A novel application of cultural consensus models to evaluate conservation education programs

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Abstract

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Conservation professionals recognize the need to evaluate education initiatives with a flexible approach that is culturally appropriate. Cultural-consensus theory (CCT) provides a framework for measuring the extent to which beliefs are communally held and has long been applied by social scientists. In a conservation-education context, we applied CCT and used free lists (i.e., a list of items on a topic stated in order of cultural importance) and domain analysis (analysis of how free lists go together within a cultural group) to evaluate a conservation education program in which we used a children's picture book to increase knowledge about and empathy for a critically endangered mammal, the Javan slow loris (*Nycticebus javanicus*). We extracted free lists of keywords generated by students (n=580 in 18 schools) from essays they wrote before and after the education program. In 2 classroom sessions conducted approximately 18 weeks apart, we asked students to write an essay about their knowledge of the target species and then presented a book and several activities about slow loris ecology. Prior to the second session, we asked students to write a second essay. We generated free lists from both essays, quantified salience of terms used, and conducted minimal residuals factor analysis to determine presence of cultural domains surrounding slow lorises in each session. Students increased their use of words accurately associated with slow loris ecology and conservation from 43% in initial essays to 76% in final essays . Domain coherence increased from 22% to 47% across schools. Fifteen factors contributed to the domain slow loris. Between the first and second essays, factors that showed the greatest change were feeding ecology and slow loris as a forest protector, which increased 7-fold, and the humancentric factor, which decreased 5-fold. As demonstrated by knowledge retention and creation of unique stories and conservation opinions, children achieved all six levels of Bloom's taxonomy of learning domains. Free from the constraints of questionnaires and

surveys, CCT methods provide a promising avenue to evaluate conservation education programs.

Introduction

As human populations and infrastructure increase, conservationists recognize the urgency to improve through education the capacity of local people living near threatened habitats to engage in behaviors that protect the species and resources on which they depend (Bettinger et al. 2010; Bickford et al. 2012). Such initiatives should strive to provide information about the target species or ecosystem (Monroe et al. 2007) and evaluate whether the population has developed the desire, knowledge, and skills to protect or restore the environment (Jacobsen & McDuff 1997). Yet understanding how such programs change attitudes and knowledge through assessment is still rare, especially over the long term (Kuhar et al. 2010; Ballouard et al. 2012).

One way to provide baseline information in conservation education programs that may lead to increased knowledge and behavioral change is the use of children's picture books. Picture books can be used to introduce participants to animals or environmental concepts for the first time. They entertain and spark imagination while initiating advocacy and pride for native species in an age- and culturally appropriate way (Wells & Zeece 2007). Picture books about animals can be a major stimulus to caring about the natural world (Myers & Saunders 2002). Applications of picture books in conservation programing, however, have rarely been assessed. For those that have been, the published assessments tend to be superficial or based on small sample sizes (Dolins et al. 2010; Pichetvit 2014).

Gauging the impact of education schemes on target audiences requires assessment that is appropriate to the style of teaching and culturally specific (Brewer 2002). Questionnaires delivered before and after the introduction of environmental education activities are a common mode of assessment but have numerous constraints (e.g., Dolins et al. 2010; Ballouard et al. 2012; Tsoi, et al. 2016). Understanding attitudes based on the responses to questions may be hindered by information researchers provide in the questions. For cultures not used to questionnaires, the questions may be perceived as an examination and elicit anxiety. For cultures where saying no is considered impolite, the respondents may strive to produce a correct answer rather than express their true beliefs (Heberlein 2012).

One alternative to questionnaire surveys is derived from cultural-consensus theory (CCT). Methods stemming from CCT originate from cognitive anthropology but have been applied to marketing, product development, ethnopharmacology, psychology, and public health (Kim et al. 2008; Heinrich et al. 2009; Ares & Deliza 2010; Schrauf & Sanchez 2010). Within a CCT framework, researchers systematically collect information from human participants to obtain responses that can be coded to estimate culturally correct answers (Weller 2007). Based on the concept that beliefs are learned and shared by members of a culture or social group, one can measure to what extent beliefs are communally held. These assessments are not designed to be a moral judgement; instead, they reveal that some individuals know more about a topic than others. To analyze such data robustly, questions must be on a single topic (domain of knowledge), have the same level of difficulty, and have only one possible set of answers. Informants should be independent and not allowed to influence each other's answers (Weller 2007). The level of consistency or agreement between an individual and the other members of their culture on a subject is known as their cultural competence (Mueller & Veinott 2008). Cultural-consensus data can be collected formally through open-ended,

multiple-choice, or dichotomous questions, and it is assumed some answers may be guesses. An informal version of the analysis is known as the cultural-consensus model (CCM) and uses a statistical approach derived from factor analysis that does not require correction for guessing. Furthermore, CCM is based on the assumption that the investigator is unaware of how much each informant knows about the domain (Romney et al. 1986). Both models produce culturally correct answers, the variability of which can be compared within the population (Weller 2007). Although CCT has been applied to examinations of traditions and conservation within communities living near wildlife, we found no evidence of its use in conservation education (Reyes-Garcia et al. 2003; Grant & Miller 2004).

