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Evaluating an in-school zoo education programme: an analysis of attitudes and learning

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Abstract

In 2020 the Convention on Biological Diversity will deliver the post-2020 global biodiversity framework. The promotion of conservation and biodiversity knowledge will form at least one of the targets set out in this framework. According to the World Association of Zoos and Aquariums (WAZA) zoos and aquariums receive around 700 million annual visits, making them well placed to contribute towards these targets. The scope of the field of zoo and aquarium education research has greatly increased over recent years demonstrating the educational value of visits. This study evaluated the impact of an in-school repeat-engagement zoo education programme provided by the Safari Rangers of Chester Zoo, UK. A pre- and post-programme survey design was used to measure conservation understanding, knowledge of pro-conservation behaviours and conservation attitudes. In total, 445 students from seven participating schools were surveyed. The results show an increase in both conservation understanding and in knowledge of pro-conservation behaviour between the pre- and post-programme surveys. Participating students showed an aggregate increase of 60.5% in their conservation understanding, and a 24% increase in their knowledge of pro-conservation behaviours. Those surveyed also demonstrated a positive change in attitude towards conservation self-efficacy. This study demonstrates that repeat-engagement in-school zoo-education programmes can successfully deliver desired learning outcomes, adding to the body of evidence that demonstrates the valuable role that zoos can play in raising the level of conservation knowledge amongst school-aged children.

Introduction

In 2020, parties to the Convention on Biological Diversity (CBD) will meet in China to adopt a post-2020 global biodiversity framework. The proposed zero draft of this framework outlines a vision for a world living in harmony with nature, where “By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people” (CBD 2020). The draft framework proposes 20 action-oriented targets for 2030. Target 17 states that “People everywhere take measurable steps towards sustainable consumption and lifestyles”, while target 18 states a need to “Promote education and the generation, sharing and use of knowledge relating to biodiversity”.

The World Association of Zoos and Aquariums (WAZA) has officially partnered with the CBD to contribute towards these targets, which once agreed upon, will place zoo- and aquarium-led education at the forefront of biodiversity conservation and the promotion of conservation-related behaviours. With a reported 700 million annual visits, zoos and aquariums have a powerful opportunity to engage with and educate a wide audience (Gusset and Dick 2010). It is now obligatory to promote education and awareness of biodiversity conservation in order to hold a UK zoo licence (DEFRA 2012), and the discussion is now moving towards evaluation of the education goals and wider conservation outcomes. In their 2015 strategic report, WAZA outlined a holistic view of their conservation education goals, highlighting the drive towards individual behaviour change and positively communicating conservation self-efficacy in zoo visitors (Barongi et al. 2015).

While it is clear that the majority of zoos and aquariums (hereafter 'zoos') see themselves as providers of conservation education (Patrick et al. 2007; Carr and Cohen 2011), a 2006 review of literature in this area found surprisingly few studies that attempted to measure and report the impact of zoo education programs (Royal Society for the Prevention of Cruelty to Animals 2007). Falk et al. (2007) did conduct a large-scale study of the impact of zoos on conservation attitudes and understanding in visitors. Although their findings were broadly positive, the study's design and self-reporting survey instrument were later criticised (Marino et al. 2010; Dawson and Jensen 2011). Troublingly, this did not prevent many zoos from making strong claims about their educational impact, despite a lack of substantial supporting evidence (Moss and Esson 2013).

In recent years, criticism and pressure from opponents of zoos (Born Free Foundation 2011) has led to a shift in zoos attempting to part-justify their existence on educational grounds. This has coincided with an increase in the number of published works assessing zoo education programmes (Kruse and Card 2010; Randler et al. 2012; Jensen 2014; Seybold et al. 2014; Macdonald 2015; Moss et al. 2015). Without identifying clear learning objectives and measurable learning outcomes, there is no way to conduct a robust and scientifically sound evaluation of an educational programme. It is important, therefore, to understand what zoos hope to achieve, specifically in terms of wider conservation benefits by being 'educational'.

