frontiers | Frontiers in Communication

TYPE Original Research
PUBLISHED 23 February 2026
DOI 10.3389/fcomm.2026.1701321

OPEN ACCESS

EDITED BY
Tarla Rai Peterson,
The University of Utah, United States

REVIEWED BY
Kerri J. Smith,
University of North Carolina Wilmington, United States
Michael J. Liles,
The University of Texas at El Paso, United States
Jonathan S. Pelegrin,
University of Santiago de Cali, Colombia

*CORRESPONDENCE
Noreen Mutoro
✉ noreen.mutoro@stud.plus.ac.at

RECEIVED 08 September 2025
REVISED 19 January 2026
ACCEPTED 22 January 2026
PUBLISHED 23 February 2026

CITATION
Mutoro N, Saerys-Foy J, Moturi A, Pfeiffer L, Marker L and Wykstra M (2026) Effectiveness of using different presentation methods on cheetah conservation awareness and education in Kenya.
Front. Commun. 11:1701321.
doi: 10.3389/fcomm.2026.1701321

Effectiveness of using different presentation methods on cheetah conservation awareness and education in Kenya

Noreen Mutoro[1,2]*, Jeffrey Saerys-Foy[3], Adelaide Moturi[2], Lauren Pfeiffer[4], Laurie Marker[4] and Mary Wykstra[2]

[1]Department of Environment and Biodiversity, Paris Lodron University of Salzburg, Salzburg, Austria, [2]Action for Cheetahs in Kenya, Nairobi, Kenya, [3]Quinnipiac University, Hamden, CT, United States, [4]Cheetah Conservation Fund, Otjiwarongo, Namibia

Conservation Education (CE) is essential for building the knowledge and skills required to solve sustainability challenges, especially biodiversity loss and for fostering positive actions toward biodiversity conservation. Quantitative evaluation of the effectiveness of conservation education is important for achieving conservation impacts with long-lasting influence on people's knowledge, attitudes and behavior. This study assessed the effectiveness of three different presentation methods (poster, puppet show or video) to raise cheetah (*Acinonyx jubatus*) conservation awareness in the Salama region of Makueni County in Kenya. Pre- and post-presentation surveys from 529 students across six primary schools were aggregated and statistically analyzed to evaluate students' learning outcomes. Verbal poster presentations showed the highest significant improvement in the students' knowledge. The results indicate immediate gains in knowledge following exposure to the educational medium. Although causal inference may be limited by the lack of validation of the survey instrument, our findings demonstrate that interactive presentations are an important factor in increasing knowledge of wildlife and awareness of the local and global threats facing vulnerable species and perceived problem predators, such as the cheetah, in conservation education. These findings can inform conservation educators, who can build on these presentation methods to achieve greater impact within their target community.

KEYWORDS

***Acinonyx jubatus*, conservation education, Makueni, posters, puppet shows, videos**

Introduction

Species declines and global extinctions have been linked to the expansion of human activities (Parkes, 2006; Hogue and Breon, 2022). According to several studies, these activities have led to the modification and creation of new environments which are hostile to many wildlife species (Woodroffe, 2000; Kija et al., 2020). Large carnivores are particularly sensitive to environmental change, such as human population growth compounded by contractions of suitable habitat within their geographic ranges (Woodroffe and Frank, 2005; Ripple et al., 2014). Cheetahs (*Acinonyx jubatus*) are particularly vulnerable to range contraction due to their spatial requirements, low population density, and historical genetic bottlenecks (Durant et al., 2017). Approximately 70% of Kenya's wildlife (Muya et al., 2013) and 78% of its estimated cheetah population (KWS, 2010) resides outside protected areas, where cheetah face numerous threats including persecution by people living on community or residential land due to actual or perceived threats to people's lives and livelihoods (Treves and Karanth, 2003; Inskip and

Zimmermann, 2009; Rust and Marker, 2014). The perceived threat that cheetah pose to communities can be influenced by local culture, government policy and international trade (Woodroffe, 2000; Dickman et al., 2014; Zuluaga et al., 2022). Local influences can either bridge the gap between the communities and wildlife or deepen the conflict. It is critical for conservation of large carnivores to reduce predator impacts on human lives without decreasing their populations both inside and outside protected areas (Woodroffe and Frank, 2005) while also bridging the aforementioned gap. Bridging the gap begins with conservation education, which can shift community strategies from a lethal response to a proactive approach to mitigation, thereby improving coexistence with wide-ranging carnivores (Dickman, 2010).

Conservation education (CE) is considered an essential tool for achieving environmental sustainability (UNESCO, 2014; UNESCO, 2020). It plays a critical role in providing students across the world with the knowledge, skills, and values necessary to discover solutions to today's sustainability challenges, especially for biodiversity loss (Marker et al., 2018; Børresen et al., 2023). CE also creates spaces that facilitate collaboration among scientists, decision-makers, community members, and other stakeholders (Ardoin et al., 2020). Through education, people and communities are made aware of the environmental problems that exist, their role in perpetuating these problems, and their potential contributions to solutions (Kioko et al., 2010; Hoare et al., 2022). As a result, conservation education programs have been implemented in both formal, school-based settings as well as in non-formal contexts, such as zoos, villages and nature centers (Breuer et al., 2017; Oražem et al., 2019; Feucht et al., 2025). To understand the problems and solutions, the choice of vocabulary and language used to increase awareness plays a vital role in shaping how the youth view wildlife (Down et al., 2017). Age is also an important consideration, as nurturing and establishing values regarding wildlife becomes more difficult to alter as the generation ages (Dickman et al., 2013; Breuer et al., 2017). Therefore, environmental education should be introduced when the student is young to maximize learning outcomes and responses (Lamanauskas, 2023). For conservation education programs to achieve long-lasting effects, changes in students' knowledge, attitude and behavior have to be evaluated by an educator (Lehnhardt, 2010; Marker et al., 2018).

Action for Cheetahs in Kenya (ACK) is a Kenyan non-governmental conservation organization whose research activities focus on the cheetah and their ecology. As a feline species under threat from both direct and indirect human impacts, the cheetah acts as a flagship species for promoting environmental awareness and broader conservation challenges. Between April and June 2009, ACK implemented a series of conservation education and awareness programs in the Machakos wildlife dispersal area in Makueni County as part of the broader study 'Sustainable cheetah survival through conservation education' (Isaboke, 2008; Supplementary material 4).

