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Using environmental education to nurture positive human–wildlife interactions in India

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Abstract

Environmental education has the potential to help reduce negative human–wildlife interactions by increasing positive attitudes toward wildlife and providing participants with knowledge and skills that can help mitigate conflict situations and promote safety. To promote positive human–wildlife relationships, effective programs could be implemented widely in areas near remote wildlife reserves and protected areas. We created and evaluated a new environmental education program for 10- to 13-year-old students in rural schools in India where human–wildlife conflicts with large mammals frequently occur. Between July 2019 and March 2020, we tested the program at 129 schools, reaching 4331 students. The program, which was iteratively designed to fit the local context, is both cost-effective and scalable. We found that participation in the program resulted in a significant positive increase in local environmental knowledge, in knowledge of safe behaviors, and in some measures of environmental attitudes. This paper reports on the lessons learned while creating this program that may help other organizations interested in using environmental education in regions where negative human–wildlife interactions frequently occur.

KEYWORDS

coexistence, conservation education, environmental education, human–wildlife conflict, India, Western Ghats

1 | INTRODUCTION

Human–wildlife interactions pose a significant challenge to conservation efforts (Abrahms, 2021; Dickman, 2010; Inskip & Zimmermann, 2009). Negative interactions and conflicts with predators and large mammals have both social and economic costs for people (Barua et al., 2013; Gulati et al., 2021) and can also result in the reduction of wildlife species (Hammerschlag & Gallagher, 2017; Mateo-Tomás et al., 2012). In places where people live near wildlife reserves, such as in rural India, encounters between humans and animals often result in damage to livestock and human property and sometimes lead to human injury and death (e.g., Karanth et al., 2018; Karanth & Kudalkar, 2017). Some of the wildlife species involved in these conflicts, such as elephants and tigers,

are globally threatened (International Union for Conservation of Nature, 2020). To protect vulnerable people and wildlife populations in remote biodiversity hotspots, there is an urgent need to find solutions that can help humans and wildlife coexist peacefully.

Environmental education (EE), a process that helps people learn about the environment and develop attitudes and skills to address environmental challenges, has the potential to help reduce human–wildlife conflicts (HWC) (Espinosa & Jacobson, 2012; Skupien et al., 2016). It can influence environmental literacy, the knowledge of environmental concepts combined with the attitudes, motivation, and skills that equip people to make environmentally sound decisions (Wheaton, Kannan, & Ardoin, 2018; Wheaton, Kannan, Selby, et al., 2018). It can also foster positive relationships with wildlife by providing people with the knowledge and skills that mitigate conflict situations and promote safety (Espinosa & Jacobson, 2012; Sponarski et al., 2016). Attitudes toward wildlife and the environment, such as empathy, can also affect whether people are motivated to engage in pro-environmental behaviors (De Young, 2000; Hungerford & Volk, 1990; Monroe, 2003), such as setting up non-retaliatory mitigation measures that safeguard people, their livestock and crops, and wildlife. Therefore, enhancing positive attitudes toward wildlife could influence how people react to HWC situations. If programs can be developed that can reach large numbers of youth, it is even possible that they could shift community norms around wildlife interactions over time.

The public education system is clearly an effective vehicle for EE to reach large numbers of youth who are of an age where attitudes may be more easily impacted (Liefländer & Bogner, 2014). Nevertheless, there are barriers to school-based EE in some regions. A global literature review on the barriers to school-based EE found that logistical barriers, including lack of instructional materials and money, were common (Anderson & Jacobson, 2018). Educational barriers, such as a lack of content knowledge and lack of teacher training, were also frequently reported. Importantly, only 5 of the 32 studies in this review were from developing countries, where many of these barriers are likely to be significant. Any EE model that seeks to reach large numbers of children in rural areas will need to address these barriers in its design.

In India, the Supreme Court has mandated that EE is taught at all levels of formal education (ages 6–18) (National Council of Educational Research and Training, 1986; Sharma & Menon, 2017). To achieve this, the country has adopted an infusion approach, incorporating EE across several subjects. While this is a positive development, there are challenges to implementing an EE curriculum at the national level of any country. First, national curriculums are less likely to cover localized environmental issues, which could make the information less relevant to solving local problems (Sharma & Menon, 2017). Second, textbook-based national curriculums may focus more heavily on increasing environmental awareness and knowledge than on influencing attitudes, skills, and behaviors. Third, the extent to which teachers can incorporate new information into their teaching depends on receiving effective in-service training opportunities and updated textbooks. In places where rote teaching and learning are the norm, training, and capacity-building may be needed to facilitate types of education, such as EE, that engage students in experiential learning, critical thinking, and problem-solving (Sharma & Menon, 2017). In India, researchers and educators have described the need for a more localized EE curriculum, more hands-on activities that help students apply what they have learned, and more EE training for teachers (Salazar et al., 2022; Sharma & Menon, 2017). Non-formal education programs have the potential to supplement school-based education but may be more available in urban areas, which typically have greater capacity, equipment, and funding.

