

Wild Birds in the Classroom: Evaluation of Student Affinities, Perceptions, and Attitudes in Response to an Experiential Curriculum

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ABSTRACT

Lack of positive outdoor experiences may lead a child to grow up perceiving that the natural world has little importance in our modern technology-based society; thus, they might not appreciate local wildlife or be interested in natural resource careers. To address this issue, we initiated a Student-Teacher-Scientist-Partnership (STSP) to enhance the knowledge and attitudes of students towards birdlife in South Texas. We developed a wild bird conservation curriculum aligned with state standards for use in K-12 classrooms. We assessed 6th (n=39) and 7th grade (n=52) students' affinity, perceptions, and attitudes towards wildlife, birds, science, and nature prior to and after the program using a mixed methods design of open-ended questions and Likert-type statements. Student Likert-type statement responses were analyzed using an upper-tailed Sign test. We expected students to improve or respond more positively to their affinity, perceptions, and attitudes towards birds, wildlife, science, and nature in response to the curriculum. Students had a positive attitude towards wildlife and working with a scientist. Their perceptions towards habitat fragmentation and its effect on wildlife improved as well as their perceived knowledge of birds. Seventh grader attitudes improved towards their ability to identify birds, yet 6th grader attitudes remained similar. Lessons provided local students with an opportunity to integrate hands-on, kit-based wildlife science activities into the classroom to enhance their appreciation of wildlife. Students also had the opportunity to be outdoors while being introduced to the STEM (Science, Technology, Engineering, & Math) career of wildlife biology.

Keywords: K-12, kit-based, experiential, wildlife education, birds, scientist in the classroom

INTRODUCTION

Outdoor play and time spent in nature has become an activity of the past. Louv's (2005) book *Last Child in the Woods* documents this change as the children of today are often restricted to the indoors leaving less freedom to explore nature. The time once spent outside is now spent inside as our world grows in the use of video games, electronics, and technology which has been termed "videophilia" (Zaradic & Pergams, 2007). Early childhood exposure to the outdoors has been a primary motivator for showing care towards nature later in life (Chawla, 2009a). A child's emotional affinity towards nature is usually influenced by what is experienced with parents or family and the valuable time that is spent in nature (Atran & Medin, 2008; Chawla, 2009b; Hoffman, 2000; Kals et al., 1999; Muller et al., 2009). Through experiences and activities with these model adults, children can begin to define important components to their lives and assign intrinsic value

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to the activities shared with those role models. Kals et al. (1999) also mentioned that environmental identity development is a lifelong process and begins growing at an early age. It is at this beginning stage of growth that environmental awareness should be a key component to not only a child's at-home life but in their formal education to encourage positive choices and feelings towards nature. Positive outdoor experiences can lead the younger generation to become environmentally aware citizens who can make sound decisions based on their experience and knowledge of science.

Environmental Education (EE) offers opportunities to study outdoors, yet EE is absent in many primary and secondary school systems, especially within urban cities (Paige et al., 2010). In the United States, the No Child Left Inside Act (2013) was proposed to encourage teachers EE training, promote hands-on field experiences, and decrease the gap in environmental knowledge in grades K-12. Yet very few schools offer opportunities in environmental science that allow students to go outside, explore, and create their own project of interest. Much of this hesitation can be due to overloaded school curriculum, lack of funds, facilities and resources, teacher training, large classroom size, lack of appropriate lessons, and potentially the location of the school (Barthwal & Mathur, 2012). Integration of hands-on activities can improve the impact of EE and bringing a scientist in the classroom could help alleviate teacher hesitations (Awasthy et al., 2012; Huxham et al., 2006). This would also be the first step in connecting students with nature as they become stewards of the environment and conservation.

Educational standards in the U.S. have undergone some changes in recent years. In 2013, the National Science Standards were replaced by the Next Generation Science Standards (NGSS) that require students to be proficient in science practices (conducting science) and understand cross-cutting concepts and disciplinary core ideas (Next Generation Science Standards, 2015). In addition, establishment of the Common Core State Standards Initiative (2015) placed great emphasis on language and math, which may lead schools to focus less on science instruction (Banilower et al., 2009). With the addition of these two standards programs, teachers often find it difficult and time consuming to integrate both into their teaching. This leaves educators without the flexibility of offering what they would like to teach and pushes their creativity and ideas aside. Experiential lessons in EE that focus on the scientific method could provide a means to meet these standards while engaging students in outdoor activities.

Teaching and Learning

Traditional methods

Finding the best way to teach is often a difficult task to accomplish. Traditional ways of conveying information have been to present the topic and information to the students verbally and/or through reading of textbooks and completing worksheets. However, this method of teaching is slowly becoming more obscure. The urge for hands-on, experiential activities and increased involvement from students (i.e., student-centered) is now the preference of most teachers and educators and has been a large focus of educational research (Chall, 2000; Cornelius-White, 2007; McCombs & Whisler, 1997).

Three categories most commonly used to identify learning styles of individuals include visual, auditory, and kinesthetic learners. However, Morgan (1992) states that education that includes multi-sensory stimuli result in much more positive responses from students, and teachers "feel" that education is taking place. LeCount and Baldwin (1986) categorized three educational program types (telling, showing, and doing) within a hierarchical format showing the effectiveness on information retention. "Telling" program types included articles, radio talks, and lectures with the least effectiveness on retention and "showing" included live demonstrations, field trips, movies, and slide programs with intermediate retention of information. "Doing" program types had the most retention and included field experiences, role-playing, simulation activities, inquiry activities, and gaming. "Doing" types of programs allow the learning to involve the whole person, making them effective and able to retain the concepts or ideas learned while incorporating multi-sensory stimuli that Morgan (1992) found important.

