. urban areas). Other studies have provided evidence of gender impacts on pre-program knowledge, often with males showing improved knowledge. We had similar results in the Pre-evaluation, where in some categories boys had more knowledge about black howler monkeys [18] but with the implementation of the program these
differences disappeared. This finding supports the importance of designing projects, such as this one, that consider the inclusivity of gender by providing spaces where girls can express and learn the same way that boys do. This design feature is important in Mexico, where gender inequalities still exist, especially in rural communities [50]. It is also particularly significant for CE because positive associations between gender equality and sustainable development have been demonstrated in countries such as Nepal and India [51].

Previous studies have found differences in knowledge about biodiversity depending on the place of residence [52] where urban residents showed greater concern [53, 54]. Other recent studies, conversely, indicate that differences among rural and urban citizens may be weakening. The reason of factors influencing on reducing differences between rural and urban populations have been linked to (1) increase of environmental services for rural areas [55] (2) migration of urban citizens with positive environmental values to rural communities [56], and the decrease of economic dependence related to natural resources industries by rural communities. In a related study to the present one, we found differences in the Pre-evaluation [18], but in a reverse pattern: rural children knew more about these animals because they had more opportunities to see them. However, in the post-evaluation of this study we found that context (urban or rural) was not a factor influencing children’s knowledge, thereby confirming again that the project worked for both contexts and reduced the differences in conservation knowledge between rural and urban areas.

**Technique used**

Except for the control group, all artistic techniques (storytelling, shadow puppets and theatre), increased children’s knowledge score about the black howler monkeys. These findings confirm the general success of the arts and science based intervention. It is important to assume that CE
programs do not work everywhere in the same way. Accordingly, it is important to test different techniques to include cultural factors, gender, and different learning styles. For instance, applying education techniques (including evaluations) that work for a Western society audience might not necessarily lead to the expected change in a developing country [4].

In Mexico, EfS is poorly implemented in the school curricula, and Arts education is rarely taught [30]. The Arts allow children to learn through all senses and promote the use of multiple intelligences [20]. Additionally, in Southern Mexico there are roughly 16 indigenous languages [58], and while the majority of schools are not indigenous, there are language, reading and writing difficulties. The underlying problem is that, since Mexico is culturally and linguistically diverse, the curriculum is unique for the whole country and the assessment instruments are in Spanish [59]. Also, teaching is typically rote-learning (memorization of information based on repetition) instead of educator-learner interactions with creative education techniques [60,61]. Hence, before applying and evaluating an education program it is crucial to adapt the program contents and the type of evaluation question to the local context, as well as considering a universe of different learners [49].

Although all techniques successfully increased children’s knowledge, Storytelling stands out as being the technique that produced both a higher Score and Increase of Learning (IL). This finding matches with the results found in the Pre-program, when learning preferences were evaluated in the same group of children [45]. The Pre Program study revealed that auditory was the preferred learning style of the children (46.4% of the sample), in accordance to Dunn & Dunn [62] and Barbe & Milone [63], who reported that it is common for children at the primary level to learn and retain information through the auditory sense. In this case we wanted to design tools which considered their preference, invited them to reflect and participate actively, and used a
technique that was important for the Mayan cultural context [64]. Furthermore, current studies show how narrative and storytelling can facilitate the communication of science to nonexperts [65], expanding the context of “framing” as being an important component of public outreach [66].

Stories form a link between our imagination and our environment [67]. In fact, for most cultures (e.g. Mayan culture), oral traditions and stories convey local knowledge and wisdom about the environment and our relationship with the earth and with others [64]. Narratives allow the audience to get to know the characters, see different perspectives, and experience their emotions and their environments. Furthermore, it is a good methodology to achieve emotional connections and symbolic thinking, goals which technology sometimes cannot accomplish. For example, replacing free play and storytelling with the audiovisual system undermines the symbolic-metaphorical intelligence of children [68]. Excessive audiovisual activities isolate children from both the world of imagination and the natural environment. However, during free play, theatre, storytelling and similar activities, children can develop inner images. This ability is the foundation of future symbolic and metaphorical thinking, and concrete operational thinking, mathematics, science, philosophy and all forms of knowledge considered as higher education [68].