Another component of cultural-consensus analyses is saliency of words on a single topic spoken by participants during interviews or generated by participants in writing exercises. Higher weight is given to words used more frequently and earlier in a list of words written or spoken by the participant. The assumption is that people tend to mention words in order of familiarity (Schrauf & Sanchez 2010). Saliency is also affected by variability of the potential answers; larger samples are needed for more complex questions (Weller 2007). Cultural-consensus analysis offers a way to collect data throughout an education treatment via creation of free lists, whereby the researcher lists words written or said in the order they were generated by the participant, which are less constrained by data collectors' biases.

To interpret how such data are related to participants' learning, an education framework can be applied for focused inquiries into communally held beliefs to evaluate processes and principles, rather than rote learning. Conservationists recognize that the learning taxonomy developed by Benjamin Bloom (1956) provides an ideal framework within which to examine people's behavior in the context of environmental issues (Patrick et al. 2007). In Bloom's taxonomy of learning domains, levels of understanding begin at basic knowledge and

comprehension, advance to application and analysis, and ultimately reach evaluation and synthesis of new concepts and ideas. These levels can be applied to beliefs and actions in an environmental-education context and evaluated through participant essays, plays, and creative games (Rule & Lord 2003).

There is an increasing need to develop new methods for analyzing environmental education programs (Bickford et al. 2012; Kuhar et al. 2012). Using the above framework, we developed a children's picture book about a cryptic nocturnal mammal, the Javan slow loris (*Nycticebus javanicus*). Found only on Indonesia's island of Java, this critically endangered primate is opportunistically targeted for illegal pet trade (Nekaris & Starr 2015). Slow lorises are prevalent in Indonesian folklore. Stories with neutral (slow lorises are an innocent animal), positive (every person has a slow loris waiting for him at the gates to the afterlife), and negative (slow loris blood causes landslides) connotations are embedded in Indonesian culture (Nijman & Nekaris 2014). Although local people are aware of such myths, they rarely encounter these nocturnal primates. Thus, the beneficial function of slow lorises in the ecosystem, namely as pest consumers and pollinators, is less known (Nekaris 2014; Nekaris 2016).

We aimed to determine whether cultural consensus methods can be used to measure knowledge about a threatened species gained through a picture book and related teaching. We evaluated our results based on Bloom's taxonomy to determine whether application, evaluation, and synthesis of knowledge gained may stimulate proconservation attitudes. We predicted that participants in our program would produce essays that could be transformed into free lists of words that could be used to evaluate knowledge gain and that cultural competence regarding the domain of slow loris would increase among the population. Creative outputs from the essays should reflect learning within the higher levels of Bloom's

taxonomy. We evaluated the suitability of this method for conservation projects of threatened species.

Methods

Slow loris education program

We created a 30-page picture book, entitled *Slow Loris Forest Protector*, intended for use by children 8-12 years old. The book contained 293 words, 175 of which were unique. We included several key concepts (Wells & Zeece 2007): the importance of the mother to its young; the need for social learning to find food; unique behaviors (inability to leap, venomous); and ecological importance (pollinating plants, consuming insect pests) (Nekaris 2014). Because a threat to slow lorises is having their teeth clipped by traders to prevent their venomous bite, implicit in the story and illustrations was that slow lorises require their teeth to survive, with the idea that the image of a slow loris with teeth would become rationalized into the child's worldview of the animal (Cosslett 2006). We intended the story to be nonthreatening and to introduce children to a unique native species in a factual but entertaining way. We produced illustrations as accurately as possible, including aspects of slow loris anatomy, everyday nature such as plants and architecture, and human dress (Trundle et al. 2008) (See Supporting Information).

We conducted the program from November 2013 to September 2015 in Cisurupan District, Garut Regency, where a long-term study of Javan slow lorises has been underway since 2011 (Nekaris 2016). The main occupations of people in the region are farming and forestry, which contribute 40% of the Regency's gross domestic product per capita (which stands at about

US$1100) (BPS, 2015). With few exceptions, all residents are ethnically Sundanese and Muslim. Islamic tenets preclude the consumption of primates but slow lorises are illegally caught to meet the demand for the exotic pet market (Nijman & Nekaris 2014). Myths surrounding slow lorises are particularly strong in Cisurupan, and levels of exploitation by residents are low (Nekaris 2016). Children are required to attend school until 12 years of age but typically attend until they are at least 14. Lessons are taught in Bahasa Indonesia and follow a national curriculum including biological sciences. The literacy rate in Garut is approximately 99%, where 98% of children attend elementary school and 75% attend junior high school, and there are no major differences in school attendance between boys and girls (BPS 2015).