Teaching by textbook was the method many educators used in the classroom, more recently the push for active-learning through hands-on activities has been preferred. Bestelmeyer et al. (2015) strongly supports these ideas but believes that alternative skills should be included in K-12 ecology education. An alternative skill that they suggest includes having K-12 students thinking as those at the graduate level by preparing them early on for future careers but also making them aware and literate of the surrounding environment. The skills of collaboration, interdisciplinary thinking, and strong communication are crucial of a scientist and

should be skills practiced at the primary and secondary school level and beyond through the use of citizen science, lessons integrating multiple subjects, and project presentation or peer-teaching opportunities.

Experiential opportunities

Much of education reform has suggested science education must go beyond the hands-on approach and provide an experience that resembles the practice of science. When one considers the scientific method, it begins with the scientist asking a question to which they seek the answer. Keeping this in mind it is clear that the backbone of the science field is inquiry. Inquiry is defined as the act of seeking an answer or knowledge, and should be the main focus of science education. Allowing students to inquire about various topics allows them to have the experience of the scientific process and learn by practicing.

A scientist often encounters limitations when it comes to research. These limitations include funding, time, and lack of staffing. It almost appears as though an untapped resource sits right in front of us, Student-Teacher-Scientist-Partnerships (STSPs). Scientists need the assistance of volunteers, or in this case students and teachers, to help collect and possibly expand their research endeavors. STSPs allow for experiential and authentic science inquiry to occur (Houseal et al., 2014). Educators are often limited in what they can provide to their students, STSPs bring in an alternative and effective method to meet the standards.

The benefits of these partnerships are tri-fold. Scientists get the help they need to complete their research with the assistance of teachers and their students, thus growing their research team or participants and hours of effort towards their research (Evans et al., 2001; Lawless & Rock, 1998) and opportunities for service hours. Scientist options for STSPs should not be limited to professionals in industry, but should include graduate students, professors, and agency personnel who may need assistance in completing their research as well. They too can benefit from these partnerships in developing communication skills with lay audiences and spreading the knowledge of their research to the community (Dolan & Tanner, 2005; Tomanek, 2005). Teachers can learn from scientists and develop their background in the field through hours of professional development and training workshops put on by planning organizations of the STSPs. Students can gain experiences that they may have never received with traditional classroom curriculum and be exposed to potential science fair projects or relevant community-based projects (Ledley et al., 2003).

By providing an inquiry-based science experience, students and teachers can provide feedback on their attitudes towards the science field and scientists. This is important to gauge whether or not these participants are relating to the scientists they are working with and finding an interest in the field. Particularly for students, it is important to see whether they are engaged and have improved attitudes towards the many aspects of science, which may result in them pursuing an interest in the field in the future. These experiences open the doors for partnerships among grades K-12 and universities and expand opportunities for students to develop a deeper connection with the multi-faceted field of science.

Need for Wildlife Education

Wildlife education is defined as “those teaching and learning processes that introduce information about specific wildlife resources, habitats, ecological relationships, conservation, and management strategies into public school and community educational programs” (Adams & Thomas, 1986). In the 1940’s, Aldo Leopold (1940, 1942), the father of wildlife management, had expressed concerns for the lack of training in land ecology for students and teachers. Land ecology integrates all of the sciences, including wildlife, and shows the public that we may learn the sciences separately in the classroom but in life, they are one. Leopold (1942) continued to express that a large amount of money had been thrown away to fund professional education and has left out the community, and he proposed to begin funding wildlife education for all citizens.

Much of the research on wildlife education has taken place during a camp or at on-site outdoor education programs that exclude the students who cannot afford or attend for one reason or another (Dettmann-Easler & Pease, 1999). The inclusion of wildlife into K-12 curriculum has the potential to expand awareness and appreciation of nature to the majority of students in primary and secondary schools who may not have the chance to participate in extra-curricular wildlife programs or camps. Wildlife science can easily fit into many of the topics covered in the life science or biology classrooms but can also blend into topics covered in the social sciences, health, math, and other subjects (LeCount & Baldwin, 1986; Waller 2011; Wilke et al., 1980). Waller (2011) also suggests for topics to be tied to the local area of the school and, as quoted from a teacher, it will allow students to “develop a good appreciation when there is a focus on species with which they are familiar.” Waller (2011) goes on to provide ideas on ways to include the topic of endangered species conservation to enrich biology curricula through activities such as class speakers, field trips, class labs, and participating in the

Endangered Species Day art contest. The topic of endangered species is also integrated with society and how we have an influence on those species through habitat destruction and introduced species.

Adams and Thomas (1986) provided three recommendations to improve wildlife education: 1) a national survey of work being done on wildlife education for future policy changes, 2) direct involvement of wildlife professionals in pre-service training for teachers, and 3) the implementation of a “conservation educator” position within wildlife department faculty of universities. Thirty-two years later, it appears that these goals have not been met. There has been a push with the “No Child Left Inside” Act, however, change has not been witnessed across schools, and teachers believe they have very little experience and knowledge to teach about the topic (Jacobson et al., 2006). Wildlife agencies have formed educational programs as part of their outreach component; however, the focus has been on providing these programs to in-service teachers and their classrooms. A few universities have created wildlife educator positions within their staff, for example Texas A&M University-College Station (AgriLife Extension) and Texas A&M University-Kingsville, yet still falling short of Adams and Thomas’ (1986) recommendation.

Wildlife lesson plans and activities have been developed through a slew of state and government agencies such as Texas Parks and Wildlife and the U.S. Fish and Wildlife Service and non-governmental organizations (NGOs) like the Texas Wildlife Association. Agencies such as these have also sponsored wildlife education programs such as the nationally known “Project WILD.” Since 1970, the goal of Project WILD has been to provide curriculum materials for wildlife-based conservation and environmental education to help students of all ages become aware, knowledgeable, skilled, and committed to the environment resulting in responsible citizens who can make informed decisions and act constructively towards the environment (CEE, 2018). Project WILD has other programs focusing on specific taxa or biomes such as Flying WILD, aimed at providing migratory bird education in urban areas. Project WILD and related programs provide curriculum and resources free of charge as long as the interested teacher or educators attend a workshop (Jacobson et al., 2006; CEE, 2018). Even with free resources available, teachers are not taking advantage of the opportunity.