To address localized environmental issues, such as HWC, effective EE models are needed that can be implemented widely in rural areas near wildlife reserves and protected areas. This need is particularly strong in India, where over 900 million people are estimated to live in rural areas (World Bank, 2022). These models should be built on best practices in EE, providing participants with opportunities to enhance environmental knowledge, attitudes, and skills to protect wildlife and the environment (United Nations Educational, Scientific and Cultural Organization, 1978). They should also be adaptable to local contexts and scalable to meet demand. These objectives can be at odds, however. The more specific the issue, the more likely it will require specialized expertise. Relying on a few well-trained individuals will greatly limit the number of participants that a program can reach. Using the public school system could help reach more youth but will require a system that can provide detailed instructional resources and training for teachers.

We developed and evaluated a model EE program in rural India, called Wild Shaale, in partnership with the Centre for Wildlife Studies (CWS), an internationally recognized non-governmental organization (NGO) dedicated to wildlife research, conservation, policy, and education. In 2018, CWS began developing an EE program for schools to complement their existing programs that addressed HWC among adults (Karanth & Vanamamalai, 2020). This effort became the Wild Shaale program for 10- to 13-year-old students in government

schools ("shaale" means school in Kannada, the state language of Karnataka). The program aims to increase local environmental literacy, enhance positive attitudes toward wildlife, increase feelings of empathy toward wildlife, and provide students with skills to help them more safely coexist with wildlife.

Our goal was to design a program that could be scaled up to reach more schools without sacrificing effectiveness. This paper assesses the degree to which this goal was realized. We report how participation in the program affected children's environmental knowledge, knowledge of safe coexistence behaviors, and attitudes toward wildlife. We also report how the program was designed to be scalable.

Our research seeks to answer the following questions:

- How can an NGO provide scalable and effective EE in rural Indian government schools to address HWC?
- To what extent does a short-term EE program affect knowledge and attitudes that could help reduce HWC?

2 | METHODS

2.1 | Study area

This study took place in the states of Karnataka and Maharashtra in India. Data reported here were collected between July 2019 and March 2020. In Karnataka, the study was carried out in 43 government schools located within 10 km of the borders of Bandipur National Park, Nagarahole National Park, Male Mahadeshwara Wildlife Sanctuary, and Cauvery Wildlife Sanctuary. These parks are in the Western Ghats biodiversity hotspot (Myers et al., 2000) and are surrounded by densely populated human settlements and agricultural fields (Karanth et al., 2018; Karanth & Vanamamalai, 2020). The border areas have high rates of HWC involving tigers, elephants, leopards, and wild pigs (Karanth & Vanamamalai, 2020). In this region, a conservation program that assists people affected by conflict with wildlife has helped file 22,589 claims on behalf of 10,242 people living around two wildlife reserves since 2015 (CWS, 2023), including claims for crop loss, property damage, livestock predation, and human injury and death. In Karnataka, many (>80%) of households are categorized as rural, earning less than US $1600 annually (Karanth & Vanamamalai, 2020), which likely exacerbates the social and financial impact of these incidents.

In Maharashtra, the study took place at 86 government schools located within 10 km of the Melghat Wildlife Sanctuary, Pench National Park, and Tadoba National Park. These protected areas have tropical, dry deciduous forests, and rich biodiversity (Dutta et al., 2016; Karanth et al., 2012). The immediate surroundings are occupied by agrarian villages, which are hotspots for HWC, involving sloth bears, leopards, tigers, and snakes (Dhanwatey et al., 2013; Sharp et al., 2022). Forest-based activities, such as the collection of non-timber forest products, may increase the probability of local communities encountering potentially harmful wildlife in these regions (Dhanwatey et al., 2013; Puri et al., 2023).

We designed the Wild Shaale curriculum to include resources and activities for both states and to reflect these context-specific habitats, species, and conservation challenges. In this way, the structure of the program would be constant, but the species would be locally relevant.

2.2 | Program design and scope

In 2018, we began program development by conducting multiple trips to schools surrounding Bandipur and Nagarahole National Parks to observe classrooms, obtain copies of textbooks, talk with teachers, and pilot test activities (Salazar et al., 2022). We used these observations and educator reflections to design an EE program that could be led by an NGO, using the formal school system, and scaled regionally. The program was then developed and improved across three phases. After each phase, we used data from the evaluation and feedback from staff to improve the curriculum and evaluation tools, and to increase the program's ability to expand while retaining quality (Salazar et al., 2022).

In the first phase, we tested two models of the program, a school and household engagement model and a school-only model, to understand whether sending materials home and spending more money per child would lead to significantly greater increases in engagement, environmental literacy and positive attitudes toward wildlife. The primary differences between the models were that the school and household engagement model (1) used more expensive art supplies (e.g., paint and dioramas) and (2) provided materials for students to take home each week that could stimulate HWC conversations at home. The school-only model used less expensive materials and only sent home materials at the end of the program (after the evaluation was complete). We also tested evaluation tools to measure these outcomes and collected observations from educators. We used these observations and data from the evaluations to inform the second phase of the program, which was an improved version of the school and household engagement model.