At a global level, all forms of education have intrinsic value for the benefit of society. Indeed, the United Nations Educational, Scientific and Cultural Organisation (UNESCO) "believes that education is a human right for all throughout life" (UNESCO 2016). However, when one considers Target 18 of the draft post-2020 global biodiversity framework, the basic idea would be that an increased knowledge of biodiversity and conservation leads, in some way, to changes in personal behaviour (CBD 2020). In this case 'behaviour' refers to specific pro-conservation behaviours, such as energy conservation, recycling and environmentally responsible purchasing. This 'knowledge deficit' model of behaviour change is one that is commonly cited by zoos (and many other environmental and conservation education providers). However, the empirical evidence would suggest that this model is inadequate, as factors such as physical and social opportunity, reflective and automatic motivation, as well as physical and psychological capacity, are all equally important predictors of behaviour and should therefore be considered when targeting a specific behaviour change (Sutton 1998; Darnton 2008; Ogden and Heimlich 2009; Schultz 2011; Heberlein 2013; Michie et al. 2014; Miller 2017). Essentially, a positive change in individual knowledge is only one possible predictor of the, ultimately desired, change in what is seen to be pro-conservation behaviour. As such, while knowledge regarding specific pro-conservation behaviours is a key component required for the behavioural process, it would be insufficient to treat knowledge as the sole measure of impact when evaluating educational programmes. Instead, other psychological variables, such as self-efficacy and attitudes, should be considered alongside knowledge.

Context for this study

While effective conservation education in adults can potentially yield immediate uptake of pro-conservation behaviours, educating children in conservation issues may improve and normalise such behaviours and attitudes in the long-term. In-school education programmes provided by zoos create an opportunity to target more hard-to-reach communities, such as children in socioeconomically deprived areas who may be less freely able to access in-zoo education. In a study of primary school-aged children in the North West of England and North Wales, Counsell (2020) found evidence that a higher percentage of free school meals (FSM) is a reliable predictor of lower aggregated baseline-levels of conservation knowledge and self-efficacy. This suggests that zoo educators working in those schools with a higher percentage FSM may be more able to reach those children who might otherwise be less engaged with the topics of conservation and conservation-related behaviours.

Similar to zoo-led conservation education camps (Kruse and Card 2010), in-school programmes enable zoo educators to use repeated engagement with the same groups of children, where concepts and ideas can be expanded over a longer period, rather than a one-off visit. Moss et al. (2017) evaluated the impact of a repeat-engagement in-school zoo education programme run by Chester Zoo, UK, and found that the programme correlated with improvements in conservation knowledge and attitude. These results compare favourably with the findings of Moss et al. (2015), who used similar measures of conservation understanding and knowledge of pro-conservation behaviour in zoo visitors. While the context of the learning scenarios are totally different, these studies add weight to the idea than an in-school programme can at least equal and possibly improve on the learning outcomes of on-site zoo education programmes.

This study

Zoos, as learning environments, can be considered 'informal' in nature (Tofield et al. 2003), or what contemporary thinking in this field would define as free-choice learning (Falk and Dierking 1998). Free-choice learning is seen as a more flexible term to describe learning that may occur in settings such as museums, galleries, science centres, botanical gardens and, of course, zoos. It describes learning that is self-directed at the individual or social group level and it is strongly based on the prior knowledge, experiences and motivations for visiting of individuals (Chang et al. 2006). This free choice, though, makes the prescription of desired learning outcomes problematic. In formal settings, such as schools and university, it is much easier to define the boundaries of learning; self-directed free-choice learning is a much more dynamic process.

A zoo-education project conducted within a formal school environment therefore creates an opportunity. With access to detailed baseline data in knowledge, attitude and understanding, and complete control over content delivered to participants of the programme, it is easier to define logical boundaries of learning. In theory, this experience should be closer to that of regular school learning than it is to the self-directed free-choice learning that occurs in zoos, with clearly defined and relevant learning outcomes allowing for a more formal evaluation. Moreover, this type of programme is one of the only opportunities to evaluate zoo-led conservation education in a formal setting. As these classes are conducted within regular school hours intended for curriculum mandated and formally examined subjects, it presents an even greater need for rigorous evaluation and consideration of the goals both long and short term. Such evaluation will enable zoo educators to understand and potentially improve the learning outcomes of such programmes.

This study evaluates the impact of an in-school education service offered by the Chester Zoo Safari Rangers. Chester Zoo's Safari Ranger service was initiated in 2010, offering free workshops to schools on an outreach basis. Since 2015, the service has focused on delivering repeat engagement programmes with schools with the aim to inspire and enable conservation action. This service was expanded in 2017 and now has a greater focus on reaching audiences who face barriers to engaging with Chester Zoo, in particular children living in economically deprived areas. The present study assesses whether the service successfully delivers on intended learning outcomes through measures of knowledge

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

School	Year groups	Student numbers	Total student numbers
School 1	3 – 4	Year 3 – 26	72
		Year 4 – 46	
School 2	3 - 6	Year 3 – 24	92
		Year 4 – 27	
		Year 5 – 17	
		Year 6 – 28	
School 3	3 - 5	Year 3 – 18	46
		Year 4 – 15	
		Year 5 – 13	
School 4	3 - 6	Mixed age class – 26	26
School 5	3 - 6	Year 3 – 19	84
		Year 4 – 21	
		Year 5 – 19	
		Year 6 – 25	
School 6	3 - 5	Year 3 – 29	78
		Year 4 – 27	
		Year 5 – 22	
School 7	3 - 4	Year 3 – 12	47
		Year 3 and 4 – 12	
		Year 4 – 23	
Total			445

and attitude. Data were gathered in 2016 from pupils (n=445) at seven participating primary schools in the local region. The key research questions were: Does the Safari Ranger programme achieve positive impacts related to conservation? Does a guided zoo visit increase positive impacts related to conservation?