Future Protection of Nature

Knowing how important wildlife is for our environment is the first step in protecting nature. Bestelmeyer et al. (2015) believes that ecological literacy should begin early and given a head start rather than waiting until the children attend college. This would already exclude a large portion of the population since more than 41% of people 25 years and older have not attended college (US Census Bureau, 2013). Not incorporating ecological education at an earlier age would exclude those of low income and/or who are not college ready.

Integrating wildlife into the grade school classroom has the potential to have positive influences on student attitudes towards wildlife (Adams et al., 1987). LeCount and Baldwin (1986) had a goal of providing the best bear information as possible to the public, and one way they saw fit was through a child’s education. Although their focus was on bears, this idea can be applied to a variety of wildlife species. The information relayed to these students can aid in future wildlife management by allowing the public an opportunity to understand species, their role in their environment, and their role in our lives.

Today’s children will be tomorrow’s decision makers in environmental policy and laws (Hayward, 2012). They are the future wildlife conservationists and with the wildlife field being small, the only way to continue the protection of wildlife species is to educate and encourage students in the classroom to be aware of nature. Children are losing touch with nature, missing outdoor experiences and with wildlife education in place it can provide the link between children and the outside. Preparation of our future conservationists has been merely a suggestion in the many presentations and articles from agency and organization leaders (Adams & Thomas, 1986; Leopold, 1942), yet there is still minimal effort to incorporate conservation education into our schools.

A New Curriculum

We developed, implemented, and evaluated a curriculum packaged as a kit (Jones & Eick, 2007) focused on wild bird conservation for 6th and 7th grade classrooms to increase student and educator interest in birds and the outdoors. Classrooms were self-selected by the teachers showing interest during the professional development workshops offered on this curriculum. Given the issues in implementation of wildlife education in the classroom, the primary author of this study (JLO) placed herself in the classroom as a visiting scientist as a form of a Student-Scientist-Teacher Partnership (STSP). She worked alongside teachers who had been trained in the curriculum and had an interest in conducting these lessons in the classroom, allowing us as scientists to complete this wildlife educational research.

The objectives of this study were to 1) develop K-12 curriculum integrating wildlife techniques specific to bird studies and research project components of ongoing or completed projects from the Caesar Kleberg Wildlife Research Institute (CKWRI) and 2) evaluate the curriculum via student pre- and post-surveys prior to and after curriculum implementation in the classroom to determine changes in students' affinity, perceptions, and attitudes towards birds, wildlife, science, and nature. We hypothesized that the curriculum would improve or influence positive responses in students' affinity, perceptions, and attitudes towards birds, wildlife, science, and nature.

METHODS

Curriculum Development

Five hands-on, kit-based, experiential lesson plans were developed to cover aspects of wild bird conservation research and techniques, making up the Wild Bird Conservation Curriculum. The curriculum was developed for evaluation in the 6th grade science classroom but was later modified for the inclusion of 7th grade assessment. The lessons were aligned with science Texas Essential Knowledge and Skills (TEKS) for ease of implementation in the classroom. Lesson plans include introductions and topic background, procedure for conducting the lesson plan, lesson assessment, and potential ways to expand the lesson to include more topics or increase the complexity for varying age groups. In addition, the lesson plan includes the standards being covered, learning objectives, related vocabulary and definitions, and materials required to conduct the lesson successfully. Basic information related to the lesson is also included such as group size required for activity, total cost, and time required to complete the lesson. All lesson plans can be modified to fit the needs of the teacher (i.e., splitting lesson into multiple time periods, reducing costs to the minimum, simplifying or increasing the complexity of the lesson depending upon the ability of the students).

Lesson plans covered the following topics: bird identification and survey methods, mist-netting and banding simulation, citizen science participation and data entry, aging quail and identifying their internal parasites, and mapping quail home ranges and the effect of habitat fragmentation. All lesson plans and supplemental material can be found on the CKWRI website under the Education and Outreach Program, Wild Bird Lesson Plans (<https://www.ckwri.tamuk.edu/research-programs/wildlife-education-outreach/events/lesson-plans/wild-bird-conservation-curriculum>).

Curriculum Implementation

Evaluation of the curriculum was open to any school within the South Texas region. Sixth grade classrooms were the original target audience for this curriculum due to the lack of state testing at this grade level, general interest from this age group, and the authors' previous experience working with students in this age group. However, to increase student exposure we opened the program to seventh graders. Two 6th grade science teachers participated from 2 different schools. These schools included Sarita Elementary (Kenedy County-Wide CSD, Sarita, TX) and Nanny Elementary (Riviera ISD, Riviera, TX). One 7th grade science teacher participated from Kaffie Middle School (Corpus Christi ISD, Corpus Christi, TX).

All state public education data provided here was sourced from the Texas Public Schools Explorer by the Texas Tribune and represents the 2016-2017 school year (2017). The student population of rural to urban participating schools varied greatly. Sarita Elementary had a total population of 75 students representing 5 ethnicities (Hispanic 84%, White 9%, African American 4%, Asian 1%, and two or more races 1%). Forty-one percent of students were considered at risk of dropping out of school, 68% being economically disadvantaged, and 7% with limited English proficiency. Nanny Elementary had a total population of 179 students with 70% being Hispanic or Latino, 27% White, and 3% two or more races. At-risk students made up 35% of students, 70% were considered economically disadvantaged, and 6% had limited English proficiency. Kaffie Middle School had a total student population of 989 and was the most diverse of the schools participating in the study. Seven ethnicities were represented: Hispanic or Latino (64%), White (25%), Asian (6%), African American (4%), two or more races (1%), Pacific Islander (<1%), and American Indian (<1%). Thirty-seven and 35% of students were considered at-risk and economically disadvantaged, respectively. Less than 1% of students had limited English proficiency.