We visited 18 schools for initial and final data collection sessions of 2 hours each. The time between initial and final sessions was 8-28 weeks (mean 18.1 [SD 6.7]). A total of 1271 children participated in the program, and 580 participated in both sessions and were included in our study. Ages of children ranged from 8 to 13 years old (n = 580, mean = 10.1 [SD 0.8]; girls, 56.5%; boys, 43.5%).

We conducted the program in Bahasa Indonesia. In both initial and final sessions, upon entering the classroom, we asked the students (hereafter respondents) to write a story about what they knew about the slow loris, prompting respondents to describe what kind of animal it is, what it looks like, where it lives, and what it eats. Because we wanted to know what the respondents knew without instruction from us, we gave no other information until after they completed the essay. Teachers and invigilators scanned the room during essay writing to minimize copying. We then read them the book and gave a 10-minute presentation on slow loris ecology. To complete the session, we used an accompanying education pack that included masks, finger puppets, and games designed by the book illustrator to reinforce the

terminology and concepts of the book (Supporting Information). During the initial session, the purpose was to introduce the children to the slow loris and its behavior. We did not mention threats or that the species was legally protected (Meyer 2002). After the initial session, we gave each child a personal copy of the book and a memory-card matching game to reinforce concepts from the book and education session. During the final session, after the essay writing, we informed the respondents that slow lorises are legally protected and that a major threat is the pet trade. Children wrote all essays in Bahasa Indonesia and included their name, age, and sex on their essay. The University Research Ethics Committee in the Faculty of Humanities and Social Sciences at Oxford Brookes University approved our research. The protocols followed the ethical guidelines proposed by the Association of Social Anthropologists of the United Kingdom and Commonwealth.

Cultural-consensus analysis

To examine the words generated from respondent essays, we ran all 8403 words through a frequency generator (NVIVO). We extracted for analysis all nouns, adjectives, verbs, and adverbs and removed irrelevant filler words (e.g., definite articles and pronouns). We removed typographical errors and combined extreme synonyms, for instance two Indonesian words for slow loris (kukang, muka geni) or the same word with different suffixes or prefixes (protect, protecting, protected). We converted all stories into free-list data by entering each respondent's first ten usable words into a csv file in the order that they were written (Schrauf 2010). We generated descriptive data on the word diversity: number of distinct words listed by all schools and word count, which was the total number of words listed regardless of the number of times each was used. We kept all words in Bahasa Indonesia throughout the data

analysis process to reduce subjective decisions and to avoid double translations (Puri 2011). We referred to the original essays throughout to ensure proper context.

We conducted a cultural-domain analysis, an anthropological method whereby the presence of a cultural domain is verified through factor analysis of words generated from free lists and subsequently the topics making up the factors are classified into a series of groups reflecting a single bounded domain of knowledge (Schrauf & Sanchez 2008). In our case, we wanted to understand the groups of terms and factors that made up the domain slow loris. First, we examined the presence or absence of domain coherence (or cultural consensus) in each school between the first and second essays (Fig. 1). The presence of domain coherence indicates respondents are drawing from the same underlying knowledge system. We created an item-respondent matrix for each school and condition (first or second essay), which consisted of binary presence and absence data for each word listed within that group. We analyzed these matrices individually with minimal residuals factor analysis (MRFA) in the program UCINET 6, which produces eigenvalues and factors (Schrauf & Sanchez 2008).

We examined changes in coherence within the same school between first and second essays (Comrey & Lee 2013). For each respondent, for each of the two essays, we calculated a mean frequency score that represented their level of competence within their school. To calculate the mean frequency score, we separated respondents into groups based on their school and condition (first or second essay). Within each group, we gave items a frequency score (the number of times each item was written in that group) and averaged them to form a mean frequency score. Relatively high mean frequency scores indicate increased cultural competency within a group (Comrey & Lee 2013).

We listed the factors resulting from the MRFA across schools within the domain of knowledge (Puri 2011). The change in these factors between conditions indicates modification of shared knowledge and cultural competence of respondents within a cultural domain (Heinrich, et al. 2009). To explore how these changes affected overall learning, we analyzed the frequency of words within each factor between first and second essays for all schools with Wilcoxon signed rank tests.

Vocabulary and cognitive complexity

To examine overall changes in vocabulary between essays, we used Smith's saliency index to calculate the change in saliency scores of all shared words between first and second essays (Schrauf & Sanchez 2008). We subtracted the initial saliency score from the final saliency score. Scores farthest away from zero represented the words that changed the most between essays.