Methods

Programme content

The Safari Ranger: Protecting Our Wildlife (POW) programme consisted of three classroom-based workshops and one outdoor workshop delivered over multiple visits to selected schools during the summer term (2016). Each session was approximately 50 min in length, conducted by Chester Zoo Safari Ranger staff and aided by class teachers and/or teaching assistants. The first two workshops, “Introduction to UK wildlife” and “UK habitats and threats to UK wildlife” delivered theoretical content. These sessions introduced the topics of UK wildlife and associated habitats, along with specific threats to both wildlife and habitats. Participants were introduced to new terminology such as native, non-native and invasive.

The third workshop “Demonstrating action” was a school-based practical session with several activities focused on reinforcing the POW learning outcomes from the first two sessions. Activities included wildflower wellie planting, bug hotel building, seed planting and bird watching. The students also all wrote a pledge during this workshop for what they will do for wildlife. The fourth workshop, “Choral speaking workshop and celebration event”, was run by Emily Capstick and her team at Peoplescape Theatre (https://peoplescapetheatre.co.uk/) and the teachers themselves following two Continued Professional Development (CPD) sessions conducted at Chester Zoo. The first CPD session introduced the choral speaking workshop, and the second introduced a literacy workshop to be delivered independently by class teachers in their school in-between visits. Words collected though the literacy activities were sent to Emily Capstick at Peoplescape Theatre who used them to write unique poems for each class. In the choral speaking workshop, these poems were performed by the students, and again at the end of the day in an assembly to the rest of the school and in some cases parents too. In addition to the classroom-based sessions, a number of the participating schools took part in a visit to Chester Zoo; this visit included additional POW workshops and related activities. The workshops were practical sessions covering bird watching and recording, bug hunting and recording, seed planting and bird feeder creation.

Participants

Schools were selected from an existing list of school groups. The programme was delivered at 14 schools with seven agreeing to take part in this research. The seven participating schools comprised 30 classes spanning the full Key Stage 2 age range (school years 3 to 6, ages 7–11). The programme was completed at all seven schools between 3 March and 19 July 2016. The zoo trip was offered to all participating schools, but was only taken up by four of the seven schools, who attended between 23 May and 19 June 2017. There was some variation in class size over the course of the programme due to illness and new students starting, for example. Of the 847 students registered in the participating classes at the start of the programme, 740 students attended all workshops; therefore, only these students were included in the survey.

The analysis only included data from respondents who attended all sessions and completed both pre- and post-surveys; this final dataset contained repeated measures surveys from 445 participants from across the seven participating schools, with 283 taking part in the zoo trip and 162 not doing so (Table 1). This allowed for a quasi-experimental research design with learning outcomes compared between these control (no zoo trip) and treatment (zoo trip) groups.

Survey instrument

A repeated-measures survey was designed to measure four dependent variables, to provide an indication of change (positive or negative) as well as the magnitude of that change over the course of the POW programme; and to assess the potential impact of the zoo visit and additional workshop on the three main dependent variables.

A repeated-measures design was chosen (i.e. the participants were measured before and after the POW programme) as it is standard practise when scientifically evaluating education impacts (Crowder and Hand 1990). In order to minimise disruption to the planned school day and encourage participation in this study, the number of measures was limited to the minimum level of two; the survey was distributed on paper to all participants immediately prior to the first POW session and within one month of the delivery of the final session.

The mixed-methods (quantitative and qualitative) survey was designed to avoid self-reporting measures for learning (Marino et al. 2010), and to provide data that could be robustly analysed to identify a number of forms of impact from the POW programme. The survey included five-point Likert scales relating to attitude statements, open-ended questions, categorical response questions and a drawing activity. The dependent variables measured by the survey were, conservation understanding, knowledge of pro-conservation behaviour, evidence of lesson-related learning outcomes and conservation attitudes.

