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Research article

Measuring the impact of an in-school zoo education programme

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Abstract
The evaluation of the educational impact of zoos and aquariums is a growing area of research. This study attempted to measure the impact of an in-school zoo education outreach programme run by Chester Zoo, UK. Specifically, this programme delivered multiple workshops under a common conservation sub-theme to the same group of students within the UK Key Stage 2 year groups (ages 7 to 11; n=199). A repeated-measures survey was used as the primary instrument for assessing impact. The main findings were that the programme correlated with a positive, measurable and statistically significant impact in the student learners, particularly in terms of conservation-related knowledge but also student attitude to conservation and zoo-related issues.

Introduction

Zoos in the UK are legally obliged to be providers of education (DEFRA 2004). The content of this provision is fairly widespread across the biological sciences, but with the majority of zoos focusing on topics related to the conservation of biodiversity and the protection of the environment in general (Andersen 2003). Problematically, though, zoos have often gone one stage further and have confidently (and publically) claimed high levels of educational impact, without the necessary evidence to do so (Moss and Esson 2013). Opponents of zoos have not been slow to point this out. The RSCPA (2006) published a review of the literature in this area and concluded that "it is not enough for zoos to aim to have an educational impact; they should demonstrate a substantial impact. From our review of the literature, this does not yet appear to be the case" (p.97). We agree; if zoos are to continue to part-justify their existence on educational grounds, then it is their responsibility to measure, and report on, the impacts of their educational programmes.

In recent times, we have begun to understand the educational value of zoo visits. Moss et al. (2015) assessed the levels of biodiversity literacy in world zoo and aquarium visitors and found that visitors ended their visits with a significantly increased understanding, both of biodiversity and what it is, as well as the actions they could take to protect it. Jensen (2014) looked specifically at educational impacts in children visiting London Zoo and found that zoo-educator guided visits resulted in increased learning outcomes. MacDonald (2015) found that visitors to an animal presentation at Wellington Zoo not only understood the educational message of the programme but actually implemented the behaviour suggested. Specifically related to school-age zoo education programmes, Seybold et al. (2013) used a control-treatment experimental design to assess knowledge gain and retention and found that the zoo-based programmes (as compared to the school-only programme) resulted in greater learning outcomes, over a longer period. Similarly, Randler et al. (2011) used a similar design to explore the effectiveness of different zoo education programmes in school children, and found that all of the zoo programmes related to a significant increase in learning, when compared to a control group.

In this study, we wanted to assess the educational impact of an in-school educational service offered by Chester Zoo - the Safari Ranger programme. Principally engaging with primary schools in the local region, we wanted specifically to evaluate a multiple-workshop programme, with a common conservation sub-theme, to the same group of children within the UK Key Stage 2 year groups (ages 7 to 11). Our key research questions, therefore, were:

- Does the Safari Ranger programme achieve positive educational impacts related to conservation?
- Can we benchmark any impacts with related studies to better understand the relative value of the Safari Ranger programme?

Methods

Programme content

The programme consisted of four workshops delivered over multiple visits to selected schools during the autumn school term (2015). The first three workshops delivered theoretical content, the fourth was a practical hands-on session that focused on reinforcing the core messages. Each workshop lasted fifty minutes in the school classroom and was aided by class teachers and/or teaching assistants. For the final workshop, zoo volunteers also assisted.

The three theoretical workshops were *"Act for Wildlife"* (covering poaching/hunting as a threat to wildlife and conservation actions), *"We need Rainforests"* (covering habitat destruction as a threat to wildlife and conservation actions) and *"Talking Rubbish"* (covering pollution as a threat, the concepts of biodegradability and sustainability, and personal conservation actions). Various bio-artefacts were used as learning aids, such as elephant tusks and snake skins, but no live animals were used. Given the timing of the project, the fourth, practical, workshop involved the creation of festive crafts with reused and recycled rubbish. Pupils from each class collected plastic bottles and bags to reuse in making either door wreaths, tree decorations or window decorations. They were also able to make bird feeders with zoo-provided materials. Pupils took their craft items home along with a specially designed booklet for them to share with their families. The booklet detailed the key messages of the workshop, reinforcing them through word games and activities. The booklet also contained instructions for the classroom craft activities and additional conservation actions that could be undertaken at home.