The final program (third phase), which we report upon here, is simple for staff educators to implement

with minimal training, but engaging and comprehensive enough to lead to desired outcomes. Through conversations with educators and a review of school textbooks, we learned that students had limited exposure to local wildlife and local environmental issues. Given this lack of exposure, a short program of one visit would be unlikely to provide enough content to raise environmental literacy or shift attitudes. Therefore, the final Wild Shaale program consists of four, 2- to 3-h modules that are implemented weekly over 1 month (Figure 1). This design takes advantage of educational practices that reinforce new concepts over time, enabling youth to make both simple and complex generalizations (Vlach & Sandhofer, 2012).

Each module uses the experiential learning model, a four-step framework in which a learner has an experience, reflects on that experience, connects that experience to the outside world, and applies what they learned to a new situation (Kolb, 1984). The program curriculum also combines classroom-based education with outdoor activities in the schoolyard, such as nature walks and outdoor games. Students are divided into groups with an average of 35 students. The environmental citizen model developed by Hungerford and Volk (1990) helped inform the overall program design. That model suggests variables that can lead to environmentally responsible behavior, including environmental sensitivity, knowledge of ecology, consequences of behaviors, and action skills. To help children develop empathy with wildlife, we incorporated games and activities that encourage perspective-taking and an appreciation of the similarities between humans and wildlife (Seattle Aquarium, 2015; Young et al., 2018). Drawing on transformative learning theory (Mezirow, 1997), we also used storytelling and role-playing activities to help children see wildlife and conflict situations from different perspectives. Transformative learning occurs when a disorienting event (e.g., role-playing or a perspective-taking

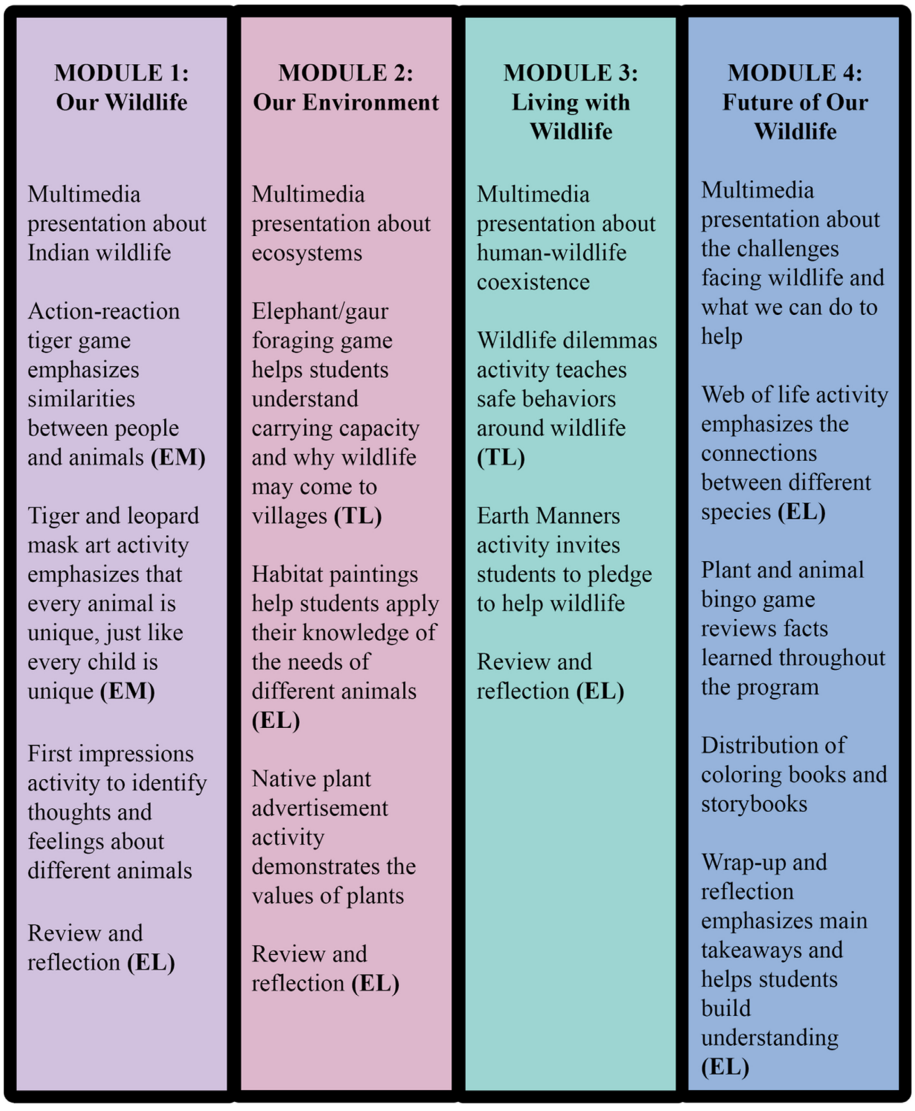

FIGURE 1 The four modules that make up the Wild Shaale final program curriculum draw heavily on experiential learning (EL), transformative learning theory (TL), and research on empathy building (EM).

activity) leads to a fundamental shift in a person's perspective or worldview.