We examined story content and change in factors between essays to assess presence of evidence that our respondents could apply their knowledge, rather than their only having memorized facts. We used the criteria for learning levels within the cognitive domains of Bloom's taxonomy to reflect achievement at various levels of learning (Fig. 2). We used increase in the relevant factor or direct evidence from respondents' essays to provide presence-absence data that indicated respondents in our population had improved levels of cognitive complexity (Rule & Lord 2003). We conducted statistical analyses in SPSS version 23.0 ($p \leq 0.05$).

Results

For the first essay, respondents wrote 2990 total words that could be included in the analysis, of which 322 were unique. For the second essay, respondents wrote 3514 words, of which 207 were unique. In the second essay, we calculated a 35.7% decrease in word diversity, but a 17.5% increase in overall word count. Initially, 43.2% of all words respondents listed occurred in the book. In the second essay, this number increased to 75.7%, and 99.3% of respondents listed at least one word from the book (*n*=576). We found marked changes in the words respondents used between essays (Table 1, Fig. 3).

We found that 197 words in the initial lists were absent from the final lists. The greatest changes (with original frequencies), when considered in context, were words that could either be construed as negative (*home*, 23 occurrences; *to keep*, 17 [e.g., "I keep the slow loris in my home in my bedroom."] or irrelevant or incorrect (*rice* , 20; *tail* , 19; *mouse*, 13 [e.g., "Like a mouse, slow loris eats rice."]). Eighty new words appeared in the final lists, including those with positive conservation connotations (*to preserve*, 45; *to be arrested*, 20 [e.g., "We must preserve the loris or it will become sad."]) or pertaining to slow loris biology (*to slither*, 26; *primate*, 12; *licking*, 11 [e.g., "It likes to slither like a snake.").

Changes in saliency scores shared between the first and second essays were most marked for words relating to ecology, loris biology, or conservation: *forest*, +0.36; *guard*, +0.33; *nail* , +0.24; *night*, +0.17; *tree*, +0.15; *preserve*, +0.12; *flower*, +0.11; *garden*, +0.10. The MRFA showed domain coherence in the first essay in 21.7% of schools (mean ratio 1.63 [SD 0.37], *n*=20), whereas in the second essay, it was present in 47.1% of schools (mean ratio of 2.95 [SD 0.32], *n*=18).

We found a significant change in the distribution of mean frequency scores between the first and second essays in 10 out of the 18 schools (Table 3). The MRFA yielded 15 factors (Table

3). Between the first and second essays, we detected a significant increase in 5 factors: feeding ecology (Z = -3.57, p<0.001, range 3.5-24.1%), forest protector (Z = -3.57, p<0.001, range 1.0-7.6%), loris biology (Z = -2.44, p=0.015, range 6.1-9.2%), and agriculture (Z = -2.11, p=0.035, range 3.5-6.0%). We detected a significant decrease in five factors: negative conservation (Z = -3.15, p=0.002; from 5.3% to 2.0%), negative feelings (Z = -2.97, p=0.003; from 1.7% to 0.1%), humancentric (Z = -3.53, p<0.001, from 5.7% to 1.1%), nature general (Z = -3.35, p=0.001, from 6.8% to 0.6%), and wild animal (Z=-3.01, p=0.003, from 19.4 to 9.9%).

Learning was achieved at all levels of Bloom's taxonomy of learning domains (Fig. 2; See Supporting Information). Focusing on word lists, 99.3% of all respondents (n=576) achieved remembering by listing words found in the book. Two-thirds of respondents (76.7%) reached understanding by listing relevant words not found in the book or program materials, whereas16.6% of respondents achieved application by including novel words directly relevant to slow loris biology. Respondents exhibited a lack of cultural competence as shown by first essays through weak domain coherence; there were only 17 factors and only 1 relating to loris biology (Table 3). In every school in the final essay, cultural competence was reached in the first factor; all factors related to slow lorises (feeding ecology, loris habitat, forest protector). All but one school generated 2-4 additional factors. These remaining factors included topics not taught directly that students must have inferred from the program (loris conservation, legal). Statements from respondent's essays reached the highest level of Bloom's taxonomy (Synthesis) when they generated a creative story or discussed conservation topics not taught in the program (Supporting Information).