The Salama region in Makueni County (Figure 1) was identified as a priority area for conservation intervention due to rapid land subdivision, which had more than tripled the human footprint by 2008 (Wambua, 2008). At the time of this study, conversion of land from large-scale ranching to small-scale farming posed a major threat to a once-thriving cheetah population. These pressures were compounded by increasing incidents of snaring and illegal bushmeat trade, including the poaching of Grant's gazelle (*Nanger granti*), the cheetah's primary prey species in the area (Mutoro et al., 2022), resulting in a declining natural prey base (Durant et al., 2017). As prey availability decreases, cheetahs are more likely to prey on livestock, heightening human–wildlife conflict and increasing the risk of retaliatory and indiscriminate predator persecution (Marker et al., 2018). Together, ecological and social pressures, coupled with the rising incidence of human–wildlife conflict, underscored the urgent need for effective environmental education and conservation initiatives across this cheetah's home range. In response, we conducted a pilot study in the Salama region to evaluate the effectiveness of three media-based presentation methods delivered in six schools to raise awareness about cheetah conservation. Specifically, the study aimed to determine which presentation method was most effective in communicating the plight of cheetahs and in improving short-term knowledge gain, awareness, and conservation attitudes among students.

Methodology

Study area

Between April and June 2009, ACK began to present various conservation education media to six public primary schools in the Machakos wildlife dispersal area, Makueni County, Kenya (10°35′ and 10°54′S, 37°10′ and 37°18′E, Figure 1). Makueni County is predominantly inhabited by the Akamba community, who constitute over 96% of the population and primarily practice agro-pastoralism (Government of Makueni County, 2022). The area encompasses private and community group ranches, covering an approximate area of 929 km^2 (Figure 1). The six public primary schools included Ulu, Itumbule, Marwa, Tangu, Kiima Kiu and Ngaamba, which were distributed across the study area (Figure 1). These public schools were selected for this study because they had previously received very limited conservation education programs for their students, as they are located far away from the boundary of the nearest protected area (Figure 1) and lie outside of areas where other youth conservation education programs, such as the Wildlife Clubs of Kenya, have been conducted. Unlike the study by D'Udine (2009), which mainly targeted adults of different education levels, this media presentation study targeted a different age demographic, mainly pupils between the ages of 8 and 17 years old. Before the start of the project with the schools, permission was first sought from two governmental institutions, the Divisional Education Officer and the Divisional Officer. Subsequently, the school authorities agreed to the planned activities prior to the study's commencement (Isaboke, 2008; Supplementary material 4).

Presentation methods

In Kenyan schools, English is the primary language of instruction from primary grade 4 through secondary school and continues to be used in higher education (Spernes et al., 2025). Accordingly, English was used in all presentations and discussions as requested by the teachers. A total of 529 students from grades 5, 6 and 7 were randomly selected from each school. The study used three different presentation methods: poster, puppet show, and video (Supplementary material 1). The poster presentations highlighted the ecological role of predators,

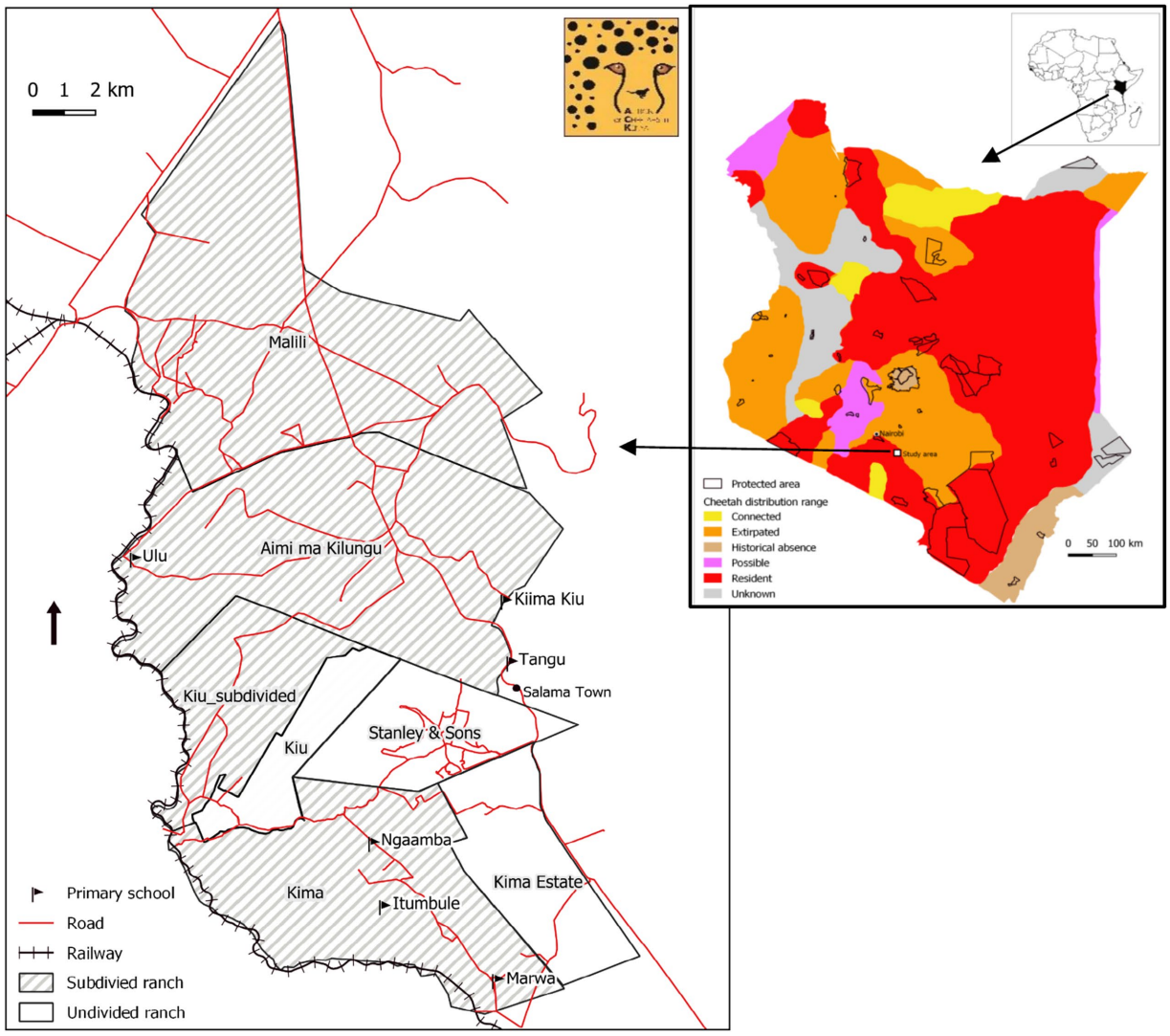

FIGURE 1
Map of the study area with the location of the schools that participated in the survey. The inset map shows the position of the study area in Kenya relative to the national parks and game reserves.

cheetah life cycle, population estimates and predator conflict. These comprehensive posters provided information on the status and threats to cheetahs in Kenya and were presented only at the Itumbule and Marwa primary schools. The puppet show, shown only at Tangu and Kiima Kiu primary schools, followed a narrated children's story about "How the Cheetah Got its Spots." This story was adapted from the Cheetah Conservation Fund's educational materials, which featured different animal characters and captured unique characteristics specific to the cheetah (Cheetah Conservation Fund, 2025). Lastly, a video titled "Perfect Mothers, Perfect Predators" from National Geographic (2003), depicting the plight of leopards and cheetahs in raising a family inside the Maasai Mara National Reserve in Kenya, was only played at Ulu and Ngaamba primary schools. Although the media varied across some schools, the process was the same at each site visited. Each presentation was 45 min long and concluded with an educator-led discussion on topics related to cheetahs in Kenya, including their history and conservation status, their role in the ecosystem, diet and life cycle, conflicts, and future conservation efforts. The short, engaging discussions that followed each medium helped create a uniform conservation message.