Curriculum Evaluation

Students were assessed using a mixed methods design of qualitative (i.e., open-ended questions) and quantitative data (i.e., Likert-type statements (strongly disagree (1) to strongly agree (5)). Students completed a pre-survey prior to their teacher conducting any bird-related lesson plan (**Appendix**). A post-survey was completed following the end of all bird-related lesson plans in the program (**Appendix**). Student pre- and post-program surveys included statements regarding their interest in wildlife, birds, their ability to identify birds, awareness of nature, and their interest in science and working with a scientist, which they responded using a ranking system (Likert-type) from strongly disagree (1) to strongly agree (5). Students also included the approximate amount of time they spend outdoors during the school year and answered an open-ended question as to their favorite Texas animal on the pre-survey and their favorite wildlife-related activity of the year on the post-survey.

Each Likert-type statement was analyzed separately (Clason & Dormody, 1994) using an upper-tailed sign test to determine improvement (Conover, 1999) and analyzed in SAS 9.4 (SAS Institute, Inc., Cary, NC, USA). Open-ended questions were summarized using content cloud analysis (Cidell, 2010) for favorite bird-related activities. Word clouds were created on Wordle (wordle.net) in which word size is related to frequency of response. Emergent themes from reasons why it was their favorite activity were identified by using open coding then axial and selective coding, when appropriate, of data into common categories of meaning (Corbin & Strauss, 1990; Glaser, 2016). Frequency effect sizes are reported by dividing the number of individuals that contributed to that response category by the total number of responses (Onwuegbuzie, 2000). Sixth and 7th grade surveys were analyzed separately, but results are shown side by side for comparison.

Students hand wrote their names at the top of both surveys for identification purposes. Following the program, we ensured that pre- and post-surveys were matched up by student name and removed, shredded, and disposed of the strip of paper that included each student's name for privacy purposes. Each student received an identification number based on their teacher's initials followed by four digits (e.g., AB1234) for our record keeping. All surveys, prior to disposal, were stored in a locked filing cabinet in A.A.T.C.'s office. All pre- and post-surveys, child assents, and consent to participate in research forms for students were approved by the Institutional Review Board for the Protection of Human Subjects at Texas A&M University-Kingsville under protocol number 2015-040.

RESULTS

The curriculum was implemented in 6th grade classrooms at Sarita Elementary (Sarita, TX) with 17 students and Nanny Elementary (Rivera, TX) with 22 students and with 52 7th graders at Kaffie Middle School (Corpus Christi, TX). Seventh grader attitudes improved towards their ability to identify birds ($n = 29$, $T = 8$, $p = 0.0025$; see **Figure 1**), yet 6th grader attitudes remained similar ($n = 30$, $T = 2.5$, $p > 0.05$; see **Figure 1**). Sixth graders appeared to enjoy collecting bird data more than 7th graders, however, both grade levels did not significantly improve (6th: $n = 29$, $T = 2$, $p > 0.05$; 7th: $n = 36$, $T = 3.5$, $p > 0.05$; see **Figure 1**). Both grade levels improved in their perceived knowledge of birds but with a majority of students falling within the neutral category (6th: $n = 27$, $T = 7$, $p = 0.0043$; 7th: $n = 29$, $T = 7$, $p = 0.0094$; see **Figure 1**).

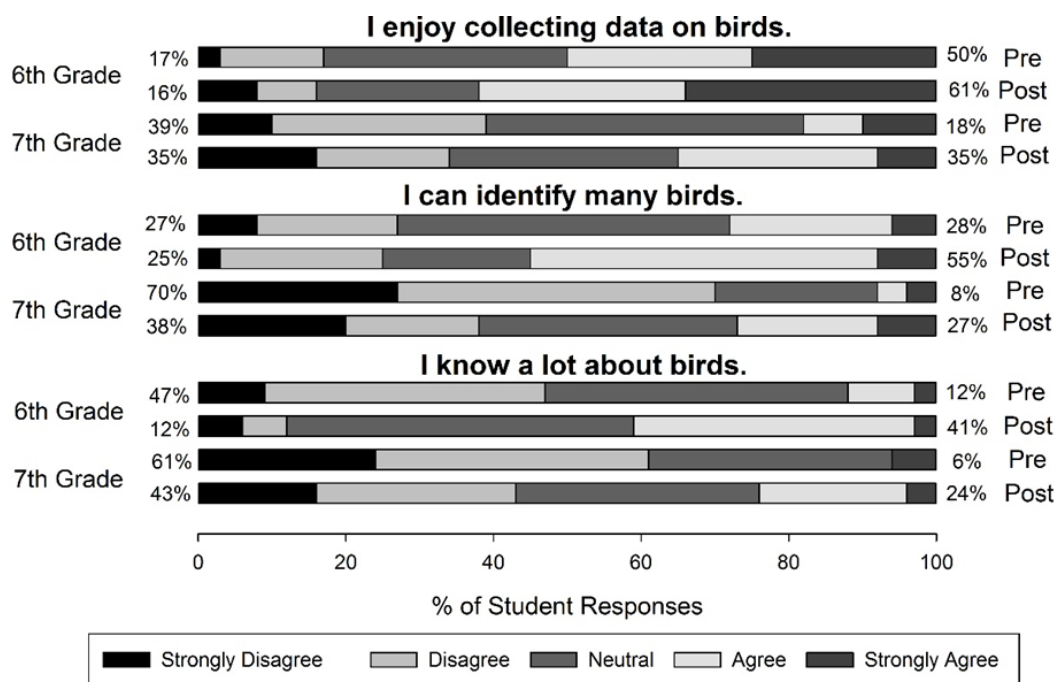


Figure 1. Pre- (top bar) and post-survey (bottom bar) 6th and 7th grade student responses to Likert-type (1-strongly disagree to 5-strongly agree) statements regarding their perceptions and perceived knowledge towards collecting bird data, identifying birds, and bird knowledge. Percentage on left represents cumulative percentage of negative responses (in disagreement) and on the right indicates cumulative percentage of positive responses (in agreement).