Discussion

We devised a novel way to investigate the impact of a children's picture book and related teaching on the knowledge and understanding of its readers. Through essays freely written by respondents with input from educators limited as much as possible, we identified several trends. Respondents learned concepts from the book and could repeat them up to 28 weeks later, as identified by frequency counts of words in the form of free lists. Using saliency indices, we found that in the final session, essays became more focused, with irrelevant words largely disappearing, and words more related to the target species' ecology becoming dominant. By applying informal cultural consensus modeling to these data, we found that the schools exhibited high coherence within the domain slow loris and showed a mutual understanding of the importance of slow lorises to the ecosystem. The education program also went beyond the basic levels of Bloom's taxonomy of learning domains remembering and understanding in that respondents demonstrated an ability to evaluate and synthesize material.

By writing an essay about the behavior and ecology of the slow loris, respondents provided a set of data that was suitable for use with CCM. We asked respondents to write a story using only words and concepts they knew, unprompted by questionnaires and with no indication there were correct answers. Invigilators monitored copying to ensure the assumption of independence was not violated (Weller 2007). Through this mechanism, our respondents demonstrated they learned a basic set of facts about the behavior and ecology of a threatened species. Every child was given a personal copy of the book and could read it multiple times. Becoming familiar with basic terminology about nature and developing an understanding of how organisms live are crucial steps toward caring about the environment and wanting to help solve environmental problems (Hsiao & Shih 2016). To this end, environmental educators stress that a familiarity with the natural world needs to begin in childhood (Trundle

2008). Such programs are deemed especially beneficial when children can learn about native organisms, especially those with which they are likely to have contact (Kollmuss & Agyeman 2002; Beaumont et al. 2016). We believe achievement of these outcomes is further supported by the resulting domain coherence of respondents in our study.

Domain coherence was present in nearly half of the schools after the final session and approached coherence in four others. Cultural domains have a core set of word and periphery sets so that most people will mention the core words and then each person will also possess knowledge of some periphery sets of words (Schrauf & Sanchez 2008). The increase in use of words comprising factors within the domain slow loris and the tightening of the domain ratios showed that respondents in the population possessed new and accurate knowledge about the species (Miller et al. 2004). Such knowledge within a population is a major first step in development and management of conservation programs (Waylen et al. 2010). Children can play an important role in a community influencing conservation outcomes. The area where we study slow lorises is not legally protected; thus, slow lorises rely on local people to leave them habitat and leave them undisturbed. By bringing the book home with them, the children could also pass conservation messages to their parents (Vaughan, et al. 2003). Further studies could examine competency of parents of respondents in our program to address the efficacy of this approach.

Our results showed that cultural-consensus methods are appropriate for a classroom setting. Wells (2007) noted the relationship among cultural competency, the number of respondents, and the validity of the findings. With median class sizes of 28, even if levels of shared beliefs are low, for instance when cultural competency is 0.50, high accuracy of answers can still be reached (0.95 validity). When cultural competency is higher (e.g., 0.60), this same level of accuracy can be obtained with class sizes of 17 or above (Wells 2007). In Cisurupan, where

our median class size was 32, after only one session, we found high levels of cultural competency for several factors, including feeding ecology and loris habitat, that resulted in high validity. Thus, the use of cultural-consensus methods for evaluation of conservation education programs is robust in situations, such as ours, where students with a largely similar socioeconomic background can be reached at once through a series of treatments. In cultures with low literacy rates, our methods could be adapted to include picture books with no words and lessons and activities taught verbally by an instructor and evaluated through free lists generated from words used by participants.

Kalof et al. (2016) emphasized that conservation education programs nurture the capacity of humans to move away from utilitarian perspectives of wildlife to perspectives that advance a greater sense of kinship with native animals. In their final essays, respondents wrote about important conservation issues, such as not cutting slow loris' teeth and the urgent need to conserve them (Table 4). Coupled with achieving higher levels within Bloom's taxonomy, results showed that respondents had not only increased their knowledge but also were actively thinking of creative applications and conservation planning with their new knowledge, an aspect considered vital in conservation campaigns (Tsoi et al. 2016). The development of such associations is vital for fostering long-term commitment to protecting nature (Zhang et al. 2014).

Cultural-consensus methods were particularly successful in evaluating the material presented in our book and associated materials. Visual media is considered an important method for experiencing nature (Marriot 2002), and picture books are a creative format that supports literacy. We displayed biology and ecology of the target species accurately and avoided negative messages. Conservation scientists entering the realm of children's education for the first time often throw hard concepts and facts at children that are too young to understand

such issues (Meyer 2002). For example, Dolens et al. (2010) describe children's books used in Madagascar aimed at 9- to 12-year-olds that cover gripping topics, such as forest fires, pet trade, and forest destruction. Such books may attempt to use fear, guilt, or inaccurate representation of environmental issues to foster proconservation behaviors before empathy and knowledge are developed about an animal or conservation issue (Marriot 2002; Meyer 2002). Such fear tactics can be ineffective and have the opposite effect, causing readers to feel afraid, isolated, or hopeless (Kriesberg 1999). The fact that slow lorises are threatened was only mentioned briefly at the end of the final session and was not illustrated with images of pet trade or animal abuse. Teaching children first to have empathy for nature and its surroundings is essential before putting the responsibility on them to tackle hard-hitting problems (Sobel 2004).