Our study shows that if multiple intelligences and senses are considered, it can improve the effectiveness of CE programs. Not only for the part of the intervention, but the evaluation should also be inclusive for all learners and indigenous cultures, since most times in primate CE assessment is done through questionnaires [4,61,34]. The drawings have been excellent tools for evaluating the effectiveness of CE programs, as well as an artistic approach that evaluated the knowledge of these animals. If it is an education based on novel tools that promote other emotional processes, then drawing is in accordance with this approach.
Protected Areas and non-Protected Areas

Differences in knowledge between those living inside and outside of PAs were found during the Pre-evaluation [18] but they disappeared when Post-evaluation was analyzed. This finding suggests that, as we found with the other context variable (rural vs. urban), that the project worked for both children living inside or outside PA and reduced differences between these groups. *Theatre* was the technique which was most effective inside PAs, and this could be due to the one specific school inside of a PA that showed an incredible excitement for this technique.

Our results do not support the idea of using only this technique inside PA, but more studies are needed to test different methodologies for different situations and contexts, and by considering the diversity of learners.

Learning indicators, decrease of misconceptions

During the Pre-program evaluation, the more common misconceptions or assumptions around children’s understanding about black howler monkeys were detected [18]. First, we used *Spondias mombin* as an indicator of knowledge. Then, to analyze if misconceptions decreased, we selected the three most common confusions depicted from the Pre-evaluation: *banana* as a food source, *brown color* for describing this animal, and locating them on the *forest floor*. *Jobo* (*Spondias mombin*) was considered as an indicator of knowledge because it is one of the tree fruit species most consumed by these animals [69]. Long-term studies reveal that black howler monkeys have a highly varied diet, largely dependent on the availability of preferred foods [6]. Therefore, it was selected for being representative both to the black howler monkey diet and to the Southern Mexico region. During the Post-evaluation, *jobo* appeared in more than half of the drawings (during the Pre-test none), indicating that the intervention was successful, that the story was understood and that the children learned about one of the elements of the actual diet of black howler monkeys.
Regarding the technique used, theatre was the most effective technique for children incorporating jobo in the drawings and, at the same time, even reducing the misconception of bananas being black howler foods. It is important to not only show that some elements are not part of their diet, but also to show which elements are correct. The same principle applies with other pro-environmental behaviors, as it does not help to say what should and should not be done, but show in a simple way what can be contributed [70]. During the theatre activity, children played with props, sometimes simulating the jobo. They integrated it for the theatre play, they ate the jobo and defecated it to represent the role of black howler monkeys as seed dispersers. The action of touching and using it in a specific situation might serve to materialize and internalize it as a concrete manipulative [71]. According to Carbonneau et al. [71], concrete manipulatives make easy learning by (a) promoting the abstract reasoning [72], (b) enhancing thought-provoking learners’ real-world knowledge [73], (c) allowing the learner to apply the concept for improved encoding [74], and (d) offering chances for learner-driven exploration while discovering new concepts [75].

With respect to assumptions or misconceptions, these three decreased in the Post-test analysis, indicating that our intervention not only helps increase learning, but also to clarify some children’s confusions. The origin of the myth that monkeys naturally eat bananas remains unidentified, but its persistence is a misconception that primate conservation education programs should address as it tends to anthropomorphize monkeys. The banana concept was tackled through the help of “dislike” sounds and negative expressions during the interventions. The brown color was explained in the stories with the different formats, but it was also reinforced by showing a real picture of the animal at the end of the activity. The forest floor misconception was highlighted in the story by relaying that howlers arrived at an extremely deforested area and
needed to cross the highway on the ground to access to other sources of fruit, but that some died while trying. Other threats and diseases that these animals face in the forest floor were also shown.