Data collection

An identical survey was administered before and after the presentation to measure the effectiveness of information delivery and retention across different media (Supplementary material 2). They did not undergo any expert validation processes, as this study was part of a larger study (see Isaboke, 2008; Supplementary material 4) and was treated as exploratory to assess short-term knowledge gains. The surveys were administered at the beginning of each program. To ensure anonymity, students were first assigned a number and given two envelopes labeled pre- and post-surveys. The survey included background questions about students' age, gender, and grade; whether they had previously visited a national park; whether they had seen certain wildlife species; and whether their family owned livestock (see

Supplementary material 2). The background questions were not repeated on the post-test. The surveys also included questions about the cheetah, its conservation status, and conflicts between cheetahs and people. As part of the survey, the students were asked to identify spotted cats (leopard, cheetah, and serval) from photos provided by the educators. Discussion questions from the students varied for each class depending on the details already provided in the main presentation, but the guided discussion focused on the information being surveyed. After the presentation, each student completed an identical post-survey questionnaire (Supplementary material 2) with the same topic-related questions.

All pre-and post-survey questions were analyzed with equal weight. The scores were aggregated for each presentation method to determine which method had the highest impact on improving the students' knowledge. The data was recorded into a binary format as follows: All correct answers were given a score of one (1). A score of zero (0) was given to all incorrect or "I do not know" answers, or questions left blank. After scoring the pre- and post-survey answers, a score of one (1) was given to questions that were initially answered incorrectly but then answered correctly after the presentations. A score of zero (0) was given when questions were either answered incorrectly or correctly, both before and after the presentations (i.e., no knowledge was gained or lost). Questions initially answered correctly in the pre-survey and then answered incorrectly in the post-survey were given a score of negative one (−1). These scores were then aggregated for each question in each test.

Data analysis

Cronbach's alpha (Tavakol and Dennick, 2011) was calculated to measure the degree to which the surveys yielded similar aggregate scores before and after exposure to the conservation education media. The effects of livestock ownership, prior cheetah exposure, and presentation type on students' aggregate test scores were examined for the full dataset. A Type III Analysis of Variance (ANOVA) using Satterthwaite's method was conducted to evaluate the main effects and interaction of livestock ownership (yes/no) and previous cheetah exposure (yes/no) on the aggregate score. ANOVA was performed using the car package (Fox and Weisberg, 2019) in R (v 4.2.2). To assess the effectiveness of different presentation types, linear mixed-effects models were fitted using the lme4 package (Bates et al., 2015) in R to account for the hierarchical structure of the data (students nested within classes and schools). Presentation method (posters, puppets, video) was included as a fixed effect. The Random intercepts were specified for class nested within school to account for clustering. Age was not included as a predictor because preliminary analyses indicated negligible contribution to score variance. *p*-values were obtained with lmerTest (Kuznetsova et al., 2017). Model fit was assessed using restricted maximum likelihood (REML). Post-hoc pairwise comparisons of presentation types were conducted using the emmeans package (Lenth, 2022) with Tukey adjustment for multiple comparisons. Effect sizes for presentation comparisons were calculated by dividing the fixed-effect estimates by the residual standard deviation (Cohen's *d*–style). Intraclass correlation coefficients (ICCs) were computed to quantify the proportion of variance attributable to class-within-school clustering. Each presentation method also was divided into five categories of knowledge: appearance, status, perception, threats, and actions. Five Mann–Whitney U tests (Mann and Whitney, 1947) were run for each category. A median test (with a Bonferroni adjusted significance level of 0.01), obtained by dividing the conventional significance level of 0.05 by the five categories (Dunn, 1961) was used to test for differences across presentation types in each of the categories of knowledge in the pre- and post-surveys to reduce familywise error.

Results

The student surveys were nearly equally distributed across the media presentations, with posters having slightly more surveys compared to the other media presentations (Table 1). Less than one-third (31.4%) of the students previously visited a national park or game reserve in Kenya (Figure 2A). Hare (*Lepus* sp.), giraffe (*Giraffa camelopardalis*) and buffalo (*Cyncerus caffer*) were the most observed game species among the students (Table 2). For the carnivore species, cheetah was the most observed species by the students, followed by lion (*Panthera leo*), spotted hyena (*Crocuta crocuta*) and serval (*Leptailurus serval*) (Table 2). For prey species, very few students had seen warthog (*Phacochoerus africanus*, 0.8%), gazelle (3.4%) or impala (*Aepyceros melampus* 6.6%) (Table 2). The majority of students reported having seen only one (21.4%) or two (17.8%) species of wildlife (Figure 2B), although most (98.1%) of the students indicated that their family owned livestock (Table 2). Overall, the gender, grade and age distributions were similar between the three media presentations. The sample comprised slightly more females (51.2%) than males (47.6%), and 1.2% of students did not indicate their gender. The students' ages ranged from 8 to 17 years old, with a majority (32%) aged 13 years old (Table 1). The age distribution varied by grade, ranging from 8 to 15 years in grade 5, 9–17 years in grade 6, and 10–16 years in grade 7. The average ages of students in grades 5, 6, and 7 were 11.5, 12.3, and 13.4 years, respectively. Thirty-eight percent of the students who took part in this survey were in grade seven (Table 1). Cronbach's alpha reliability was low at pre-test ($\alpha = 0.40$) but improved following exposure to the educational materials (post-test $\alpha = 0.58$). The Type III ANOVA indicated that neither livestock ownership ($F(1,515.6) = 0.79$, $p = 0.37$) nor proir exposure to cheetahs ($F(1,512.2) = 2.67$, $p = 0.10$) had a statistically significant effect on student aggregate test scores. Additionally, the interaction between livestock ownership and prior cheetah exposure was not significant ($F(1,512.4) = 1.49$, $p = 0.22$). Presentation type, however, showed a significant effect on scores ($F(2, 15.3) = 3.85$, $p = 0.044$). After accounting for clustering within classes and schools in the linear mixed-effects models, the presentation method significantly influenced students' aggregate scores. Posters, which served as the reference category, significantly improved the students' overall knowledge on cheetahs more effectively than puppet shows and videos (Figure 3). Videos were significantly less effective, with aggregate scores lower than those for the posters ($\beta = -1.44$, SE = 0.50, $t = -2.89$, $d \approx 0.63$). Scores for the puppets were slightly lower than for the posters ($\beta = -0.91$, SE = 0.50, $t = -1.83$, $d \approx 0.40$), representing marginal evidence. Approximately 9.6% of the variance in scores was attributable to differences between classes nested within schools (ICC = 0.096).