Students had a positive affinity towards wildlife (6th: $n = 22$, $T = -3.5$, $p > 0.05$; 7th: $n = 23$, $T = -3.5$, $p > 0.05$; see **Figure 2**) and improved attitude towards habitat fragmentation and its potential effect on wildlife populations (6th: $n = 22$, $T = 6.5$, $p = 0.0044$; 7th: $n = 39$, $T = 12$, $p < 0.0001$; see **Figure 2**). There was no change in either grade level on taking the time to stop and look at the wildlife they see (6th: $n = 25$, $T = -4$, $p > 0.05$; 7th: $n = 33$, $T = -2.5$, $p > 0.05$; see **Figure 2**). Attitudes towards working with a scientist (6th: $n = 16$, $T = -0.5$, $p > 0.05$; 7th: $n = 25$, $T = 0.5$, $p > 0.05$; see **Figure 3**) and science affinity (6th: $n = 23$, $T = -4$, $p > 0.05$; 7th: $n = 21$, $T = 0$, $p > 0.05$; see **Figure 3**) remained positive across both grade levels. The majority of students (between 70 and 80%) reported agreement that they do not disturb or harm the animals and plants they see outside across both surveys and grade levels (6th: $n = 21$, $T = -2$, $p > 0.05$; 7th: $n = 27$, $T = 2.5$, $p > 0.05$; see **Figure 4**). Each grade level responded similarly on both surveys regarding their free time spent outside (6th: $n = 23$, $T = 3.5$, $p > 0.05$; 7th: $n = 27$, $T = 4$, $p > 0.05$; see **Figure 4**), yet a higher percentage of 6th graders agreed with this statement (Pre: 69%, Post: 80%) as compared to the 7th graders (Pre: 43%, Post: 53%).

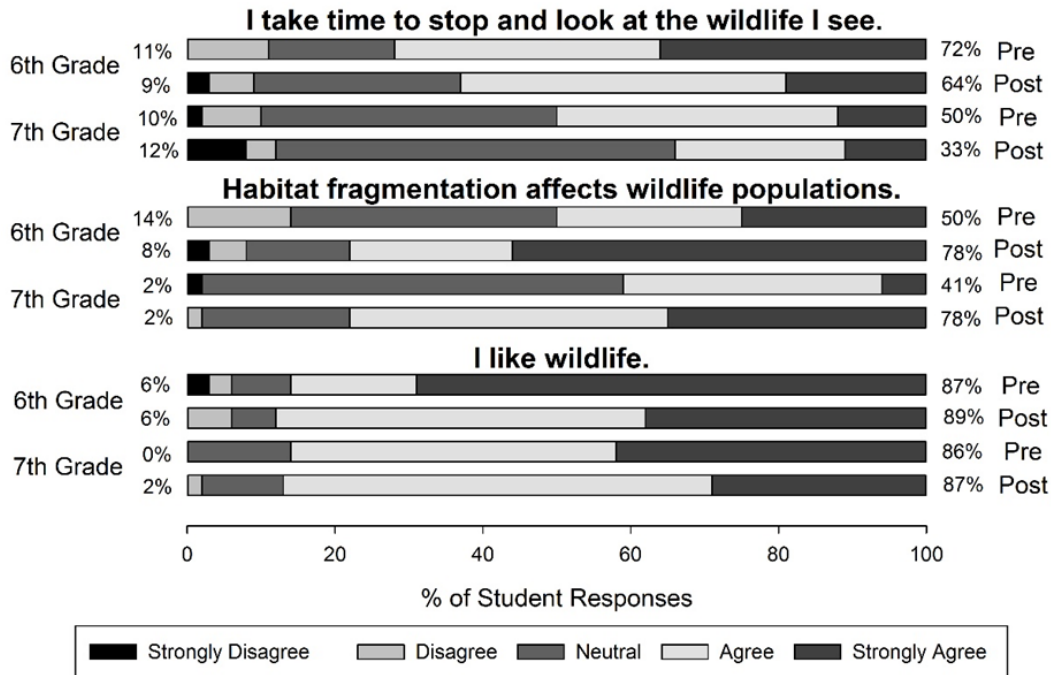


Figure 2. Pre- (top bar) and post-survey (bottom bar) 6th and 7th grade student responses to Likert-type (1-strongly disagree to 5-strongly agree) statements regarding their perceptions and affinity towards taking time to look at wildlife, habitat fragmentation, and wildlife. Percentage on left represents cumulative percentage of negative responses (in disagreement) and on the right indicates cumulative percentage of positive responses (in agreement).