Conservation understanding was measured using an open-ended written survey question "What is conservation?". Knowledge of pro-conservation behaviour was measured in a two-part question, an initial categorical question "Do you think that YOU can help protect native UK wildlife?", followed by an open-ended written question "If yes, how can you help?"; this question design was intended to measure both conservation self-efficacy and knowledge. Evidence of lesson-related learning outcomes was measured with a drawing activity, where students were given space (approximately half of one side of A4 paper) to draw an annotated picture to the question: "Can you draw and label some different native UK wildlife AND some of the things we can do to help protect them?". Attitudes to the following self-development statements were measured using standard five-point Likert-type scales, "Protecting UK wildlife is important to me", "It is wrong for animals to be kept in zoos", "There's nothing I can do to help wildlife", and "Zoos are for saving animals from dying out ('extinction')".

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 learning outcomes) were subjected to content analyses to provide quantitative data suitable for statistical analyses.

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.

Knowledge of pro-conservation behaviour

The first stage responses were coded under an initial categorical variable (YES, NO or MAYBE) to determine whether a participant believed that personal actions could help protect native UK wildlife. Those who answered YES were given the opportunity to demonstrate their knowledge of pro-conservation actions or behaviours. Initial qualitative analysis of data for this variable suggests that the actions reported fell along a continuum ranging from very general to very specific behaviours. Responses were coded under and initial binary variable (YES or NO) to determine where 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): 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 traditional 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").

Evidence of lesson-related learning outcomes (drawings)

A scoring framework was developed based on the desired learning outcomes as specified in the education or lesson plan for this subject. These were native UK wildlife, UK habitats, pro-conservation behaviours, other conservation content relevant to specified outcomes, and other zoo-related content. 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.

Statistical analysis

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), Evidence of lesson-related learning outcomes (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).

Once coded, all quantitative data from the repeated-measures surveys were analysed with generalised linear mixed models (fit by maximum likelihood), using the lme4 package (Bates et al. 2007) in the R environment (version 3.3.3). P-values for regression coefficients were obtained using the car package (Fox et al. 2016). For each quantitative response variable, a maximal model was built with school and pupil specified as random effects, thereby accounting for inherent bias caused by mean variation between schools. The independent variables were included as fixed effects: repeat measure condition; inclusion on the zoo trip; and gender. Categorical data from the question "Do you think that YOU can help protect native UK wildlife?" were analysed with multinomial logistic regression using the nnet package (Venables and Ripley 2002) in the R environment. The independent variables repeat measure condition and inclusion on the zoo trip were included as cofactors.

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.

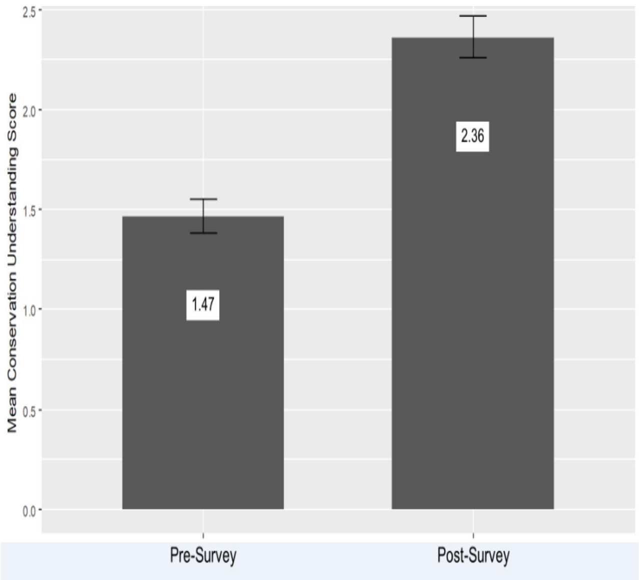

Figure 1. Mean Conservation understanding score between pre– and post-survey (on a 5-point content analysis scale). Error bars: 95% confidence intervals. Significant difference, P<0.001.

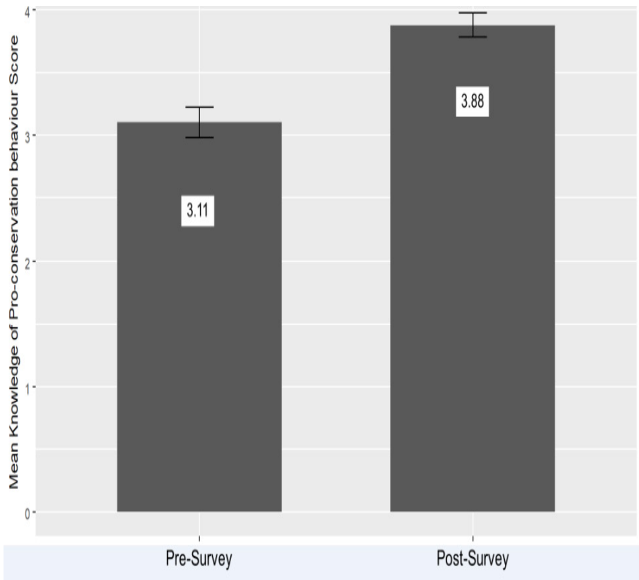

Figure 2. Mean knowledge of pro-conservation behaviour scores between pre– and post-survey (on a 5-point content analysis scale). Error bars: 95% confidence intervals. Significant difference, P<0.001.