10.3389/fcomm.2026.1701321

Grade 7 students showed greater improvement in cheetah knowledge than students in grades 5 and 6 (Figure 4). Puppet shows showed the greatest improvement in the students' knowledge on cheetah conservation status, human-wildlife conflict and future conservation compared to poster presentations for students in grade 6 (Supplementary material 3). Puppet shows also had the greatest improvement in students' knowledge about human-wildlife conflict for students in grade 5 (Figure 4). The poster presentation was the most effective method for learning about cheetah identification across all three grades. Videos only had the greatest improvement for grade 5 students and learning about future conservation efforts.

Discussion and conclusion

This pilot study assessed the effectiveness of three presentation methods (poster, puppet show, and video) in conservation education programs to increase students' awareness of the plight of cheetahs in rural schools within the cheetah home range in southern Kenya. The results demonstrate significant short-term gains in knowledge and understanding of the cheetah and their conservation status across all three presentation methods. These findings highlight the significance of conservation education programs in increasing awareness of wildlife and environmental issues and the importance of providing such education programs in schools. They also support findings from

TABLE 1 Demographics of students who took part in different media presentations.

Demographics		Video (%)	Posters (%)	Puppets (%)	Total (%)
# Participants		172 (32.5)	183 (34.6)	174 (32.9)	529 (100)
Gender	Male	85 (49.4)	81 (44.3)	86 (49.4)	252 (47.6)
	Female	86 (50.0)	99 (54.1)	86 (49.4)	271 (51.2)
	Unknown	1 (0.6)	3 (1.6)	2 (1.2)	6 (1.1)
Grade	5	50 (29.1)	58 (31.7)	60 (34.5)	168 (31.8)
	6	39 (22.7)	64 (35.0)	55 (31.6)	158 (29.9)
	7	83 (48.3)	61 (33.3)	59 (33.9)	203 (38.4)
Age	8	0 (0)	0 (0)	1 (0.6)	1 (0.2)
	9	2 (1.2)	0 (0)	3 (1.7)	5 (1.0)
	10	9 (5.2)	12 (6.6)	22 (12.6)	43 (8.1)
	11	31 (18.0)	32 (17.5)	21 (12.1)	84 (15.9)
	12	38 (22.0)	46 (25.1)	35 (20.1)	119 (22.5)
	13	47 (27.3)	71 (38.8)	51 (29.3)	169 (32.0)
	14	30 (17.4)	19 (10.4)	27 (15.5)	76 (14.4)
	15	14 (8.1)	2 (1.1)	11 (6.3)	27 (5.1)
	16	1 (0.6)	1 (0.6)	1 (0.6)	3 (0.6)
	17	0 (0)	0 (0)	1 (0.6)	1 (0.2)
	Unknown	0 (0)	0 (0)	1 (0.6)	1 (0.2)

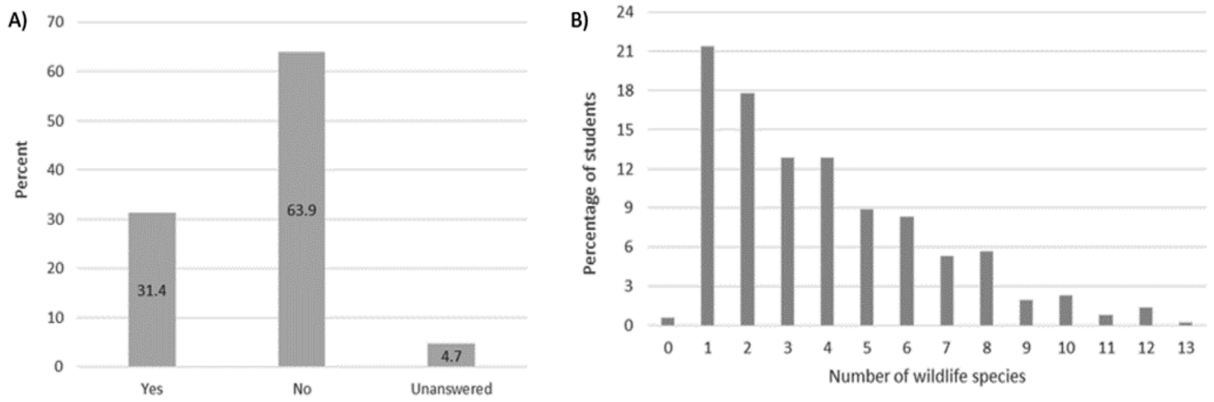

FIGURE 2
Percentage of students who **(A)** have or have not visited a national park or game reserve in Kenya, and **(B)** the number of different wildlife species students have seen.

TABLE 2 The percentage of students whose family owns livestock and the percentage of students who have personally seen different wildlife species.

Species	# Students	Percentage
Livestock		
Goats	334	64.4
Sheep	280	53.9
Chickens	382	73.6
Cattle	399	76.9
Pigs	63	12.1
Donkeys	14	2.7
No livestock	8	1.5
No answer	2	0.4
Wildlife		
Antelope	30	5.7
Buffalo	232	43.9
Cheetah	159	30.1
Dik dik	157	29.7
Deer	6	1.1
Elephant	148	28
Gazelle	18	3.4
Giraffe	303	57.3
Hare	441	83.4
Hyena	14	2.6
Impala	35	6.6
Leopard	132	25
Lion	126	23.8
Monkey	64	12.1
Porcupine	53	10
Rhinoceros	82	15.5
Serval	14	2.6
Warthog	4	0.8
Wildebeest	11	2.1
Zebra	34	6.4
No sightings/no answer	3	0.6

previous studies on the impact of environmental education programs in increasing students' awareness of environmental issues (see Kioko et al., 2010; Randall, 2012; Oražem et al., 2019; Hnatyuk et al., 2024).

Of the three presentation methods, posters produced the highest learning outcomes, particularly regarding the appearance and perception of cheetahs, even after accounting for classroom and school-level clustering. Video was the least effective at educating students about cheetah conservation issues, whereas puppets performed at an intermediate but meaningfully lower level. According to Killeen (2010), presentations should engage the audience and create an emotional connection between them and the subject, with the aim of increasing awareness of the related issue. Psychological research has found that children learn best from educational materials when they can engage in the dialogue and interaction rather than passive viewing (e.g., DeLoache et al., 2010). This finding corroborates our results that the interactive presentation methods (posters and puppet shows) were more effective than the video presentation. The use of pictures and visuals in the posters may have aroused the students' interest and imagination, providing a shared experience that stimulated their imagination and initiated a discussion (Ganguly, 2011). Additionally, interactive poster presentations offer the greatest use of principles that enhance learning, such as the use of text and images to reinforce information. The interactive nature may also allow the researchers to use signals (e.g., pointing, eye gaze) to direct attention to key information (e.g., Mayer, 2002).