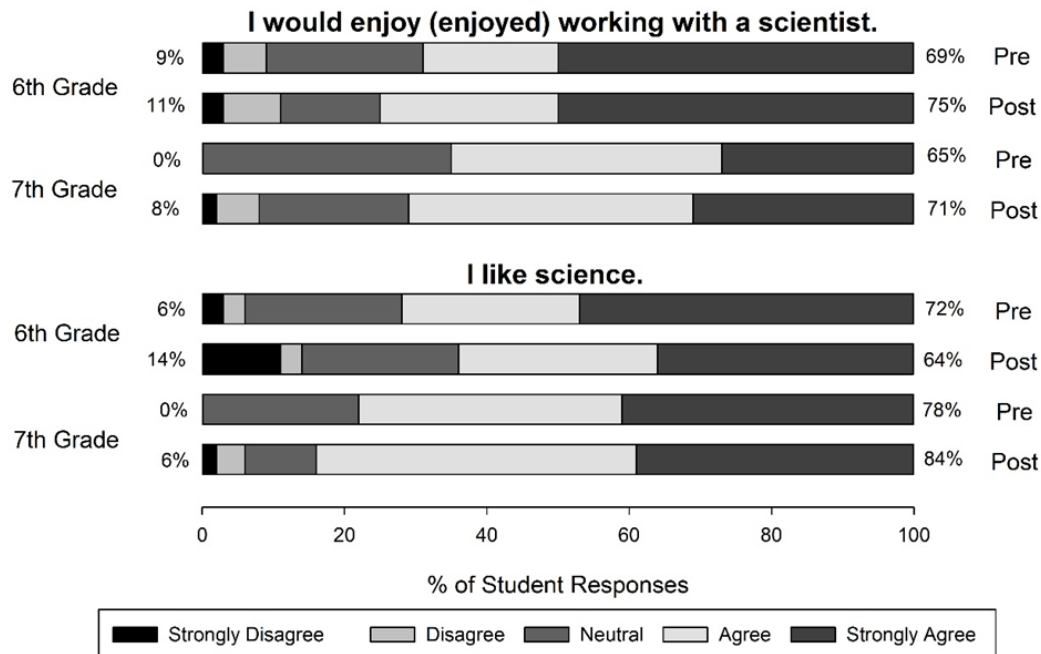


Figure 3. Pre- (top bar) and post-survey (bottom bar) 6th and 7th grade student responses to Likert-type (1-strongly disagree to 5-strongly agree) statements regarding their perceptions and affinity towards a scientist and science. Percentage on left represents cumulative percentage of negative responses (in disagreement) and on the right indicates cumulative percentage of positive responses (in agreement).

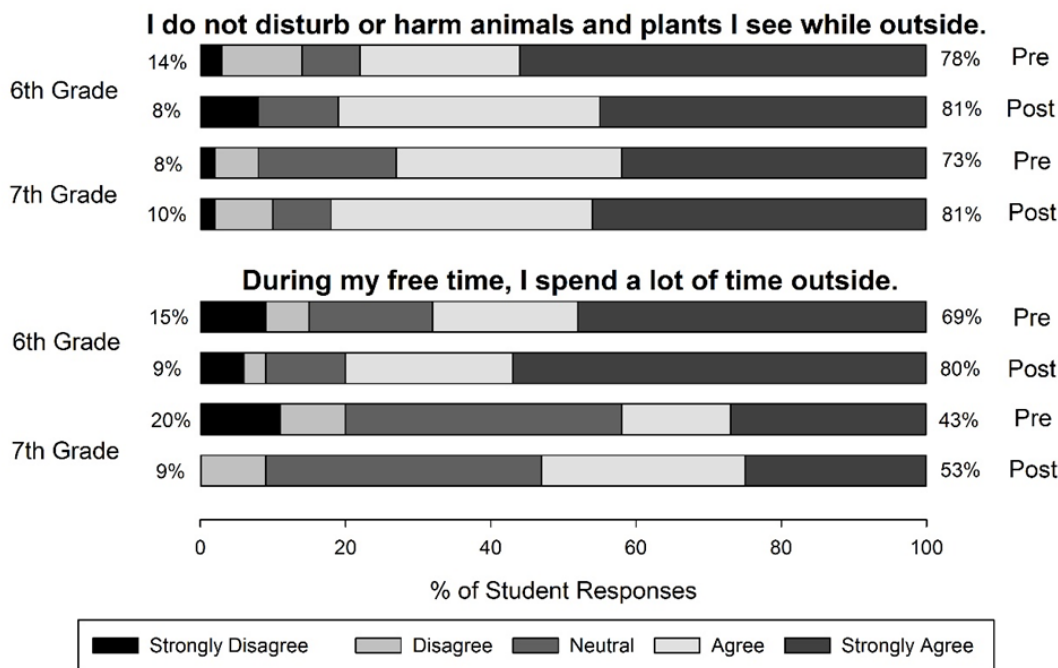


Figure 4. Pre- (top bar) and post-survey (bottom bar) 6th and 7th grade student responses to Likert-type (1-strongly disagree to 5-strongly agree) statements regarding their attitudes towards disturbing or harming nature and spending time outside. Percentage on left represents cumulative percentage of negative responses (in disagreement) and on the right indicates cumulative percentage of positive responses (in agreement).



Figure 5. Content cloud analysis of 6th grade student responses to their favorite Texas animal on the pre-program survey. Most frequent response was deer (n = 4 of 13 responses, 10%) followed by hog, cat, and dove. Thirteen percent of students had no response. Larger words indicate responses that are more frequent. Word cloud created on Wordle.net.

Pre-program survey responses to favorite Texas animal resulted in a variety of domestic and wild animal answers (see **Figures 5 & 6**). Sixth graders’ most frequently reported animal was deer (n = 4) followed by hog (n = 3), cat (n = 3), and dove (n = 3). They included a variety of wild native and non-native Texas species including quail, nilgai, mountain lion, and cardinal as well as domestic animals such as chicken, bunny, and pig. Fifty-nine percent of 6th graders included at least 1 native wild animal. There was a 13% no response rate in 6th graders. Seventh graders responded most with armadillo (n = 5) followed by all (n = 3) and dog (n = 3). Only 25% of the 7th graders included at least 1 native wild animal which include javelina, roadrunner, and horned lizard. One 7th grader included a response of a non-animal, the bluebonnet, the state flower of Texas. Seventh graders had a very high no response rate of 57%.



Figure 6. Content cloud analysis of 7th grade student responses to their favorite Texas animal on the pre-program survey. Most frequent response was armadillo (n = 5 of 11 responses, 10%) followed by all and dog. Fifty-seven percent of students had no response. Larger words indicate responses that are more frequent. Word cloud created on Wordle.net.