Results

Conservation understanding. The generalised linear mixed model revealed a positive change in conservation understanding between the pre- and post-surveys (F=88.851, P<0.001) (Figure 1). However, there was no significant interaction effect between those participants who did or did not take part in the zoo trip.

Knowledge of pro-conservation behaviours

The multinomial logistic regression analysis conducted to measure potential change in participant conservation self-efficacy and their ability to personally help protect native UK wildlife, showed an aggregate increase in participants answering YES (χ^2=24.096, P<0.001) and a decrease in participants answering NO or MAYBE between the pre- and post-survey. In the follow-up questions measuring the knowledge of pro-conservation behaviours,

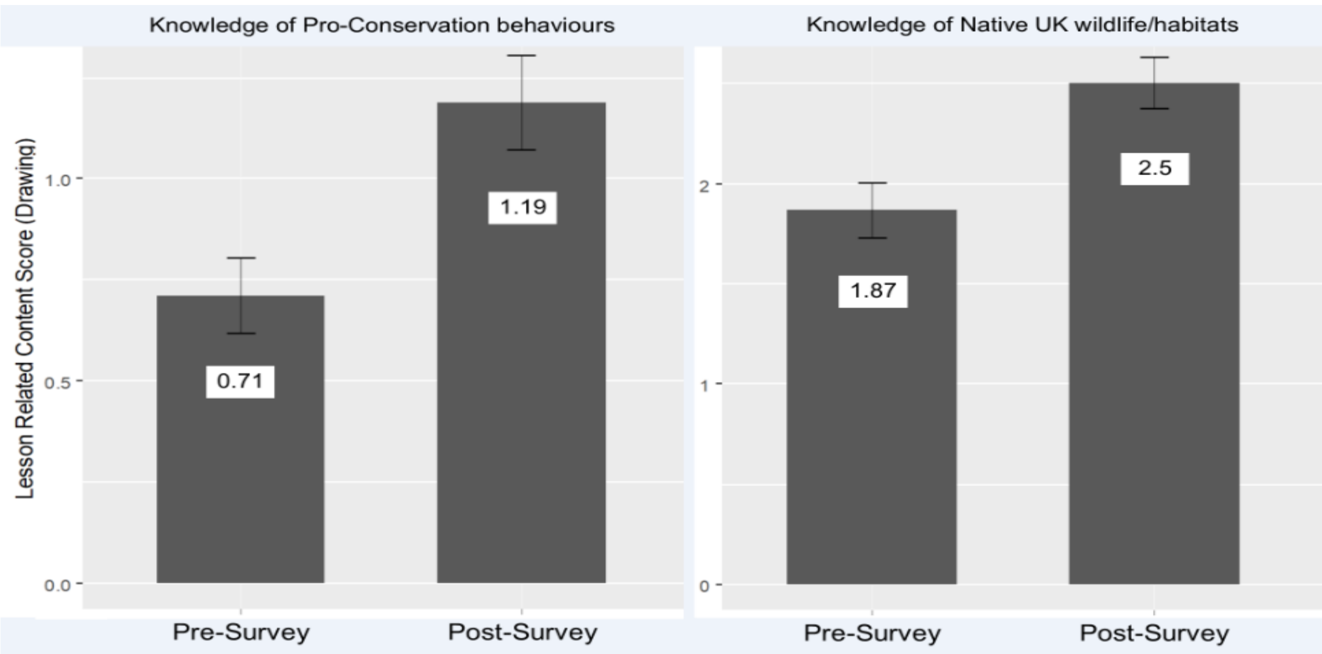

Figure 3. Mean lesson-related content scores (drawing) between pre– and post-survey (on a 3-point content analysis scale for Knowledge of Pro-Conservation behaviours, combined 6-point content analysis scale for Knowledge of Native UK wildlife/habitats). Error bars: 95% confidence intervals. Significant difference, p<0.001.