The puppet show also significantly increased the students' knowledge compared to the video. Animal puppet characters used during the show may have emotionally connected the students to the presentation, making them more responsive. In addition, students could easily identify with the characters in the story and were invested in their situations (Ganguly, 2011). A study conducted in Mexico using different presentation methods found that the storytelling technique significantly impacted the students' knowledge (Franquesa-Soler et al., 2020). The same was true in our study, possibly because students are more likely to remember the story than the information presented during the subsequent discussion. This finding suggests the story was significantly more memorable than other aspects of the presentation (Rey, 2012). The inclusion of enhancers in lesson delivery, such as visual and sound help, stimulate connectivity among students in communicating conservation or the topic of interest you want them to engage with (Jacobson et al., 2015). The puppet show may have been more effective if it included key information in the story. However, the addition of more information must not detract from the enjoyment of the story. Conversely, videos showed the lowest improvement in students' knowledge on cheetah conservation, though retention of information was still significant. While videos are considered highly persuasive to the target audience (Ganguly, 2011; Leeds et al., 2017), the present study suggests a lower emotional connection between students and the subject, probably due to minimal engagement between educators and students during the presentation. The effectiveness of both the poster and puppet presentations suggests that personal interaction may be a key element in a successful conservation education program. Whereas using videos may prevent educators from sharing specific information with students, failure to incorporate other printed materials during the video presentation may also have contributed to lower but significant knowledge gain on the subject matter. Despite differences in outcome measures across the three presentation methods, the increase in internal consistency following exposure (post-test $\alpha = 0.58$) suggests that students' knowledge improved after the presentations. This indicates that their responses became more systematic after instruction. However, given the moderate reliability of the post-test, the findings of this study should be considered exploratory.

School and age did not account for variation in students' knowledge outcomes across the six schools, although they are identified as significant contributors to variation in the outcomes of conservation education programs among school-going children (Liefländer, 2015; Pauw and Petegem, 2018). Schools often have dissimilar teaching environments, which can affect students' performance (Valenzuela-Morales et al., 2022; Børresen et al., 2023). In contrast, the lack of variation in knowledge outcomes across schools in this study was likely due to all the participating

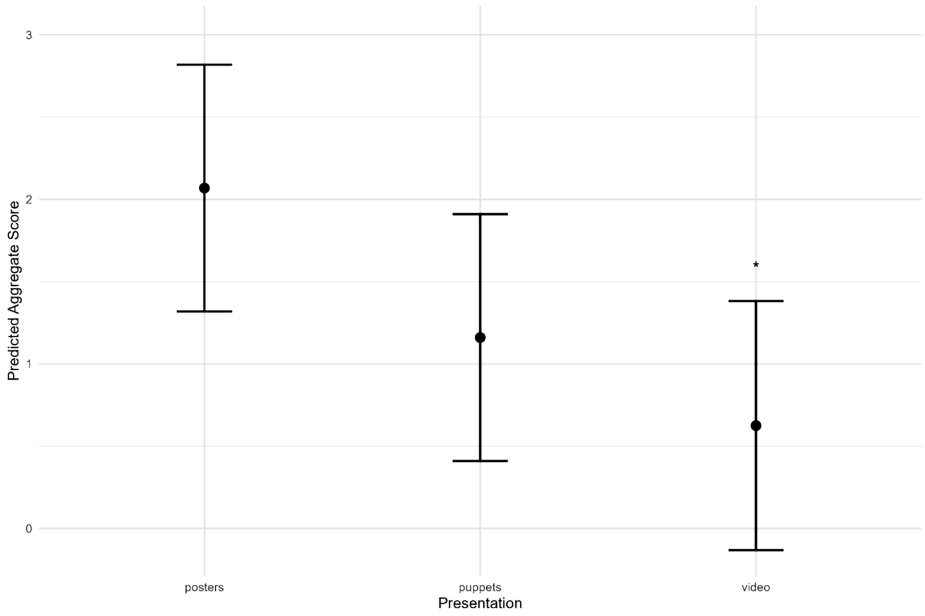

FIGURE 3
Predicted aggregate scores by presentation method, adjusted for class and school clustering. Error bars represent 95% confidence intervals. Horizontal lines with asterisks indicate significance of all pairwise comparisons between presentation methods ($p < 0.05$, $p < 0.01$, $p < 0.001$).

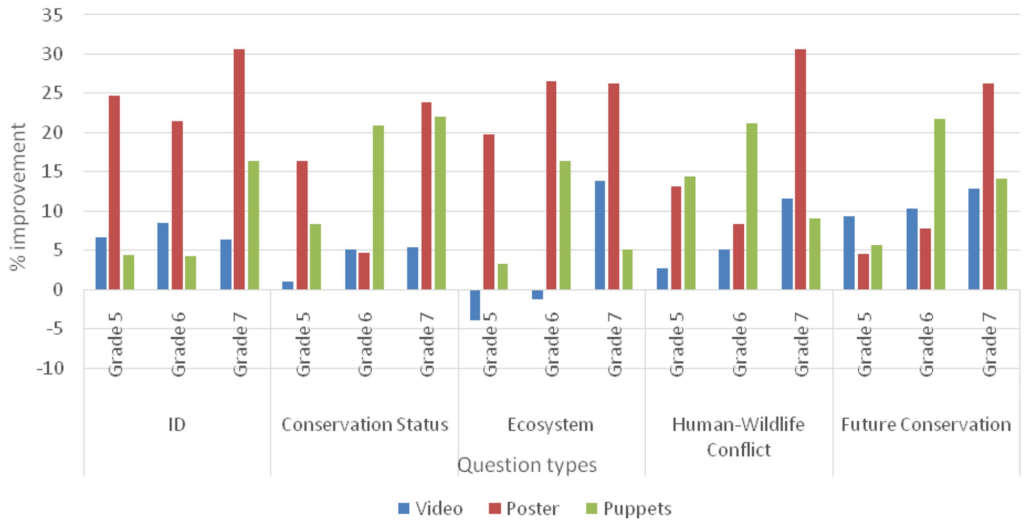

FIGURE 4
Students' ability to correctly answer the survey questions after different types of conservation education media presentations based on students' grades.

schools being publicly owned and having similar resources, teaching methods and training techniques, as reported by Kipkogei et al. (2025). Additionally, confounding factors arising from school-level characteristics (e.g., program design, teacher orientation) may have been eliminated through restriction (see Pourhoseingholi et al., 2012) due to their interaction with broader socioeconomic and regional factors in the study area. For example, the area is highly homogeneous, comprising one major ethnic community that primarily practices agro-pastoralism. In this study, neither livestock ownership nor prior exposure to cheetahs had a significant effect on test scores. However, Hughes (2013) found that the knowledge and perceptions of a group of Namibian students regarding cheetahs were largely shaped by their families' prior experiences with the species. Grade appeared to have a greater impact on knowledge outcomes, with Grade 7 students demonstrating more improvement in their knowledge of cheetahs than students in Grades 5 and 6 (Figure 4). Regardless of their varying ages, they generally answered conservation questions in the survey with a pro stance. This suggests that the medium of conservation education presented in the classes has a greater influence on conservation attitudes than biological age. Furthermore, unlike in other school systems where age closely

correlates with grade, Kenyan public schools may exhibit incongruence between age and grade (World Inequality Lab, 2022).