2.3 | Educator training to maintain quality and increase the potential to expand

During the rural school visits, pilot tests, and observations in Phase 1, we learned that teachers were overburdened with high student–teacher ratios, that teacher attrition was high, and that experiential learning was uncommon. Because of these challenges, we did not think it would be feasible to train classroom teachers to implement experiential and unfamiliar activities, given our resources and capacity. However, with the required approvals from administrators in India, NGO staff can engage with youth in schools through structured programs. We, therefore, hired and trained a team of young college graduates to travel to different schools to implement the program. These staff were from the regions where the program was being implemented to ensure that they were familiar with the local language and culture of the places they were teaching. They came from a variety of professional backgrounds, including wildlife biology, ecology, education, arts, and chemistry.

Before the third phase started, 26 staff participated in a 4-day training program in Bengaluru, India that introduced them to experiential learning theory, best practices in EE, and evaluation. During the training, they conducted program activities and received feedback. A professional facilitator and acting instructor also led a half-day session on presentation skills. Any staff hired after the training received a comparable training program using a similar model led by the Wild Shaale Project Coordinators.

We evaluated the training using a written pretest and posttest (Supporting Information S1). The survey instruments included scaled items (from 1 = *not at all* to 5 = *a great deal*) to assess staff members' comfort with experiential learning and teaching. It also included open-ended questions about perceptions of education, the role of teachers, and the goals of EE. The posttest asked for reflections on the training workshop, reflections on personal growth, and reflections on future learning goals.

2.4 | Assessing program effectiveness

Between July 2019 and March 2020, 129 schools participated in this study and the third phase of the program across Karnataka and Maharashtra. We studied whether participation in the program led to changes in environmental knowledge, knowledge of safe behaviors around wildlife, and positive attitudes toward wildlife and the environment using a survey instrument (Supporting Information S2). All students took the survey on paper at the beginning of the program (Week 1) and at the end of the program (Week 4). The survey was translated into Kannada for Karnataka and into Marathi for Maharashtra; it was then back-translated by different staff into English to ensure accuracy (Brislin, 1970). To increase comprehension, all evaluation tools were read aloud to the students by the educators (Musser & Malkus, 1994). The study design and protocols were reviewed and approved by the Institutional Review Board at the University of Florida (IRB201901271).

Data were analyzed separately for Karnataka and Maharashtra because the programs met the needs of the different wildlife conflicts and school curricula. Continuous data were analyzed using dependent *t*-tests to compare pretest and posttest scores and all statistical tests were carried out using SPSS Version 28.0.1.0. Responses to two open-ended questions were coded for content and for the frequency with which different themes appeared. To check the validity of the coding system, a second coder applied the codebook to 10% of randomly selected responses. The inter-rater reliability scores were 78% and 89%, which is acceptable (Campbell et al., 2013). The two coders discussed the differences in coding and reapplied the final codebook to the data.

2.5 | Environmental knowledge

Students were asked five knowledge-based multiple-choice questions tied to the program curriculum. The questions were worth a possible total of 14 points in Karnataka and 16 points in Maharashtra; students were assigned an environmental knowledge score based on the number of correct responses (e.g., 7 out of 14 was 0.5). The multiple-choice question about safe behaviors around wildlife focused on elephants in Karnataka and sloth bears in Maharashtra (Singh et al., 2018). Only students who completed all questions on the pretest and posttest were included in this analysis.

2.6 | Safety behaviors

Children were also asked an open-ended question about how to keep livestock safe from tigers and leopards. To understand whether students were more likely to list safe behaviors after program participation, their responses were coded for content and frequency.

2.7 | Environmental attitudes

Students were asked eight questions about their attitudes toward wildlife and environmental issues using a 7-point scale ranging from *not at all* to *very much*, indicated by circles of increasing size. At the end of each posttest, children were asked to list two things that they learned in the Wild Shaale program that they did not know before. Their responses were coded for content and frequency.

3 | RESULTS

3.1 | Program design and scope

We found that the program model we developed was scalable to more rural schools in India and was effective after we made several adjustments in the first two phases (Figure 2). In the first phase, we found that both the school and household engagement and the school-only models led to small, but significant increases in environmental literacy. The school and household engagement model costs approximately US $2.97 per student for materials and educator salaries. The school-only model costs approximately US $2.76 per student. Costs not included in this calculation include the one-time purchase of a digital projector and laptop (US $833). Food, accommodation, and transportation costs for educator teams were not included in these calculations since they varied by the set and number of schools that were visited each month. The school and household engagement model led to a slightly larger mean increase in environmental literacy (10.35%) from pretest to posttest than the school-only model (7.75%) (Supporting Information S3). The tools we tested to measure empathy and attitudes in this phase did not provide valid and reliable results (Salazar et al., 2022). Therefore, we were unable to determine whether the models had a different effect on students'

Adjustments to Program to Increase Scalability

Change in materials: After realizing that some art and game materials were more difficult or expensive to obtain locally, we revised activities to utilize less expensive and more readily available materials.

Reliance on technology: We scaled back our use of technology in the program after realizing that electricity could be unreliable in schools. We used battery-powered digital projectors and a battery-pack to give a short visual presentation at the beginning of each module.