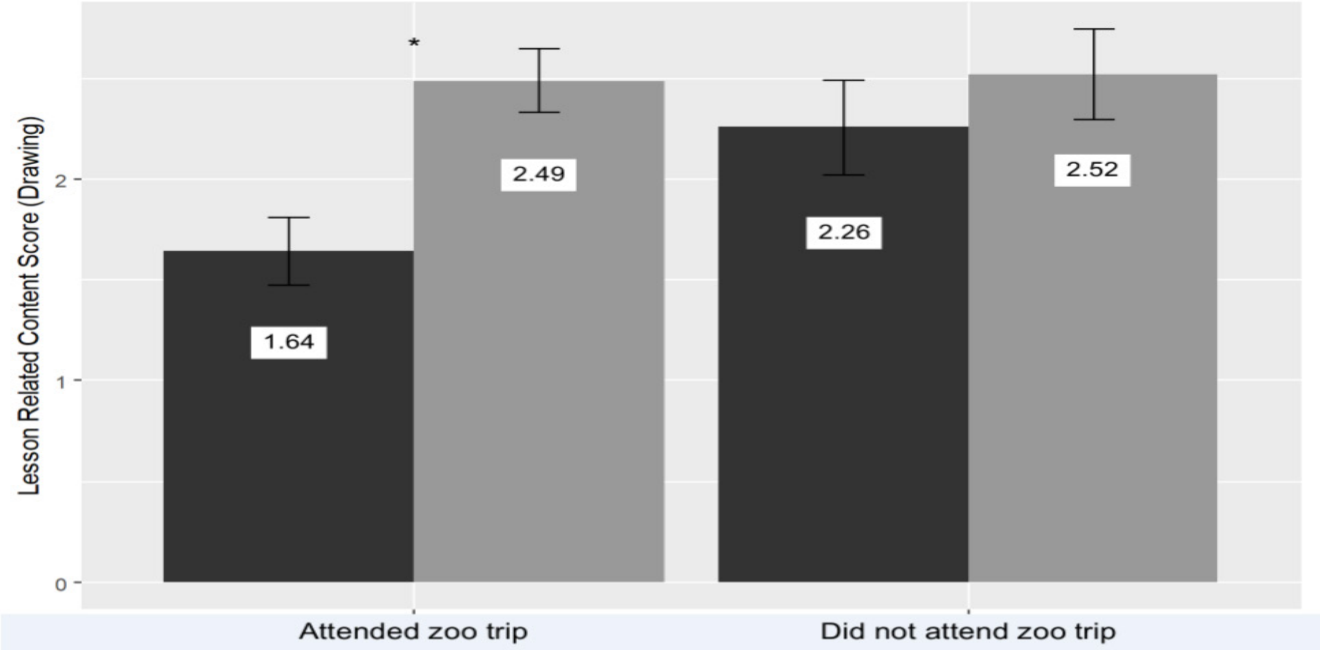

Figure 4. Mean lesson-related content (Native UK wildlife/habitats) scores from pre– (Dark Grey) and post-survey (Light Grey) between those who attended the additional zoo trip and workshop, and those who did not attend (on a 6-point content analysis scale). Error bars: 95% confidence intervals. * Significant difference, P<0.001.

participants' response scores improved between the pre- and post-survey (F=24.2521, P<0.001) (Figure 2). The zoo trip and additional workshop did not have any observable impact on the trends observed in either of these models.

Evidence of lesson-related learning outcomes

Participants scored higher on aggregate in two of the learning outcomes between the pre- and the post-survey, "native UK wildlife/UK habitats" (F=38.3604, P<0.001) and "pro-conservation behaviours" (F=48.4579, P<0.001) (Figure 3). Attendance of the zoo trip and zoo-based activities had an impact on the learning outcome "native UK wildlife/UK habitats", as participants who attended the zoo trip and workshop improved between the pre- and post-surveys (F=10.5251, P<0.001) while there was no improvement observed amongst those who did not attend (Figure 4). Improvement in "pro-conservation behaviours" measure was not affected by the zoo trip.