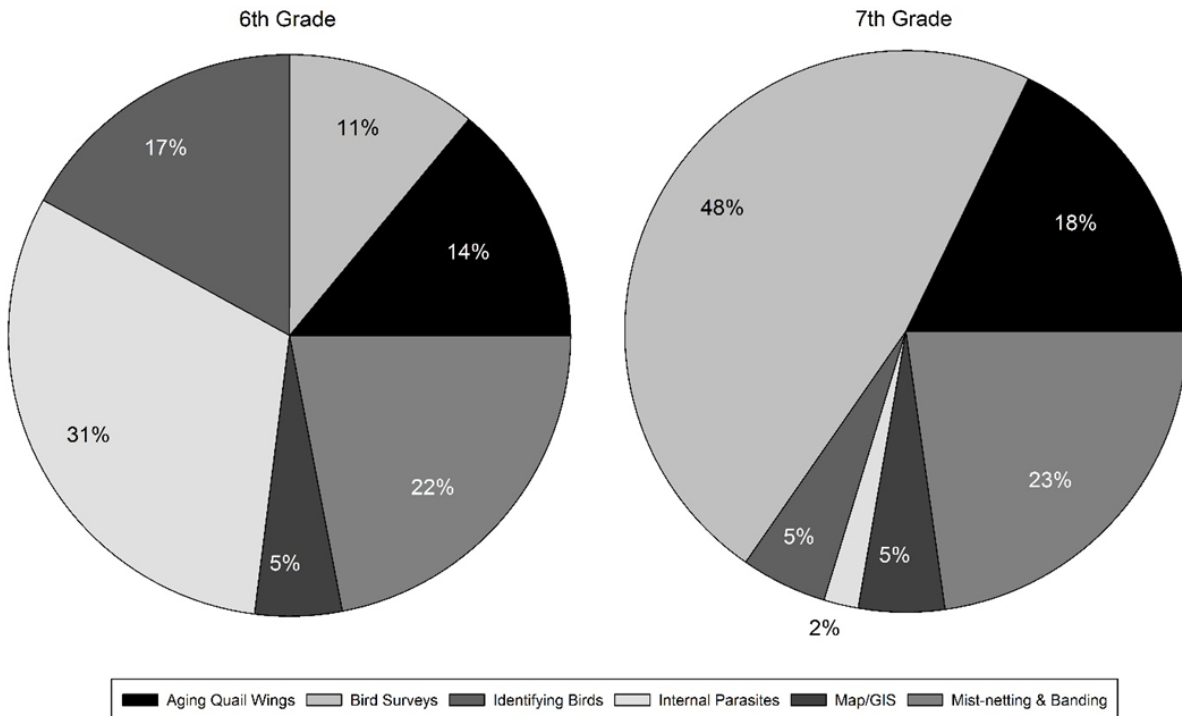


Figure 7. Sixth (n = 36) and 7th grade (n = 49) student responses for favorite bird-related activity administered on the post-program survey.

Post-program survey responses to students’ favorite bird-related activity varied across both grade levels. Sixth graders (n = 36) favorite activity was internal parasites of quail (31%), followed by mist-netting and banding (22%) and identifying birds (17%) (see **Figure 7**). Almost half (48%) of 7th graders (n = 49) reported bird surveys as their favorite activity. Followed by mist-netting and banding (23%) and aging quail wings (18%) (see **Figure 7**). Students were asked to elaborate on why their provided response was their favorite activity. Emergent themes in student responses are summarized in **Table 1**. A total of 5 themes were identified among both grade levels based upon common words used in student responses to the question.

Table 1. A summary of emergent themes identified in 6th and 7th grade student responses explaining why their selected bird-related activity was their favorite. Frequency effect size was calculated by dividing the number of students that mentioned each theme by the total number of participants for each grade.

Theme	6 th Grade	7 th Grade	Exemplar Quote
	Frequency Effect Size	Frequency Effect Size	
No Activity	3%	0%	“Weighing them because we didn’t do much.”
Experiential and/or Hands-on	18%	33%	“When we worked on how to band birds, it gave us the ideal way people band birds.”
Enjoyment	28%	19%	“Looked cool and was fun.”
Visual	13%	10%	“The one where we looked at the birds with binoculars because we got to see them closely.”
Outdoors	0%	25%	“Catching birds because we got to go outside.”
No Response	51%	29%	N/A

DISCUSSION

Our hypotheses regarding positive influence or improvement in student affinity, perceptions, and attitudes in response to the curriculum were minimally supported given the results of this study. Students had a positive affinity towards wildlife and attitude towards working with a scientist prior to and after curriculum implementation. Their perceived knowledge of habitat fragmentation and its effect on wildlife and birds improved. Seventh graders’ perceived ability to identify birds improved, yet 6th graders’ perceptions remained similar.

The results presented here show the presence of an intrinsic affinity to wildlife and nature in children prior to curriculum participation with not much room for improvement or positive influence. This is shown in the literature previously as a precursor for individuals to be conservation minded, environmentally aware and sensitive to issues regarding animals (Chawla, 1999; Schultz et al., 2004). Our attitude towards a particular animal or species can be a good indicator of our concern regarding animal welfare, and it is this value we place on animals which expresses our compassion and our shift away from previous thinking that humans dominate wildlife (George et al., 2016; Manfredo et al., 2009; Owen et al., 2009). Particularly within urbanizing areas, the idea of mutualism among humans and wildlife is the domineering attitude (George et al., 2016), which shows a potential for the future conservation of our wildlife populations with a growing human population and land use expansion.