Participants

The selection of schools came from our existing list of school groups. In order to ensure we could deliver within the timeframe we decided to work with classes spanning the full Key Stage 2 age range (school years 3 to 6; ages 7-11), which ended up being across three schools (Table 1). The programme was completed in all three schools between 3 November and 17 December 2015. There was some variation in class sizes over the course of the programme due to illness, new students starting, etc. 199 students attended all workshops and therefore only these students were included in the analysis.

Programme evaluation

A repeated-measures survey was the main tool used to assess educational impact (a copy of the survey design is included as a supplementary file). All students who participated in this study (n=199) were asked to complete a survey. In order to minimise the disruption to the school day, the number of measures was kept to the minimum level of two; that is, one measure prior to the pilot programme and the second measure the day after the pilot programme ended. The survey design included a mixture of qualitative and quantitative items, including simple rating scales relating to attitude statements, open-ended questions and a drawing activity. The three main dependent (outcome) variables that were measured by the survey were:

- Conservation understanding
- Knowledge of pro-conservation behaviours
- Evidence of lesson-related learning outcomes

The first two were operationalised by open-ended written survey questions, namely *"What is conservation?"* and "*Do you think that YOU can help protect endangered species? If yes, how could you help?*". The third dependent variable was operationalised with a drawing activity, where students were given a space (approximately half of one side of A4 paper) to draw an annotated picture, in answer to the question: *"Can you draw some of the ways that we can help stop animals from becoming extinct? (include labels if you can)"*. Attitudes to the following self-developed statements were measured using standard five-point Likert-type scales: *"It is wrong for animals to be kept in zoos"; "Zoos are for saving animals from dying out ('extinction')*"; "*Zoos are for learning about animals"; and "Zoos are for me to have fun in"*.

Table 1. Participant description including school, class and number of students.

School	Year groups (number of classes)	Student numbers	Total student numbers
School 1	3-6 (4)	Year 3: 20 Year 4: 26 Year 5: 25 Year 6: 22	93
School 2	5-6 (2)	Year 5: 20 Year 6: 18	38
School 3	3-4 (3)	Year 3: 25 Year 3/4: 28 Year 4: 24	77
Total			208

Data processing and content analysis of qualitative data

The qualitative data from the three knowledge-related dependent variables (conservation understanding and knowledge of pro-conservation behaviours and evidence of lesson-related outcomes – drawings) were subjected to content analyses to provide quantitative data suitable for statistical analyses.

Dependent variable 1: Conservation understanding

The preliminary qualitative analysis of data for this variable suggested that there were continuous degrees of conservation understanding or accuracy. From this, a 5-point unidirectional scale was developed. Each response was scored according to the following scale:

1 – Incorrect understanding: complete confusion of topic e.g. "conservation is talking to people"
2 – Limited understanding of topic, perhaps understanding that conservation is to do with animals, but no further elaboration.
3 – Some positive evidence: some understanding, makes the link between conservation and animals, perhaps some general platitudes about "saving animals" but no additional detail.
4 – Positive evidence: good understanding, clearly mentioning that conservation is about saving or protecting animals, using key vocabulary, such as "endangered" or "extinction".
5 – Strong positive evidence: excellent understanding, mentions protecting or saving species and using key vocabulary (as above). Often includes reference to specific threats.

Dependent variable 2: Knowledge of pro-conservation behaviours

Initial qualitative analysis of data for this variable suggested that the actions reported fell along a continuum ranging from very general to very specific personal actions/behaviours. Responses were coded under an initial binary variable (yes or no) to determine whether an action or behaviour was mentioned (yes = 1 point and no = 0 points).

If an action or behaviour was mentioned (1 point), then further points were added along a continuous scale as follows (up to a maximum of 5 points per action):

0 – Action or behaviour identified not relevant to conservation
1 – No specific action or behaviour mentioned (vague platitudes about need for change, e.g. "save ecosystems");
2 – Specific identification of pro-conservation action or behaviour at a general level (not feasible to address as an individual, e.g. "stop hunting", "stop Chinese medicine", "scientific research in environmental studies and conservation", "don't cut our forests", "give animals space and protect their environment");
3 – Very specific identification of pro-conservation action or behaviour that can be done at an individual level (e.g. "hanging bird houses, feeding birds in winter time", "drive less to reduce effects of climate change");
4 – Very specific identification of pro-conservation action or behaviour that the respondent clearly states is a personal action or behaviour (e.g. "I recycle my mobile phone for gorillas").