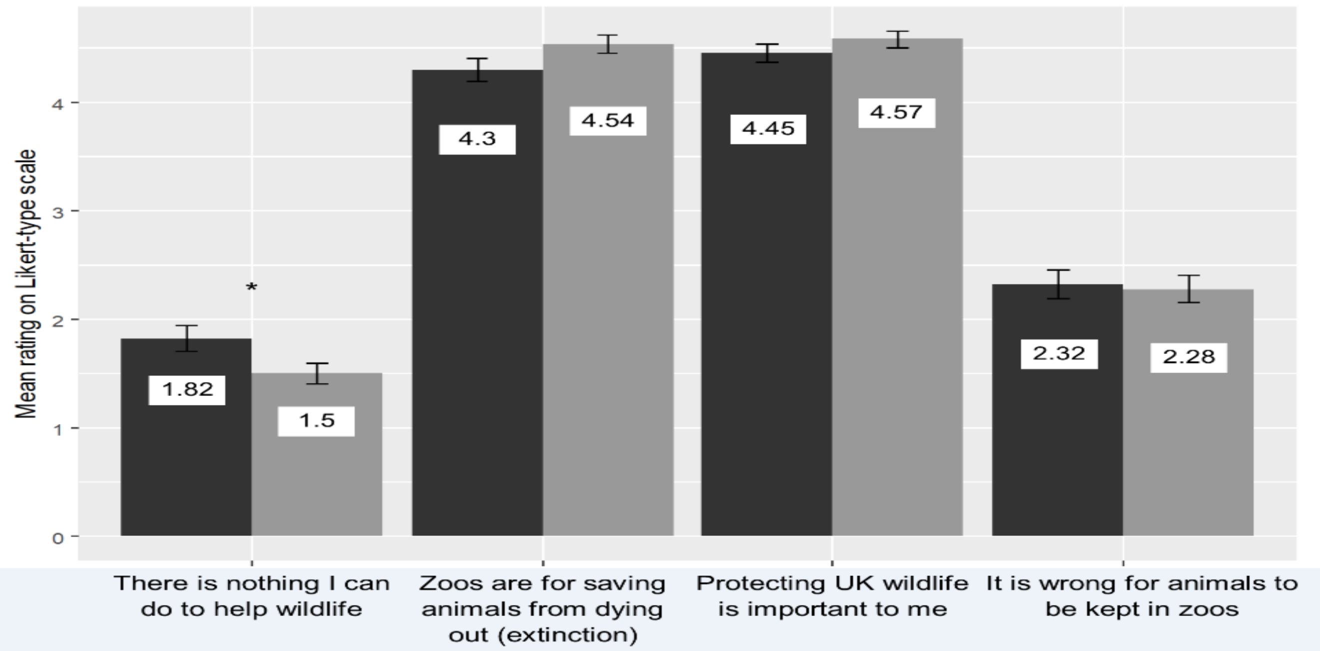

Figure 5. Changes in attitude between pre– (Dark Grey) and post-survey (Light Grey) . All attitude statements were rated using a 5-point Likert-type scale (from 1 = Strongly Disagree to 5 = Strongly Agree. * Significant difference, P<0.001

Conservation attitude measures

Of the four attitude questions measured with Likert-type scales, only one showed any difference between the pre- and post-surveys. Participants rated the question “There’s nothing I can do to help wildlife” significantly lower, on aggregate, in the post-survey, meaning there was less support for this statement following the POW programme ($F=12.1926$, $P<0.001$) (Figure 5). There was no significant difference noted in any of the other three attitude questions, “Protecting UK wildlife is important to me”, “It is wrong for animals to be kept in zoos” and “Zoos are for saving animals from dying out (‘extinction’)”. In all attitude questions there was no difference found between those participants who attended the zoo trip and those who did not attend.

Discussion

Zoos are increasingly part-justifying their existence on educational grounds, and zoo education programmes are under pressure to demonstrate their impact. This study examined the effectiveness of the Safari Ranger: “Protecting Our Wildlife” in-school zoo education programme that aimed to enhance conservation understanding, knowledge of pro-conservation behaviours and improve attitudes towards conservation.

This study revealed significant aggregate increases in both conservation understanding and knowledge of pro-conservation behaviours following participation in the Safari Ranger programme (Figure 1). Using a similar methodology as that outlined here, Moss et al. (2017) found aggregate increases in these same dependent variables when investigating the impact of a shorter Safari Ranger pilot programme. This study found an aggregate increase in conservation understanding of 60.5%, the magnitude of this change compares less favourably with the 860% aggregate increase reported by Moss et al. (2017). Although the magnitude appears dramatically smaller here, the participants in this study demonstrated a much higher baseline understanding of conservation; some of this difference in the magnitude of change can be accounted for by this higher level of prior knowledge. A possible explanation for this is likely related to the stochastic variation in experience of pupils between the schools involved in this study compared with those in the 2017 study.