As the majority of students in this study had not visited a national park or game reserve, and came from agro-pastoral backgrounds, negative perceptions of carnivores and other wildlife species can arise from fear or prior negative interactions with wildlife (Castillo-Huitrón et al., 2020) and/or adult community perceptions. Moreover, the results revealed an interesting trend: while 30.1% of students had seen a cheetah, only 3.4% had observed cheetah prey (gazelles), suggesting a knowledge gap between predators and their prey. This highlights a potential prey awareness gap, whereby students are familiar with the 'problem' predator, cheetahs in this case, but lack direct experience of the ecosystem components that sustain them. This finding warrants further exploration in future studies; for example, students could learn about the ecological relationships of the 'problem' species to foster a more holistic understanding of their conservation (Mara Elephant Project and Escape Foundation, 2018).

Conservation education outcomes are strongly influenced by the extent to which students become aware of conservation issues, such as the protection of species and habitats, and are critically dependent on the type of teaching to which students are exposed (Caro et al., 2003). Quantitative evaluations of conservation education programs and delivery methods are therefore essential for validating their efficacy and refining future programs in Kenya. Although exploratory, the results of this study demonstrate significant short-term gains in knowledge and understanding of the cheetah and their conservation status across all three presentation methods. By increasing students' knowledge of wildlife through conservation education, some studies suggest that students gain interest in wildlife and become more involved in conservation (Kioko et al., 2010; Down et al., 2017). Students in rural communities are often overlooked in the planning of environmental education programs due to their remote locations. Nevertheless, these communities should have access to educational programs that incorporate diverse presentation methods to create interactive, engaging, and innovative learning opportunities. Educating students while they are still at school can help to cultivate a generation of future farmers who are passionate about wildlife, which would ultimately contribute to the long-term benefits of wildlife populations (Megaze et al., 2017; Morehouse et al., 2020). Conservation education programs must also evaluate changes in knowledge, attitudes, and behavior of the students before and after the presentations using pre- and post-surveys, to maintain learning objectives. Although our pilot study showed significant improvement in students' knowledge about cheetah, further research should be conducted over a longer period of time and replicated in both private and urban schools, and in other rural communities to further investigate the full-scale impacts alternative educational environments can provide. This would foster a better understanding of the overall effectiveness of different presentation methods in enhancing environmental awareness.

In the present study, no one school received all three presentations. To better assess the effectiveness of the three presentation types at each participating school, future study design should be more randomized in the event that different schools will receive different education materials. Lastly, to enhance accurate measurement of learning gains, the survey instruments should undergo validation, reliability testing and pilot evaluation before the audience interacts with them.

In conclusion, our exploratory study provides only a small yet significant overview of how presentation methods in conservation education can influence students' short-term knowledge and attitudes toward wildlife. It further highlights that interactive presentation methods, such as posters and puppet shows, are effective media for engaging students in cheetah and other wildlife conservation education initiatives. While videos are efficient for knowledge transfer (see, e.g., Leeds et al., 2017), our results suggest a value gap in advocacy that requires a more interactive approach. Students in rural areas rarely have access to educational resources on wildlife and their environment, underscoring the vital need for engaging local conservation education programs to enhance awareness and support conservation efforts.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors without undue reservation.

Ethics statement

Ethical approval was not required for the studies involving humans because the study was part of a larger project on raising community awareness, understanding, and involvement in the control of bush meat activities in the study area. This project, funded by the Rufford Grant, involved education and outreach activities with schools and other community members in the study area. Permission to conduct the project in the study area, including the schools, was first sought from two governmental institutions: the Divisional Education Officer and the Divisional Officer. Subsequently, the school authorities were informed of the planned activities prior to the study's commencement. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and institutional requirements because we got permission from the two governmental institutions as well as the school authorities prior to the study.

Author contributions

NM: Conceptualization, Formal analysis, Visualization, Writing – original draft, Writing – review & editing. JS-F: Conceptualization, Formal analysis, Writing – review & editing. AM: Writing – review & editing. LP: Writing – review & editing. LM: Writing – original draft, Writing – review & editing. MW: Conceptualization, Funding acquisition, Methodology, Visualization, Writing – original draft, Writing – review & editing.

Funding

The author(s) declared that financial support was received for this work and/or its publication. This project was funded by Rufford Grant Foundation (grant number 35.05.08) and in-kind support from Cheetah Conservation Fund and Action for Cheetahs in Kenya. Lastly, we gratefully acknowledge the support for open access publication provided by the Paris Lodron University of Salzburg Publication Fund.

Acknowledgments

We are grateful to Wallace Isaboke for leading all the sessions and to the school principals for allowing us to conduct the surveys in their schools. We also thank all the students and teachers who took part in this study.

Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that Generative AI was not used in the creation of this manuscript.

Any alternative text (alt text) provided alongside figures in this article has been generated by Frontiers with the support of artificial intelligence and reasonable efforts have been made to ensure accuracy, including review by the authors wherever possible. If you identify any issues, please contact us.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcomm.2026.1701321/full#supplementary-material

References

Ardoin, N., Bowers, A., and Gaillard, E. (2020). Environmental education outcomes for conservation: a systematic review. *Biol. Conserv.* 241:108224. doi: 10.1016/j.biocon.2019.108224

Bates, D., Mächler, M., Bolker, B., and Walker, S. (2015). Fitting linear mixed-effects models using lme4. *J. Stat. Softw.* 67, 1–48. doi: 10.18637/jss.v067.i01

Børresen, S. T., Ulimboka, R., Nyahongo, J., Ranke, P. S., Skjaervø, G. R., and Røskaft, E. (2023). The role of education in biodiversity conservation: can knowledge and understanding alter locals' views and attitudes towards ecosystem services? *Environ. Educ. Res.* 29, 148–163. doi: 10.1080/13504622.2022.2117796

Breuer, T., Mavinga, F., Evans, R., and Lukas, K. (2017). Using video and theatre to increase knowledge and change attitudes: why are gorillas important to the world and to Congo? *Am. J. Primatol.* 79:e22692. doi: 10.1002/ajp.22692

Caro, T., Borgerhoff Mulder, M., and Moore, M. (2003). Effects of conservation education on reasons to conserve biological diversity. *Biol. Conserv.* 114, 143–152. doi: 10.1016/S0006-3207(02)00423-8

Castillo-Huitrón, N. M., Naranjo, E. J., Santos-Fita, D., and Estrada-Lugo, E. (2020). The importance of human emotions for wildlife conservation. *Front. Psychol.* 11:1277. doi: 10.3389/fpsyg.2020.01277

Cheetah Conservation Fund. (2025). CCF teacher's resource guide: a predator's role in the ecosystem. Available online at: https://cheetah.org/resource-library/new-4th-edition-cheetah-a-predators-role-in-the-ecosystem/ (Accessed December 28, 2025).