Dependent variable 3: Lesson-related learning outcomes (drawings)
A scoring framework was developed based on the desired learning outcomes as specified in the education/lesson plan for this subject. These were:

- Poaching
- Habitat destruction
- Recycling
- Other pro-conservation behaviours
- Other zoo/conservation content relevant to specified outcomes

For each learning outcome, if depicted in the drawing, a score between 1 and 3 was assigned. 1 = limited evidence of understanding; 2 = some positive evidence of understanding; 3 = strong positive evidence of understanding. The maximum score possible for each drawing was therefore 15.

Content analysis reliability
One trained coder completed the content analysis for each of three main dependent variables. A second coder blind-coded a random selection (approximately 20% of the sample) of responses from each variable. A Cohen's kappa statistic of inter-coder reliability was then calculated: conservation understanding (kappa = 0.836, $p<0.001$); knowledge of pro-conservation behaviours (kappa = 0.774, $p<0.001$); lesson-related content-drawing (kappa = 0.744, $p<0.001$). These statistics tell us that there was a "substantial" or "almost perfect" agreement between the coders (Landis and Koch 1977).

Statistical analysis
Repeated-measures LMMs (linear mixed models) were used to explore any statistical differences in our dependent variables between pre- and post-test. This procedure was chosen because it allowed us to control for the likely similarities and differences found between students in the same class and/or school. We therefore included school and class as random effect factors in the model. No additional potential explanatory variables were included. All statistical tests were two-tailed, and had a significance level of $p<0.05$.

A reflective teacher survey and small student discussion (focus) groups were also conducted but are not included in the present analysis.

Research ethics
All students were fully informed regarding the research from the beginning and had the right to withdraw or not participate at all. The survey research was anonymous; the matched pre- and post-test surveys used use a numbered or first name-only coding to ensure that they can be matched up. The survey was designed to represent a normal school worksheet that was hopefully enjoyable to complete, rather than something that mimicked a test.

Results

Repeated-measures survey: quantitative findings
We observed statistically significant increases in all three of our dependent variables between the pre- and the post-test (conservation understanding: $F=789.525$, $p<0.001$, Figure 1; knowledge of pro-conservation behaviour: $F=37.519$, $p<0.001$, Figure 2; lesson-related content (student drawings): $F=118.902$, $p<0.001$, Figure 3).

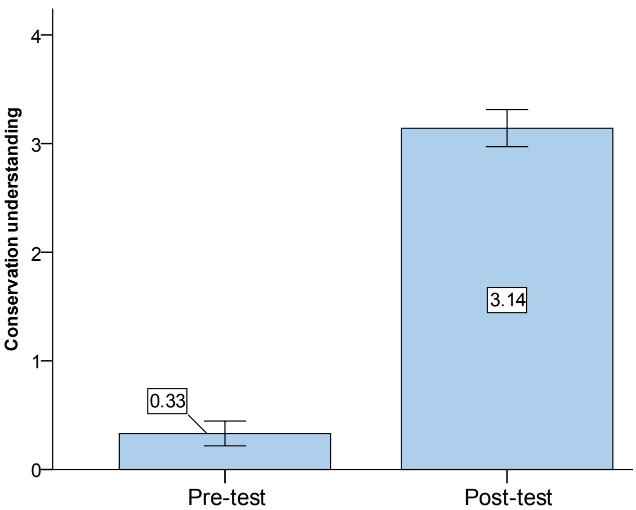

Figure 1. Mean conservation understanding scores between pre- and post-test (on a 5-point content analysis scale). Error bars: 95% confidence intervals. Significant difference, $p<0.001$.

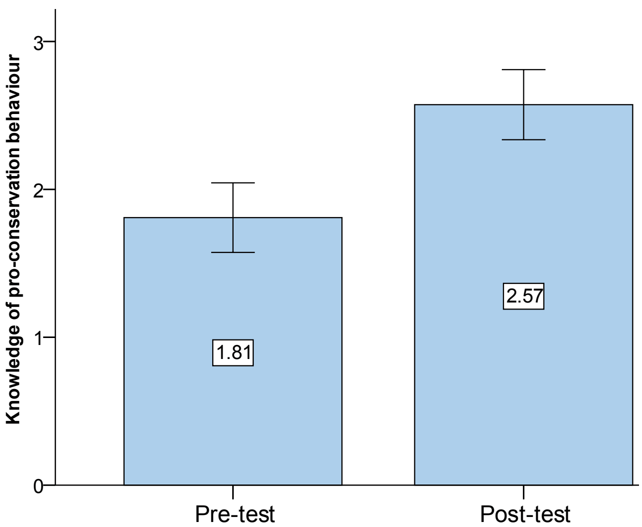

Figure 2. Mean knowledge of pro-conservation behaviours scores between pre- and post-test (on a 5-point content analysis scale). Error bars: 95% confidence intervals. Significant difference, $p<0.001$.