**Satisfaction survey**

The use of evaluation tools is really important for conservation education programs [61]. To know which are the most effective conservation programs, it is essential to assess the children’s perceptions and knowledge about certain topics. It is also important to understand the children’s feelings and opinions about the conservation program [4, 34]. We sought to assess the latter through the *satisfaction survey*. Because children from Mexican communities are usually taught through the traditional teaching system, it is not common for them to be consulted about the educational programs that they receive or to be asked to evaluate their teachers’ performance. For this reason, it is important to take into account that their answers may be conditioned, resulting in overestimating our performance. However, the satisfaction survey is still a useful tool to explore their reactions about our activities and also to enhance critical thinking, which is necessary for the decision-making processes about sustainability issues.

The general results of the satisfaction survey show a positive response to this conservation education program by the students. Children stated that they had learned about the black howler monkey conservation and considered it an important issue. We attribute these reactions to their enjoyment of the learning process and the arts-based techniques used. Including an emotional component in the design of education programs can act as a motivation factor by facilitating students’ engagement and making the learning process more stimulating [26]. Although the percentage of negative perceptions obtained in this survey was very low, it is important to consider that some children thought that the time invested in the implementation of the program
should have been longer. This is in agreement with some primate education projects that have found that longer programs are associated with a greater increase in participants’ knowledge [61,33] and that long-lasting projects would be more effective (Swartz et al. 2012). That said, other studies found that the length of participant involvement did not affect knowledge retention [16,76]. The message posts left by the children on the board all contained positive content. Most of these messages allude to their enjoyment with some of the artistic activities or icebreaker games we did during the process. On the one hand, the use of games is a powerful teaching strategy because it makes the learning process more interesting and fun [77]. On the other hand, researchers have found that arts offer a way for people to connect emotionally to the conservation topic of interest, and therefore are proving successful. A good learning process includes feelings and is vital to achieving long-term changes in perceptions and behaviors [26]. Moreover, children showed in their messages that they really appreciated our activities and the time they spent with us, and that they would love to repeat the experience.

Conclusions

We contend that the program was effective not only because of the techniques used, but because it was a holistic program. According to Stern et al. [78], after reviewing 86 programs, they found that a common element of success in the interpretation of Education for Sustainable Development field was the concept of providing a holistic experience [78]. Since we started asking for permits from the Secretaría de Educación Pública - Secretariat of Public Education in the Government office of each State, we considered presentation days, ice breaker games, establishing rapport or trust with the school community (and the general community). We also did a pre-test with inclusive, qualitative and comfortable evaluating tools (drawings). We worked with small
groups, naming those groups with the corresponding fruits and animals which appeared in the
story. We conducted activities beforehand in order to prepare the artistic language for the
different techniques of the intervention. We based the program on an artistic approach,
conducting several dialogues in between, and other drawing activities to reinforce learning. We
also conducted the satisfaction survey, as well as games to invite reflection and the sharing of
experiences, emotions and cultural exchanges. We spent 2-3 weeks at each place, living there,
sharing food with the local people, getting to know the parents, grandparents and places in which
they loved to play or explore after school. We also participated in some activities important for
the local community (e.g. town or school festivals, sport events). To sum up, it was a holistic
experience. Holistic experiences involve conveying a complete idea or story within the
educational context. They thus carry high potential to provide a coherent picture of the relevance
of the educational activity and a clear take-home point for students to reflect upon or pursue
following the experience [78].

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Figure 5

What did you learn?

- Did you like working as a team?
- Did you have fun?
- Did you have enough time to learn?

Could you give your opinion?

- Do you think this topic is important?
- Did you like how we told you the story?

Would you repeat the experience?

- Not satisfied
- Medium
- Very Satisfied
Example of permits obtained

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