Experiential learning model: We reordered some activities and revised some activities to better reflect the steps in the experiential learning model. This change required less background knowledge on the part of the educator because they learn and reflect along with students.

Use of question box: We added a question box where students could place questions that would be answered at the beginning of the next module because students can be shy and because the level of background knowledge varied among educators.

Educator recruitment: To reduce attrition, we recruited educators from areas near the schools where the program was being implemented.

Module length: Limiting the length of the modules to under three hours enabled a pair of educators to implement the 4-part program twice a day, reaching 10 schools each month.

Train-the-trainer model: Program coordinators were involved in the development of the training program so that they could confidently train new staff as they joined the program. The program coordinators also conducted capacity building workshops for staff throughout the year to help them continue learning and improving their EE practice.

Clear targets: The team set clear targets for the number of schools and students the program should reach per month. Staff worked together to ensure that the targets were realistic so that the educator teams did not burn out.

Dedicated fundraising: In 2019, program staff submitted two to three funding proposals for Wild Shaale per month and ran fundraising campaigns to ensure that the program would be sustainable and could continue to expand. Fundraising was clearly linked to student and school targets.

FIGURE 2 Adjustments made to the Wild Shaale environmental education program to increase scalability.

attitudes toward wildlife. However, observations from educators suggested that students were interested and engaged in both models.

For Phases 2 and 3, we only implemented a single version of the program (we used the school and household engagement model with some adjustments based on our learning in Phase 1) (Figure 2). As the program expanded, we realized it was important to increase salaries to attract and retain high-quality staff. Because hiring and training staff is a key element of this model, and because these staff have significant responsibilities during program implementation, CWS increased the average educator salary by approximately 38% in Phase 3. After adjustments for Phases 2 and 3, the average program cost per student (for four modules, including materials and educator salaries) is about US $4.05. Food, accommodation, and transportation costs for educator teams were not included in this calculation since those vary by assigned schools. This cost is raised by CWS, so the program can be provided at no cost to schools. The final program model (Figure 1) reached approximately 14,463 students from 2019 to 2020.

3.2 | Educator training

We found that the 4-day training was sufficient to train new educators in the program. Twenty-one of the 26 educators completed both the pretest and posttest. Only eight educators reported having any experience in EE before the training. After the training, 62% of the educators reported that their most important lesson learned was related to presentation and communication skills, 14% reported it was related to experiential learning, and 10% reported that it was related to education being more than conveying knowledge. Fourteen percent reported other, unique lessons. On a scale of 1–5, after the training, educators reported being more confident about leading students in experiential learning ($M = 4.52$, SD $= 0.69$) than before the training ($M = 4.17$, SD $= 0.71$). They were also slightly more comfortable answering questions about wildlife after ($M = 4.24$, SD $= 0.62$) than before ($M = 4.17$, SD $= 0.86$). On the posttest, they reported that the training was very useful ($M = 4.76$, SD $= 0.72$). Seventy-six percent of educators said that the training changed their views about education. Of these, the majority said it had exposed them to a new way of teaching. For example, one wrote, "I did not know the exact process of experiential learning and this training helped me with understanding the entire process and [how] to apply it to my work." Other educators wrote that it had changed their confidence, how they thought about the role of an educator, their views on evaluation, their knowledge of the environment, and their classroom management skills. On-going support was provided by the program coordinator after the initial training and included recorded video guides for each session, monthly capacity-building sessions, and monthly quality control checks through site visits and reports.

3.3 | Program effectiveness

In Karnataka, 1557 students across 43 schools participated in the Wild Shaale program evaluation. Of these students, 1326 (85.16%) provided parental consent and student assent and were included in this study. In Maharashtra, 2774 students across 86 schools participated in the Wild Shaale program evaluation. Of these students, 2371 (85.47%) provided parental consent and student assent and were included in this study.

3.4 | Environmental knowledge

In both Karnataka and Maharashtra, environmental knowledge scores increased significantly between the pretest and posttest (Table 1). There was a moderate effect size in Karnataka and a large effect size in Maharashtra. In Karnataka, the results of a dependent t-test show that students had significantly higher environmental knowledge scores on the posttest ($M = 0.64$, SD $= 0.19$) than on the pretest ($M = 0.52$, SD $= 0.16$). Participation in the program resulted in a mean increase of 12.04% in environmental knowledge scores between pretest and posttest, 95% confidence interval (CI) [0.11, 0.13] and this increase was statistically significant, $t(1088) = 17.41$, $p < .001$, $d = 0.53$. In Maharashtra, students had significantly higher knowledge scores on the posttest ($M = 0.75$, SD $= 0.18$) than on the pretest ($M = 0.59$, SD $= 0.15$). Participation in the program resulted in a mean increase of 15.50% in environmental knowledge scores between pretest and posttest, 95% CI [0.15, 0.16] and this increase was statistically significant, $t(2021) = 35.73$, $p < .001$, $d = 0.79$.