In tropical countries, access to multimedia resources about wild animals is often scarce and text books are not written from a native perspective. Learning about exotic species only may prevent the conservation of threatened native taxa, potentially leading to reduced conservation actions (Dolins et al. 2010; Genovart et al. 2013). A factual yet engaging children's picture book can help fill this gap, yet assessments are needed of this popular educational tool to demonstrate its utility. We found there is potential in applying CCT in conservation education in a classroom setting and advocate the use of cultural-consensus methods to evaluate such programs in an objective and quantitative manner.

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Table 1. Frequency of occurrence of the 10 most commonly used words (all schools combined) in student essays written before 2, 2-hour education sessions in response to the question, "Tell me what you know about a slow loris."

First essay	Second essay

word frequency	word	total (%)	word frequency	word	total (%)
230	forest	7.7	385	forest	11.0
176	animal	5.9	213	tree	6.1
112	tree	3.8	178	*Calliandra*	5.1
71	grass	2.4	176	acacia	5.0
64	night	2.1	168	night	4.8
42	cute	1.4	158	to protect	4.5
42	leaf	1.4	139	sap	4.0
41	human	1.4	132	flower	3.8
40	land	1.3	104	animal	3.0
39	eye	1.3	85	insect	2.4

Table 2. Factors within the domain slow loris identified through minimum residual factor analysis.

Factor category (*n*)	Example Words	Description
Wild animals (51)	wild animal, insect, duck	animals not native to Indonesia; members of this category can be domesticated, wild, or extinct
Nature general (21)	forest, tree, grass	words associated with floral features found in nature and not necessarily associated with loris ecology
Loris biology (37)	venom, eye, tooth	words accurately associated with some part of slow loris biology, including morphology and taxonomic descriptors
Loris habitat (18)	forest, tree, night	specific words about the ecological aspects of slow loris habitats and activity patterns
Feeding ecology (7)	*Acacia*, gum, *Calliandra*	words about items in the slow loris diet or their feeding techniques such as gouging for gum and licking nectar
Humancentric (34)	father, house, human,	words associated with daily human life including people, places, modes of transport, and country names
Agriculture (19)	garden, rice paddy, farmer	words related to gardens, farms and insects; everyday words for residents of farming communities
Education (14)	drawing, school, teach	words associated with the classroom activities of the education program

Loris conservation (22)	wild, rare, conserve	words that allude to positive conservation feelings such as protecting slow lorises and recognizing they are rare
Negative conservation (29)	hunter, meat, extinct	words related to undesirable feelings regarding slow loris conservation, including hunting and keeping them as pets
Legal (8)	arrested, jailed, administration	words that show an implicit understanding of the laws placed on slow lorises and the legal consequences faced by individuals who break these laws
Forest protector (7)	guard, friend, protect	reiteration of the key concept taught in the story book that slow lorises are friends to farmers and protect the forest
Positive feelings (31)	good, funny, sweet	adjectives that would be considered positive about the slow loris and its ecology within the forest environment
Negative feelings (19)	afraid, evil, sinister	adjectives that describes a negative sentiment that was attributed to a slow loris
Irrelevant (6)	tempeh, factory, milk	words irrelevant or incorrect related to slow lorises that could not be placed in the other categories yet still important to the context of the stories from which they came

Table 3 Results of the cultural-consensus analysis conducted to understand shared meaning regarding the cultural domain of slow loris for all 18 schools visited in Cisurupan District, Java.¶