D'Udine, F. (2009). Perceived effectiveness of domestic dogs and other livestock husbandry tools in mitigating human–cheetah conflicts in the Salama-Kiu region, Kenya (Master's thesis). London, England: University College London.

DeLoache, J. S., Chiong, C., Sherman, K., Islam, N., Vanderborght, M., Troseth, G. L., et al. (2010). Do babies learn from baby media? *Psychol. Sci.* 21, 1570–1574. doi: 10.1177/0956797610384145

Dickman, A. J. (2010). Complexities of conflict: the importance of considering social factors for effectively resolving human–wildlife conflict. *Anim. Conserv.* 13, 458–466. doi: 10.1111/j.1469-1795.2010.00368.x

Dickman, A., Hazzah, L., Carbone, C., and Durant, S. (2014). Carnivores, culture and 'contagious conflict': multiple factors influence perceived problems with carnivores in Tanzania's Ruaha landscape. *Biol. Conserv.* 178, 19–27. doi: 10.1016/j.biocon.2014.07.011

Dickman, A. J., Marchini, S., and Manfredo, M. (2013). "The importance of the human dimension in addressing conflict with large carnivores" in Key topics in conservation biology. eds. D. W. Macdonald and K. Willis, vol. 2 (John Wiley & Sons, Ltd., Chichester, West Sussex, United Kingdom: Oxford University Press), 110–126.

Down, L. O., Modi, C. G., Sek, I. M., and Miller, S. J. (2017). "Language" in Textbooks for sustainable development (UNESCO Mahatma Gandhi Institute of Education for Peace and Sustainable Development).

Dunn, O. J. (1961). Multiple comparisons among means. *J. Am. Stat. Assoc.* 56, 52–64.

Durant, S., Mitchell, N., Groom, R., Pettorelli, N., Ipavec, A., Jacobson, A., et al. (2017). The global decline of cheetah Acinonyx jubatus and what it means for conservation. *Proc. Natl. Acad. Sci.* 114, 528–533. doi: 10.1073/pnas.1611122114

Feucht, V., Dierkes, P. W., Haeser-Kalthoff, A., Kästner, A., Mager, C., Reichhardt, S., et al. (2025). Environmental education in zoos: analysis of different scales to measure the impact of educational programs. *Environ. Educ. Res.* 31, 776–793. doi: 10.1080/13504622.2024.2386631

Fox, J., and Weisberg, S. (2019). An R companion to applied regression. 3rd Edn. Thousand Oaks, CA, USA: Sage.

Franquesa-Soler, M., Jorge-Sales, L., Aristizabal, J. F., Moreno-Casasola, P., and Serio-Silva, J. C. (2020). Evidence-based conservation education in Mexican communities: connecting arts and science. *PLoS One* 15:e0228382. doi: 10.1371/journal.pone.0228382

Ganguly, S. (2011). "Communicating media and strategy" in Participatory adult learning, documentation and information networking (PALDIN), 141–154.

Government of Makueni County. (2022). Makueni County statistical abstract. County Government of Makueni. Available online at: https://makueni.go.ke/sandbox/site/files/2023/11/Makueni-County-Statistical-Abstract-2022.pdf (Accessed January 6, 2026).

Hnatyuk, V., Pshenychna, N., Kara, S., Kolodii, V., and Yaroshchuk, L. (2024). Education's role in fostering environmental awareness and advancing sustainable development within a holistic framework. *Multidis. Rev.* 7. doi: 10.31893/multirev.2024spe012

Hoare, G., Leneuyia, K., Higgins, P., and Lowerikoi, J. (2022). Wildlife and indigenous communities in Kenya: the influence of conservation education in supporting co-existence between wildlife and a Maasai community. *Southern African J. Environ. Educ.* 38, 43–57. doi: 10.4314/sajee.v38i.08

Hogue, A., and Breon, K. (2022). The greatest threats to species. *Conserv. Sci. Pract.* 4, 1–9. doi: 10.1111/csp2.12670

Hughes, C. (2013). Exploring children's perceptions of cheetahs through storytelling: implications for cheetah conservation. *Appl. Environ. Educ. Commun.* 12, 173–186. doi: 10.1080/1533015X.2013.838870

Inskip, C., and Zimmermann, A. (2009). Human–felid conflict: a review of patterns and priorities worldwide. *Oryx* 43, 18–34. doi: 10.1017/S003060530899030X

Isaboke, W. (2008). Sustainable cheetah survival through conservation education at the Machakos wildlife dispersal area, Makueni District, Kenya. United Kingdom: Rufford Small Grants for Nature.

Jacobson, S., McDuff, M., and Monroe, M. (2015). Conservation education and outreach techniques. 2nd Edn. Oxford, United Kingdom: Oxford University Press.

Kija, H. K., Ogutu, J. O., Mangewa, L. J., Bukombe, J., Verones, F., Graae, B. J., et al. (2020). Spatio-temporal changes in wildlife habitat quality in the greater Serengeti ecosystem. *Sustainability* 12:2440. doi: 10.3390/su12062440

Killeen, S. (2010). The power of presentation. *J. Int. Zoo Educ. Assoc.* 46, 30–35.

Kioko, J., Kiringe, J. W., and Wahungu, G. (2010). Youth's knowledge, attitudes and practices in wildlife and environmental conservation in Maasailand, Kenya. *Southern African J. Environ. Educ.* 27, 92–101.

Kipkogei, K. E., Ondigi, S. R., and Nyamu, F. K. (2025). An Analysis of the teaching and learning resources available for Social Studies under the Competency-based Curriculum in public primary schools in Nakuru County, Kenya. *Journal of Education*, 5, 44–60.

Kuznetsova, A., Brockhoff, P. B., and Christensen, R. H. B. (2017). lmerTest package: tests in linear mixed effects models. *J. Stat. Softw.* 82, 1–26. doi: 10.18637/jss.v082.i13

KWS (2010). Kenya national strategy for the conservation of cheetahs and wild dogs in Kenya: Kenya Wildlife Service (KWS).

Lamanauskas, V. (2023). The importance of environmental education at an early age. *J. Balt. Sci. Educ.* 22, 564–56. doi: 10.33225/jbse/23.22.564

Leeds, A., Lukas, K., Kendall, C., Slavin, M., Ross, E., and Robbins, M. (2017). Evaluating the effect of a year-long film-focused environmental education program on Ugandan student knowledge of and attitudes toward great apes. *Am. J. Primatol.* 79:e22673. doi: 10.1002/ajp.22673

Lehnhardt, K. (2010). Are we evaluating children's nature experiences? *J. Int. Zoo Educ. Assoc.* 46, 4–5.