3.5 | Safety behaviors

After participating in the program, more students listed safe strategies for protecting their livestock from tigers and leopards (Table 2). In Karnataka, for example, the percentage of children listing unsafe behaviors that could lead to human injury or death dropped to 1.94% ($N = 20$) after the program from 18.17% ($N = 187$) before the program. In Karnataka, a large portion of responses (32.26%

TABLE 1 Changes in environmental knowledge scores from pretest to posttest for students who participated in the Wild Shaale program in Karnataka and Maharashtra.

	N	Pretest *M* (SD)	Posttest *M* (SD)	*T*-test *T* (df)	95% CI	Sig. (two-tailed)	Effect size (Cohen's *d*)
Environmental literacy scores for Karnataka	1089	0.52 (0.16)	0.64 (0.19)	17.41 (1088)	(0.11, 0.13)	<0.001[a]	0.53
Environmental literacy scores Maharashtra	2022	0.59 (0.15)	0.75 (0.18)	35.73 (2021)	(0.15, 0.16)	<0.001[a]	0.79

[a]Indicates a statistically significant result.

TABLE 2 The percentage of Wild Shaale student participants who listed safe and unsafe behaviors to protect their livestock from tigers and leopards in a pretest and posttest.

	Karnataka		Maharashtra	
Type of behavior	Pretest (number of responses)	Posttest (number of responses)	Pretest (number of responses)	Posttest (number of responses)
Safe behaviors (e.g., keep livestock in shed, do not graze livestock in the forest)	320 (31.10%)	698 (67.83%)	971 (51.13%)	1482 (78.04%)
Unsafe behaviors (e.g., chase, hit, or kill tigers and leopards, throw firecrackers)	187 (18.17%)	20 (1.94%)	254 (13.38%)	49 (2.58%)
Practice conservation (e.g., plant trees, protect forest)	12 (1.17%)	18 (1.75%)	50 (2.63%)	61 (3.21%)
Protect livestock (no specific action provided)	123 (11.95%)	32 (3.11%)	282 (14.85%)	109 (5.74%)
Ambiguous or unclear answer	387 (37.61%)	261 (25.36%)	342 (18.01%)	198 (10.43%)

on the pretest) were rejected because they were unreadable or ambiguous.

3.6 | Environmental attitudes

3.6.1 | Scale questions

Results from the eight attitude questions suggest that children generally had very positive baseline attitudes toward wildlife and conservation and that the program helped enhance positive attitudes. Results of dependent *t*-tests show a significant positive change in attitudes between the pretest and posttest for four out of eight questions in Karnataka and seven out of eight questions in Maharashtra, although the effect sizes were small in all cases (Table 3). In both states, postsurveys indicated children valued tigers more, were more interested in learning about animals, felt that it was more important for people in their village to learn to live with wild animals, and were slightly less afraid of leopards. However, in Karnataka, after participating in the program, there were also negative changes in children's attitudes—children were slightly less happy that their village was close to the forest and slightly less likely to say they want more tigers in the future.

3.6.2 | Open-ended questions

In both states, some students recounted an attitude shift they had experienced or behavior they intended to change because of the Wild Shaale program: 253 students (24.23%) in Karnataka and 219 students (11.92%) in Maharashtra. One student wrote, "We should not take our cattle to the forest. We were destroying trees. Now I know the importance of our environment and trees." Another student wrote "Before, I didn't even think about wild animals, and now I realized how important wildlife is and we should not destroy the forest for their better future." Many students wrote about behaviors that could help keep them and their families safe. For example, one student wrote, "If they are near crop fields, we should not burn crackers [fireworks; we] should not chase them. If they destroy [crops], we should inform the forest department."

TABLE 3 Students' attitudes toward wildlife and conservation in Karnataka (KA) and Maharashtra (MH), India before and after participation in the Wild Shaale program, as measured by a 7-point scale where 1 = *Not at all* and 7 = *Very much*.

Question	State	(*n*)	Pretest *M* (SD)	Posttest *M* (SD)	*T*-test *t* (df)	Sig. (two-tailed) [95% CI]	Effect size (Cohen's *d*)
How interested are you in learning about wild animals?	KA	1127	6.73 (0.91)	6.80 (0.79)	2.06 (1126)	0.04[a] [0.003, 0.12]	0.06
	MH	2135	6.42 (1.23)	6.58 (1.04)	5.42 (2134)	<0.001[a] [0.10, 0.22]	0.12
How much do you value tigers?	KA	1129	5.53 (2.02)	5.82 (1.78)	4.31 (1128)	<0.001[a] [0.16, 0.43]	0.13
	MH	2082	5.75 (1.81)	6.06 (1.45)	7.22 (2081)	<0.001[a] [0.23, 0.40]	0.16
How afraid are you of leopards?	KA	1120	5.76 (2.05)	5.46 (2.11)	−4.21 (1119)	<0.001[a] [−0.45, −0.16]	0.13
	MH	2139	5.72 (2.05)	5.43 (2.02)	−5.22 (2138)	<0.001[a] [−0.39, −0.18]	0.11
How afraid are you of spotted deer?	KA	1128	2.24 (2.12)	2.47 (2.27)	2.84 (1127)	0.005[a] [0.07, 0.39]	0.08
	MH	2125	3.20 (2.39)	4.03 (2.37)	12.74 (2124)	<0.001[a] [0.70, 0.95]	0.28
How happy are you that your village is close to the forest?	KA	1138	6.70 (1.02)	6.54 (1.25)	−3.74 (1137)	<0.001[a] [−0.25, −0.08]	0.11
	MH	2122	5.83 (1.91)	6.01 (1.65)	3.80 (2121)	<0.001[a] [0.09, 0.28]	0.08
How important is it to you that wild animals are protected?	KA	1137	6.57 (1.22)	6.63 (1.09)	1.36 (1136)	0.17 [−0.03, 0.14]	0.04
	MH	2123	6.37 (1.31)	6.49 (1.09)	3.61 (2122)	<0.001[a] [0.05, 0.19]	0.08
Imagine the future, do you hope there will be more tigers in the forest?	KA	1117	5.22 (2.31)	4.70 (2.52)	−5.62 (1116)	<0.001[a] [−0.71, −0.34]	0.17
	MH	2122	5.34 (1.97)	5.73 (1.70)	7.52 (2121)	<0.001[a] [0.28, 0.49]	0.16
How important is it for people in your village to learn to live with wild animals like tigers, peacocks, and gaur nearby?	KA	1126	6.12 (1.66)	6.28 (1.48)	2.67 (1125)	0.008[a] [0.04, 0.28]	0.08
	MH	2163	6.40 (1.20)	6.47 (1.16)	2.15 (2162)	0.03[a] [0.006, 0.13]	0.05