		Word diversity (count)[a]		Wilcoxon Z[b]	Domain Ratio[c]	Factor 1[d]		Factor 2[d]		Factor 3[d]		Factor 4[d]	
School	No. students	initial	final			initial	final	initial	final	initial	final	initial	final
Al. Pasirwangi	37	58 (180)	20 (98)	-0.47	4.71†/1.69	HC	FE	NF	LH	IR	-	-	-
Cibatarua	9	22 (43)	20 (81)	-2.66**	- / 1.21	-	FE	-	LC	-	-	-	-
Cipaganti	31	70 (198)	33 (162)	-0.59	0.57/4.64†	-	FE	-	LC	-	NG	-	-
Ganumukti	28	28 (79)	43 (183)	-1.13	0.53/1.35	-	FE	-	FP	-	LH	-	-
Mankurayat 1	46	52 (237)	64 (263)	-1.04	0.44/3.83†	-	LH	-	NG	-	FE	-	-
MI Al-Hidayah	17	29 (101)	79 (202)	-3.11***	1.26/1.44	LB	FP	WA	LC	NG	LH	HC	FE
Pakuwon 1	42	60 (142)	64 (251)	-0.98	0.51/2.58	-	FE	-	NG	-	LH	-	-
Pakuwon 3A	30	28 (87)	48 (245)	-0.73	0.59/5.54†	-	LH	-	NG	-	FE	-	-
Pakuwon 3B	33	29 (85)	53 (173)	-1.67	0.58/4.12†	-	LH	-	AG	-	FE	-	-
Pamulihan 1	42	88 (170)	32 (212)	-4.74***	4.33†/3.24†	-	LH	-	FE	-	NG	-	-
Pamulihan 2	15	38 (53)	19 (50)	-1.99*	1.73/1.21	IR	FP	NF	FE	NC	-	-	-
Pangauban 1	19	22 (42)	23 (87)	-3.41***	- /2.42	-	FE	-	AG	-	LH	-	-
Pangauban 2	27	43 (97)	28 (90)	-1.40	5.46†/4.61†	NG	FP	NC	FE	WA	LC	-	-
Papandayan	29	46 (98)	23 (96)	-4.05***	3.37†/3.25†	HC	FP	NG	PF	ED	FE	WA	LH
Sinarjaya 2	41	85 (202)	67 (369)	-5.23***	0.47/3.85†	-	FE	-	LC	-	LB	-	LG
Sinarjaya 3	33	56 (118)	43 (196)	-4.26***	0.56/2.70	-	FE	-	FP	-	AG	-	LH
Simagahlih 1	39	53 (131)	43 (187)	-4.57***	0.49/ -	-	FP	-	-	-	-	-	-
Sukarame 2	62	62 (205)	52 (321)	-4.59***	0.38/2.41	-	FP	-	FE	-	LB	-	AG

[a]Diversity and total count of words (nouns, adjectives, verbs, and adverbs) used by all students in each school in essays they wrote art the start of a teaching session.

[b]Significance of Wilcoxon signed rank tests: *, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$.

[c] Significant domain coherence ratios are marked with a dagger. Dash indicates no coherence present in a school.

[d] Abbreviations: WA, wild animals; NG, nature general; LB, loris biology; LH, loris habitat; FE, feeding ecology; HC, humancentric; AG, agriculture; ED, education; LC, loris conservation; NC, negative conservation; LG, legal; FP, forest protector; PF, positive feelings; NF, negative feelings; IR, irrelevant.

Figure 1. Cultural-domain analysis theories and processes.