Lenth, R. V. (2022). Emmeans: estimated marginal means, aka least-squares means (R package version 1.7.3). Available online at: https://CRAN.R-project.org/package=emmeans (Accessed January 7, 2026).

Liefländer, A. (2015). Effectiveness of environmental education on water: connectedness to nature, environmental attitudes and environmental knowledge. *Environ. Educ. Res.* 21, 145–146. doi: 10.1080/13504622.2014.927831

Mann, H. B., and Whitney, D. R. (1947). On a test of whether one of two variables is stochastically larger than the other one. *Ann. Math. Stat.* 18, 50–60.

Mara Elephant Project and Escape Foundation. (2018). Understanding young people's attitudes towards wildlife and conservation. Available online at: https://maraelephantproject.org/wp-content/uploads/2018/02/Understanding-Youth-People%E2%80%99s-Attitudes-Towards-Wildlife-and-Conservation.pdf (Accessed December 28, 2025).

Marker, L., Boast, L. K., and Schmidt-Küntzel, A. (2018). Cheetahs: biology and conservation. San Diego, CA, USA: Academic Press.

Mayer, R. E. (2002). "Multimedia learning" in Psychology of learning and motivation, vol. 41 (San Diego, CA, USA: Academic Press), 85–139.

Megaze, A., Balakrishnan, M., and Belay, G. (2017). Human–wildlife conflict and attitude of local people towards conservation of wildlife in Chebera Churchura National Park, Ethiopia. *African Zool.* 52, 1–8. doi: 10.1080/15627020.2016.1254063

Morehouse, A. T., Hughes, C., Manners, N., Bectell, J., and Bruder, T. (2020). Carnivores and communities: a case study of human–carnivore conflict mitigation in southwestern Alberta. *Front. Ecol. Evol.* 8, 1–15. doi: 10.3389/fevo.2020.00002

Mutoro, N. M., Chira, R., Gichuki, N., Kariuki, E., Eberle, J., Habel, J. C., et al. (2022). Dietary preference of cheetahs (*Acinonyx jubatus*) in South-Eastern Kenya. *Ecol. Evol.* 12. doi: 10.1002/ece3.8556

Muya, S. M., Kamweya, A. M., Muigai, A. W. T., Kariuki, A., and Ngene, S. M. (2013). Using range condition assessment to optimize wildlife stocking in Tindress wildlife sanctuary, Nakuru District, Kenya. *Rangeland Ecol. Manag.* 66, 410–418. doi: 10.2111/rem-d-12-00075.1

Oražem, V., Tomažič, I., Kos, I., Nagode, D., and Randler, C. (2019). Wolves' conservation through educational workshops: which method works best? *Sustainability* 11, 1–17. doi: 10.3390/su11041124

Parkes, M. (2006). Personal commentaries on "ecosystems and human well-being: health synthesis—a report of the millennium ecosystem assessment". *EcoHealth* 3, 136–140. doi: 10.1007/s10393-006-0038-4

Pauw, J., and Petegem, P. (2018). Eco-school evaluation beyond labels: the impact of environmental policy, didactics and nature at school on student outcomes. *Environ. Educ. Res.* 24, 1250–1267. doi: 10.1080/13504622.2017.1307327

Pourhoseingholi, M., Baghestani, A., and Vahedi, M. (2012). How to control confounding effects by statistical analysis. *Gastroenterol. Hepatol. Bed Bench* 5, 79–83.

Randall, T. (2012). Assessment of change in conservation attitudes through zoo and aquarium education. *J. Int. Zoo Educ. Assoc.* 48, 13–16.

Rey, G. D. (2012). A review of research and a meta-analysis of the seductive detail effect. *Educ. Res. Rev.* 7, 216–237. doi: 10.1016/j.edurev.2012.05.003

Ripple, W. J., Estes, J. A., Beschta, R. L., Wilmers, C. C., Ritchie, E. G., Hebblewhite, M., et al. (2014). Status and ecological effects of the world's largest carnivores. *Science* 343:1241484. doi: 10.1126/science.1241484

Rust, N. A., and Marker, L. L. (2014). Cost of carnivore coexistence on communal and resettled land in Namibia. *Environ. Conserv.* 41, 45–53. doi: 10.1017/S0376892913000180

Spernes, K., Bjørnstad, G. B., Jacobsen, K. B., and Chang'ach, J. K. (2025). Navigating the curriculum and languages in Kenyan education: empowering preservice teachers in a multilingual context. *Int. J. Educ. Dev.* 117:103377. doi: 10.1016/j.ijedudev.2025.103377

Tavakol, M., and Dennick, R. (2011). Making sense of Cronbach's alpha. *Int. J. Med. Educ.* 2, 53–55. doi: 10.5116/ijme.4dfb.8dfd

Treves, A., and Karanth, K. U. (2003). Human–carnivore conflict and perspectives on carnivore management worldwide. *Conserv. Biol.* 17, 1491–1499. doi: 10.1111/j.1523-1739.2003.00059.x

UNESCO. (2014). Shaping the future we want: UN decade of education for sustainable development (2005–2014) final report. Available online at: https://unesdoc.unesco.org/ark:/48223/pf0000230171 (Accessed December 28, 2025).

UNESCO (2020). Education for sustainable development: a roadmap (ESD for 2030). Paris: UNESCO. Available online at: https://unesdoc.unesco.org/ark:/48223/pf0000374802

Valenzuela-Morales, G., Hernández-Téllez, M., Ruíz-Gómez, M., Gómez-Albores, M., Arévalo-Mejía, R., and Mastachi-Loza, C. (2022). Water conservation education in elementary schools: the case of the Nenetzingo River catchment, Mexico. *Sustainability* 14:2402. doi: 10.3390/su14042402

Wambua, C. (2008). Wildlife density, distribution and abundance with emphasis on cheetah prey in Machakos and Makueni districts, Kenya (Master's thesis). Addis Ababa, Ethiopia: Addis Ababa University.

Woodroffe, R. (2000). Predators and people: using human densities to interpret declines of large carnivores. *Anim. Conserv.* 3, 165–173. doi: 10.1111/j.1469-1795.2000.tb00241.x

Woodroffe, R., and Frank, L. (2005). Lethal control of African lions (*Panthera leo*): local and regional population impacts. *Anim. Conserv.* 8, 91–98. doi: 10.1017/S1367943004001829

World Inequality Lab. (2022). World Inequality Database on Education (WIDE). [Data for Kenya, Overage 2+ indicator]. Available online at: https://www.education-inequalities.org/indicators/overage2plus/kenya#ageGroups=%5B%22overage2plus%22%5D&years=%5B%222022%22%5D&dimension=null

Zuluaga, S., Vargas, F., Kohn, S., and Grande, J. M. (2022). Top-down local management, perceived contribution to people, and actual detriments influence a rampant human–top predator conflict in the Neotropics. *Perspect. Ecol. Conserv.* 20, 91–102. doi: 10.1016/j.pecon.2021.11.001