[a]Indicates a statistically significant result.

In Karnataka, 494 students (47.32%) listed wildlife facts they had learned. Of those, 113 students recalled information that demonstrated empathy, which was a focus of the program curriculum. For example, one student wrote, "Elephants also have a family, elephants look at their reflection, elephants also have a habitat, elephants love their children." Another wrote, "I never knew elephants swim, but elephants also swim and take care of their young, just like humans." In Maharashtra, 1838 students (87.94%) listed facts they had learned and 22 of those facts related to empathy with wildlife.

4 | DISCUSSION

We developed a scalable EE model for rural India that can be implemented in schools by NGOs and other organizations. The four-part program was affordable, at a cost of approximately US $4.05 per student, and educators could be prepared to lead the program with only 4 days of training and additional practice sessions. The program has a core set of activities in which locally relevant species can be inserted, leading to a program that can be expanded to other states by raising more funds and training more educators. We found that participation in the program resulted in a significant positive increase in environmental knowledge, knowledge of conflict avoidance behaviors, and some measures of environmental attitudes. We believe the program was effective because it utilized the experiential learning model and provided a unique experience for children that helped them understand the reasons underlying HWCs and how to reduce them. While novel and exciting activities have the potential to distract from core learning outcomes, we believe these qualities may have made our messages more memorable to students. However, the program might have been even more effective at changing attitudes and behaviors if it had been longer in duration, included follow-ups, and addressed attitudes toward specific behaviors more directly (Wheaton, Kannan, & Ardoin, 2018; Wheaton, Kannan, Selby, et al., 2018). The model described here may be useful to NGOs that want to develop and scale up EE programs in regions with limitations on funding, technology, and familiarity with EE. Costs associated with the program could be further diminished if teachers were trained to lead the program as part of the school curriculum.

Our program was designed to overcome both logistical and educational barriers to EE (Anderson & Jacobson, 2018). Programs that can be implemented at a low cost per student can increase scalability and potential reach. We know that it is possible to create EE programs that change attitudes and other outcomes of interest (e.g., Dettmann-Easler & Pease, 1999; Stern et al., 2008), but these programs often rely on specialized staff, equipment, and field trips, which can be costly. A recent review found no studies on the cost-effectiveness of nature conservation education interventions (Pienkowski et al., 2021). To meet the demand for EE programs when funding for conservation is so limited (McCarthy et al., 2012), it is critical to consider the cost-effectiveness of different approaches and program designs (Van der Ploeg et al., 2011).

We found that children who participated in the Wild Shaale program generally had positive baseline attitudes toward wildlife and conservation, even though they live in areas where their families and neighbors likely experience frequent HWC. This suggests that programs like ours could play an important role in nurturing positivity from an early age. Their positive attitudes could be due to the religious and cultural significance of many wildlife species, such as tigers and elephants (Gogoi, 2018). Children may also have a natural affinity toward nature (Kahn, 1997). Children's high baseline scores led to a ceiling effect for most items, leaving little room for changes due to the program. Ceiling effects have been an issue in the evaluation of other EE programs using scaled items (Ernst & Theimer, 2011). The ceiling effects may help explain the small effect sizes we saw in positive attitude shifts. There were also differences in the patterns we saw between states. For example, in Karnataka, children valued tigers more after the program, but did not hope there would be more tigers in the future. Children also reported being slightly less happy that their village was close to the forest after the program. In Maharashtra, we found a small positive shift in both attitudes. This variation could be due to many factors, such as the difference in educators and the mix of positive and negative experiences that both children and adults have with wildlife in these landscapes.