Our ability to become environmentally conscientious has been tested by our growing disconnect with nature. Author Richard Louv (2005) coined the term “nature-deficit disorder” to define our lack of time spent outdoors as one of the causes of the increase in behavioral problems we are seeing in young children. But when time is spent in nature, there are added health benefits such as improved social ability, self-discipline, concentration, motor skills, agility, wonder, and curiosity (Fjortoft, 2001; Kellert, 2002; Taylor et al., 2001). Time spent outdoors appeared to be an important characteristic of the Wild Bird Conservation Curriculum as shown by the 7th graders in an urban setting. Some of the primary barriers of using natural outdoor settings as learning environments are the lack of walking access to the outdoors, lack of time, weather conditions, and safety concerns (Ernst, 2014). However, in this study, the use of the school yard and surrounding area (e.g., residential area with 7th graders) fulfilled this need of outdoor time. This shows that a nearby park or natural area is not necessary for students, instead access to an environment that is out of their everyday classroom sufficed, unlike what was described in Awasthy et al. (2012).

Students had a pre-existing affinity towards wildlife and improved perceptions towards issues such as habitat fragmentation and its potential effects on wildlife. Our hope was that this affinity for wildlife would carry over to the student perceptions of birds. Although there was improvement on behalf of the students, a majority of students fell within the neutral category, which according to Raaijmakers et al. (2000) may be a reaction of “don’t know” or “undecided” in response to bird-related statements. This suggests that more work is needed in gauging the true knowledge and ability of students rather than just their perceptions. Providing a test or quiz on the activity content and bird identification may be an option if we wish to measure knowledge

gains as opposed to participant perceptions. Using a local species or taxa in this study brought relevant animal models that were easily accessible for classroom activities and have not been completely utilized in teaching (Huxham et al., 2006). However, additional barriers exist to the implementation of curriculum such as the one developed and used in this study.

Science attitudes in students have been covered in depth at many grade levels and across educational settings (Foley & McPhee, 2008; Houseal et al., 2014). Overall, students had positive attitudes towards science and working with a scientist in the classroom (e.g., STSP), which has been documented in other studies (Houseal et al., 2014). Students who strongly believe that they can succeed in a science activity are more likely to choose those activities, work hard at them, and in the end increase their confidence in completing them successfully (Britner & Pajares, 2006). Observation, data collection, and microscope use were key science practices used in the lessons of this study, with a majority of 6th grade students enjoying the data collection process. The ability of middle school students to use science process skills has been found to be a strong predictor of a student's persistence in the sciences (Gallagher, 1994). This is particularly important when considering the science pipeline and how minority and female students, specifically, "leak out" of the pipeline between their time in high school and into college (Hilton & Lee, 1988). This is where the presence of a visiting scientist (e.g., STSP) that is reflective of the student population demographic can be important in influencing the public's science literacy and diversity of the future workforce (Laursen et al., 2007). Students see these visiting scientists as role models and are influenced by how personable they are and may change their misconceptions about the science field (i.e., stereotypical scientist image and women scientists) (Laursen et al., 2007; Conner & Danielson, 2016; Van Raden, 2011). Scientists in the classroom put a human face to the field and allow the scientist to develop valuable communication skills applicable to a broad audience and increase their public service as a professional (Wellnitz et al., 2002). It is important to implement this type of STSP or experiential learning opportunity in a classroom setting that is inclusive of all students (Cuevas et al., 2005) and not limited to students who have access to outdoor programming or camps.

Survey responses from students towards wildlife, science, and nature began and ended positively or improved. Because many of their responses to particular statements were already positive to begin with, it is difficult to say whether this curriculum changed any of their behaviors or feelings toward the topic at hand. Further research into conservation-related behaviors, outdoor recreation involvement, and conservation efforts with this study population are needed to gather more details on whether this curriculum has made changes beyond the classroom. Follow-up interviews or focus groups would be ideal to gather information as to what the students have become involved or interested in after their participation in the Wild Bird Conservation Curriculum. Furthermore, incorporating a control group to measure the true attitudes and perceptions of students in that age group of the studied grade levels will further solidify the study design.

Childhood experiences have been described by many as the foundation for their later relationship, appreciation, and commitment to the environment (Chawla, 1999). We have shown that 6th and 7th graders have positive attitudes towards wildlife, science, birds and the establishment of a scientist partnership. In addition, student interest in these hands-on, outdoor activities and scientist visits highlight the need to incorporate such lessons into schools. These lessons provided local educators with additional tools to incorporate wildlife topics and for students to be outdoors during their allocated class time. More importantly, students were introduced to the STEM (Science, Technology, Engineering, & Math) career of wildlife biology. STSPs can be an avenue to address the lack of conservation education in K-12 education by providing a strong community connection and resource opportunities between institutions and local schools to foster more environmentally aware citizens who can make sound decisions based on their experience and knowledge of science.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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APPENDIX

Pre-Program Survey for Students

Name: _____

Please complete the following.

<i>Put a check mark on your answer.</i>	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I like wildlife.					
I know a lot about birds.					
I can identify many birds.					
I take time to stop and look at the wildlife I see.					
Habitat fragmentation affects wildlife populations.					
During my free time, I spend a lot of time outside.					
I do not disturb or harm animals and plants I see while outside.					
I like science.					
I would enjoy working with a scientist.					
I enjoy collecting data on birds.					

Circle answer.

1. How much time do you spend outside during class time during the school year?

0-1 hour 1-2 hours 3-5 hours 6-10 hours 10+ hours

2. Do you have a favorite wild animal of Texas?

Yes Somewhat No

If yes or somewhat, what is/are your favorite Texas animal(s)?

Post-Program Survey for Students

Name: _____

Please complete the following.

<i>Put a check mark on your answer.</i>	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I like wildlife.					
I know a lot about birds.					
I can identify many birds.					
I take time to stop and look at the wildlife I see.					
Habitat fragmentation affects wildlife populations.					
During my free time, I spend a lot of time outside.					
I do not disturb or harm animals and plants I see while outside.					
I like science.					
I would enjoy working with a scientist.					
I enjoy collecting data on birds.					

Circle answer.

1. How much time did you spend outside during class time this past year?

0-1 hour 1-2 hours 3-5 hours 6-10 hours 10+ hours

2. What was your favorite bird related activity and why?