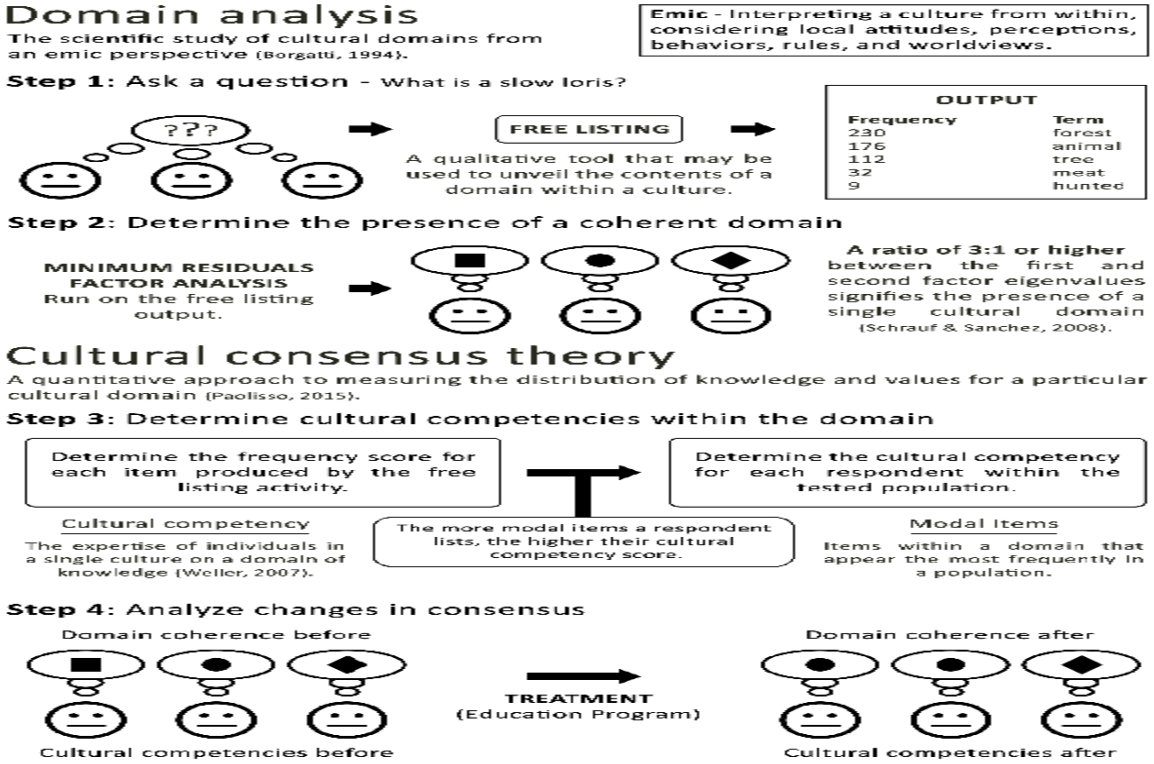

Figure 2. Levels of learning in Bloom's taxonomy of learning domains as they apply to outcomes of the slow loris educational program.

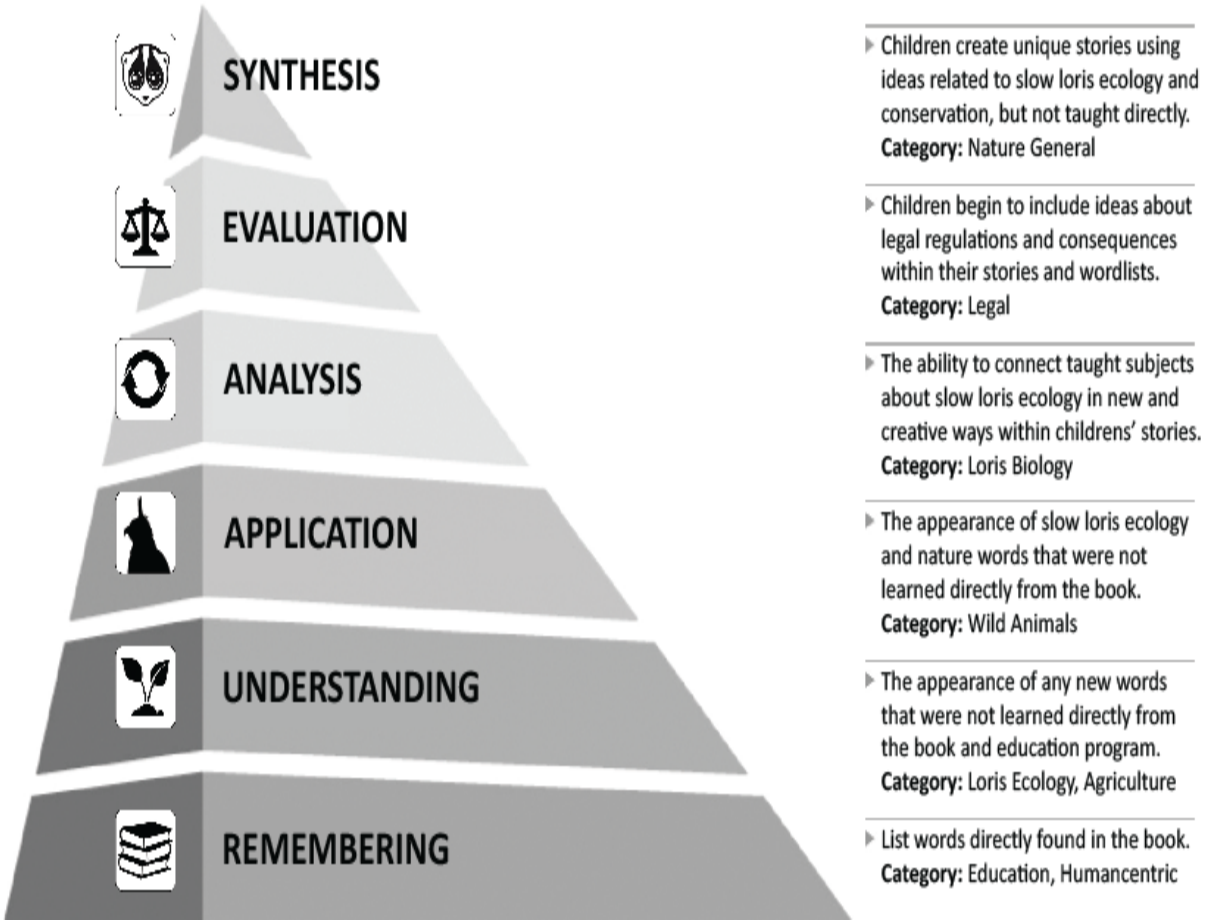

Figure 3. Across all schools, the 25 words from respondents' essays that underwent the largest change in number of uses between essays written before (gray) and after (black) the educational program on slow loris.