The open-ended question about what children had learned in the program provided interesting insights into their attitude changes. While most children reported facts they learned, over one-fifth of students in Karnataka wrote about their increasingly positive attitudes and credited the program. Of the children who reported facts, at least 20% of their responses demonstrated empathy with wildlife, which was a key focus of the program. The program may have helped children see wildlife differently. It is interesting that we did not see a similar pattern in responses in Maharashtra, where only 22 facts (1.2%) related to empathy with wildlife. This could be due to cultural differences between states or to small differences in the two curriculums. There was a stronger emphasis on elephants in Karnataka than in Maharashtra. To

better understand these shifts, future studies could utilize more open-ended questions (Salazar et al., 2022).

The fact that many children had positive attitudes toward wildlife before the program suggests that it may be important to focus on other outcomes, such as procedural knowledge about taking actions to reduce HWC in this context. In our study, many children listed unsafe ways of protecting their livestock from leopards and tigers before participating in the program. By focusing the program on knowledge of why animals behave the way they do (to generate empathy) and knowledge of safe behaviors in wildlife encounters, we saw a positive shift in children's attitudes toward wildlife and a reduction in their fear of leopards over the course of the program. Our results are similar to those of Sponarski et al. (2016), who found that an EE program that focused on knowledge of safety behaviors in coyote encounters positively influenced participants' attitudes toward coyotes as well as their feelings of control in coyote encounters. Similarly, a program in Russia that sought to influence students' attitudes toward Amur tigers found that an increase in knowledge of tiger ecology was correlated with an increase in positive attitudes toward the species (Mukhacheva et al., 2015). This Amur tiger program also engaged children in discussions and activities that promoted safe behaviors for human–tiger interactions.

It is important to acknowledge that program participation resulted in negative shifts in some attitudes toward wildlife among students in Karnataka. After the program, children in Karnataka were slightly less happy that their village was close to the forest and slightly less likely to say they wanted more tigers in the future. This may be because the program focused on HWC and made some students more aware of the scale and complexity of the issue. Their increased awareness may have increased their perception of risk, which could result in less positive attitudes toward tigers.

While attitudes are important, they are not the only factor that influences behavior. In this case, children generally had positive attitudes toward wildlife, but did not know how to reduce risk. An education program that addressed HWC with Andean bears in Ecuador resulted in less positive attitudes toward bears after the program, but higher behavioral intentions to decrease bear conflicts (Espinosa & Jacobson, 2012). Programs that increase risk perception, while also providing constructive pathways for addressing those risks, may also be effective at motivating behavior (Maartensson & Loi, 2022). To address complex relationships between humans and wildlife, programs could be designed to influence more than positive attitudes. They can focus on specific attitudes, such as those toward risks or about what to protect, provide clear and factual information that helps students make informed decisions, and enable students to practice new actions.

While our evaluation suggests that the program is working as intended, we did face several challenges in evaluating the program, which limits the generalizability of our findings. First, we did not use a control or comparison group in either state, which prevents us from addressing causality. However, as care for local wildlife is not part of the school curriculum, it is unlikely that this information was covered elsewhere in the schools. To help confirm the impact of the program, future evaluations could include an active control group that participates in a similarly structured program about another environmental issue, such as water. Second, the open-ended questions gave interesting insights into what students learned from the program, but children's unclear handwriting led to substantial data loss. This may have skewed the results on these questions toward students with more legible handwriting. To ensure that all students have an equal opportunity to participate in the study, future evaluations could rely on oral interviews with a randomly selected subset of students, rather than written surveys. In addition, while the positive increases we see in environmental knowledge and attitudes across both programs suggest that program participation made a difference, there is always the possibility that students were eager to please the Wild Shaale educators, whom they admired (Browne-Nuñez & Jonker, 2008).

Despite these challenges, the Wild Shaale EE program is a scalable model that led to positive increases in local environmental knowledge, knowledge of conflict avoidance behaviors, and some measures of environmental attitudes. To help address HWC in rural areas, more EE programs that carefully address actions in a cultural context with innovative activities and trained staff could be developed. It may be helpful for NGOs to lead these initiatives in contexts where teacher training and school resources are limited. To address the diverse contexts in which HWC occurs, more research is needed on how to adapt EE programs and evaluations to different rural areas in developing countries (Johnson-Pynn & Johnson, 2005). Future studies should also address whether short-term increases in positive attitudes toward wildlife are sustained and whether they can lead to reductions in HWC in communities. While it is challenging to make causal links between an EE program for children and a reduction in HWC, these types of investigations are critical to our understanding of whether and how EE programs are contributing to conservation outcomes (Ardoin et al., 2020).

AUTHOR CONTRIBUTIONS

Gabby Salazar contributed to the program design and research design, designed the evaluation tools, conducted the data analysis, wrote the first draft of the manuscript, and revised the manuscript. Nitya Satheesh and Ishika Ramakrishna contributed to the program design, collected data, and reviewed the manuscript. Martha C. Monroe helped design the evaluation tools and reviewed the manuscript at all stages. Morena Mills contributed to the program design and research design, helped design the evaluation tools, and reviewed the manuscript at all stages. Krithi K. Karanth contributed to the program design and research design and oversaw data collection and program implementation in India. She also reviewed the manuscript at all stages. All authors approved the submitted version.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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