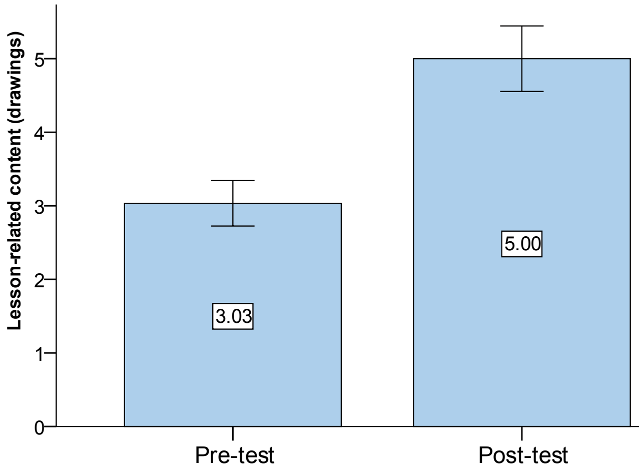

Figure 3. Mean lesson-related content scores (drawings) between pre- and post-test (on a 15-point content analysis scale). Error bars: 95% confidence intervals. Significant difference, $p<0.001$.

We also observed some significant differences in attitude between the pre- and the post-test (Figure 4). Students rated the statement *"It is wrong for animals to be kept in zoos"* significantly lower, on aggregate, in the post-test and hence, supported the statement less ($F=0.298$, $p=0.013$). Students rated the statement *"Zoos are for saving animals from dying out ('extinction')"* significantly higher, on aggregate, in the post test (0.175, $p=0.037$). However, there were no significant differences noted between pre- and post-test for the remaining two statements "*Zoos are for learning about animals"* ($F=0.04$, $p=0.575$) and *"Zoos are for me to have fun in"* ($F=0.193$, $p=0.055$).

Discussion

Two of our dependent variables – conservation understanding and knowledge of pro-conservation behaviour – are closely based on the measurement of biodiversity understanding and knowledge of actions to help protect biodiversity that was outlined in Moss et al. (2015), where the educational impact of a zoo visit was measured in around 6,000 visitors to 26 world zoos. The variables from both studies were scored using almost identical content analysis frameworks, so some tentative comparisons can be made.

In the present study, the proportion of students who could demonstrate at least "some positive understanding" of conservation increased from 4.5% in the pre-test to 79.8% in the post-test (an increase of 1673.3%). This compares favourably to the proportion of adult zoo visitors who demonstrated at least some positive understanding of biodiversity between pre-zoo visit (69.8%) and post-zoo visit (75.1%) in the global study of zoo visitors (Moss et al. 2015). This equates to an increase of 7.6%. Similarly, the proportion of students in the present study who could name a specific pro-conservation behaviour that could be achieved at the individual level (that is, something that an individual could do) increased from 40.7% in the pre-test to 60.8% in the post-test (an increase of 49.4%). In the global zoo survey, the proportion of zoo visitors who could name a specific action to help protect biodiversity at the individual level increased from 50.5% to 58.8% from pre- to post-zoo visit (an increase of 16.4%). Whether this suggests that an in-school zoo education programme is in some way more beneficial when compared to a standard zoo visit is open to debate. The context of the two different scenarios is completely different. The motivation for an average visit to a zoo is unlikely to be completely based on educational desires. For example, Packer and Ballantyne (2002) explored visit motivations to three sites: a museum, an art gallery and an aquarium. They found that visitors to the aquarium rated learning and discovery goals significantly