The knowledge of pro-conservation behaviours increased here by 24% compared with 55% in the pilot study (Moss et al. 2017). Again, a higher baseline score was recorded amongst the participants of the current study than those in Moss et al. (2017). The drawing task revealed an even larger margin of improvement, where drawings depicting pro-conservation behaviours improved on aggregate by 68%. This finding is of great significance; when attempting to communicate understanding of a pro-conservation action the participants scored on average 44% higher when drawing their response than when asked to write it. This could possibly be explained by the lower levels of literacy in participants at this age, making them more comfortable expressing ideas through drawings than words. It is also an example of how different survey instruments can capture different aspects of learning; highlighting the importance of selecting an appropriate measure for your participants and learning outcomes. This aligns with the findings of Bowker (2007) who, while measuring changes in children’s perceptions and learning before and after a visit to the Eden Project, also found evidence to suggest that children may be better able to clearly express new information through drawing than through words.

Concerning the additional zoo trip, this study found only one significant interaction effect relating to attendance of the zoo trip, when asked to draw something relating to native UK wildlife, those students who attended the zoo trip improved significantly post-trip while those who did not attend showed no significant improvement. Through no intent or design, the schools who attended the zoo trip had lower baselines in all measures of conservation knowledge and self-efficacy, as well as less desirable attitudes towards conservation issues, compared with those schools who did not take part in the zoo trip. As such, caution is necessary in drawing conclusions about the impact of the zoo trip. Speculatively, however, this could suggest there were systematic differences in achievable programme outcomes, relating to the baseline levels of understanding and the associated potential for individual learning journeys (Wilder and Lillvist 2018). As the survey is essentially a written task requiring literacy skills, differences in general literacy levels between the schools, not accounted for in this analysis, could also be problematic (Duncan and Seymour 2000; Van Vechten 2013). This could explain why children were consistently much closer in terms of achieved outcomes in the drawing task (see Figure 4).

However, given the claims made by zoos regarding their educational value (Moss and Esson 2013), a wider difference between those children who did experience the zoo trip as part of the POW programme might be expected. The obvious explanation is that a single zoo trip does not significantly consolidate or increase the learning that is achieved during the four in-school sessions, although research into almost identical learning outcomes in adult visitors did find significant improvements over the course of a single zoo trip (Moss et al. 2015). Another possible explanation is that the POW programme itself is based on native UK wildlife and not something of which the animal collection at Chester Zoo is very representative. Future research could explore the effect of zoo trips (as part of school education programmes), using a true experimental design, with additional treatments including school groups experiencing only a zoo trip, and others experiencing only the in-school parts of the programme, compared to counter-factual control groups.

In the present study there was a statistically significant shift in the response to only one of the four attitude statements, with a higher number of students disagreeing or strongly disagreeing with the statement “There is nothing I can do to help wildlife” in the post-programme questionnaire. In the earlier study, Moss et al. (2017) recorded small but significant post-programme positive changes in attitude towards the following statements “It is wrong for animals to be kept in zoos” and “Zoos are for saving animals from dying out (‘extinction’)”. The present study did not find a similar significant change in response to either statement. It should be noted, however, that while significant, the magnitude of change reported by Moss et al. (2017) represented a very small real-world change in terms of the shift in attitude, and so the lack of significant change here should not be seen as a comparative failing of this instance of the Safari Ranger programme. The statements already possess a socially desirable element, meaning that baseline responses may be biased towards positive responses, leaving little room for a large positive change in attitude. Utilising open text fields in response to attitude measures, might allow for a more detailed analysis of how exactly attitudes change. It is also important to stress here that it can be much more difficult to alter an individual’s attitudes compared to an individual’s knowledge.

The programme assessed in the present study was considerably longer and went into more theoretical depth than the earlier programme assessed in the pilot study. It would be expected that a greater magnitude of improvement would be recorded following a more in-depth programme. It should be noted that any conclusions drawn from direct comparison with the pilot study need to be considered in light of the differences between programme content and delivery that are not accounted for in the analyses. Regardless, these findings have important implications for the delivery and evaluation of future in-school programmes for two reasons: firstly, if demographic and socioeconomic predictors of the differing baseline levels of knowledge found within the present study can be identified, as well as between the participants involved in this study and the pupils involved in Moss et al. (2017) study, it could help those delivering these programme to identify schools where this type of intervention would net the largest positive change in learning outcomes. The second reason is that while the present study demonstrates that these repeat-engagement in-school zoo-education programmes can deliver desired learning outcomes, there is no evidence to suggest that a markedly longer programme (e.g. several months) has any greater impact on learning outcomes than a shorter programme (e.g. a few weeks). This is important to know because if similar impacts can be achieved with less zoo educator input, then more schools and school children can be reached with the same staff resource.

Whilst this study adds to the growing body of evidence that demonstrates a correlation between zoo education endeavours and pro-conservation learning outcomes, it is clear that much more could be explored in relation to the value of in-school and in-zoo education programming.

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