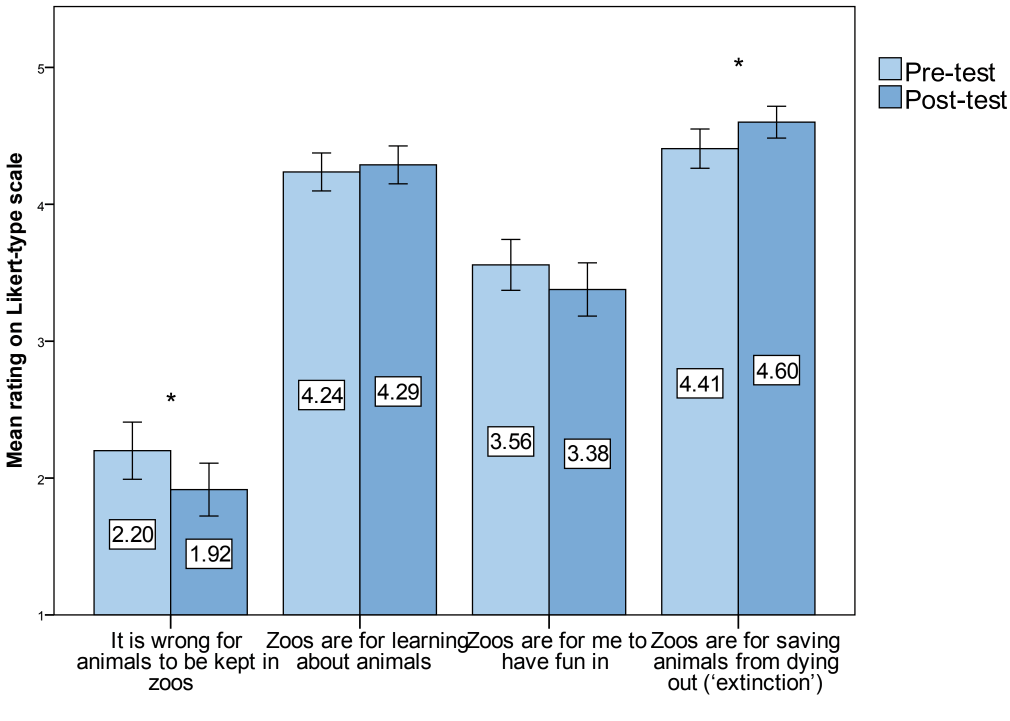

Figure 4. Change in attitudes between pre- and post-test. All attitude statements were rated using 5-point Likert-type scales (from 1 = strongly disagree to 5 = strongly agree). *Significant difference, $p<0.05$.

less than visitors to either the museum or art gallery. Falk et al. (1998), albeit in a museum setting, provide empirical evidence confirming the hypothesis that an educational motivation to visit resulted in increased learning outcomes. Logically, it would be unusual for us to find that students in a school setting, engaging with a specific education programme delivered by zoo educators (over a series of weeks), would show less in the way of improved learning outcomes when compared to a single visit to a zoo that is not always motivated by educational aspirations.

The statistically significant shift, between pre- and post-programme, in two of the four attitude statements was also of interest. The fact that students agreed with the statement *"It is wrong for animals to be kept in zoos"* significantly less post-programme; and agreed with the statement *"Zoos are for saving animals from dying out ('extinction')*" significantly more post-programme, is also a positive outcome. However, we must be cautious in applying too much meaning to statistically significant differences that may not to relate to large "real-world" differences. For example, with the statement *"Zoos are for saving animals from dying out ('extinction')*" a shift from a mean agreement of 4.41 pre-programme, and a mean agreement 4.60 post-programme is significantly different, but the magnitude of difference (along a five-point scale) is actually quite small.

Note that all of these are aggregated findings; there may be individual cases (learners) where the impact has been either negative or neutral, but this has not been assessed by this present analysis. We also recognise that the adoption of a control-treatment experimental design would have improved our ability to attribute cause between the education programme and the impact findings we have presented. The logistics of recruiting schools/classes that would be prepared to act as a control group(s) proved impossible for this study. An increased sample of schools, classes and participants would also have been beneficial, allowing us to increase our confidence in the external validity (generalisability) of these findings, but also to allow a more in-depth statistical analysis of various other demographic factors, such as the location of the school (for example, levels of affluence, or the degree of urbanisation in the area). Another suggestion for similar future research would be to include additional experimental-type treatments; specifically, whether a physical trip to the zoo would provide any further positive benefits to learners, in addition to the in-school Safari Ranger programme. A recent study (Wünschmann et al. 2016) found that an in-school education programme resulted in greater learning outcomes compared to a control group, but a visit to a reptile and amphibian zoo resulted in greater learning outcomes than both. There is clearly much more we need to understand about the nature and structure of zoo education programmes, either in-school or in a zoo setting, in order for us to maximise the positive educational benefits of zoos and aquariums.

Conclusion

The overarching finding from this research is that the multiple-visit Safari Ranger pilot programme correlated with a positive, measurable and statistically significant impact in the student learners, particularly in terms of conservation-related knowledge but also student attitudes toward conservation and zoo-related issues.

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