AN INVESTIGATION INTO THE IMPACT OF LIVE ANIMALS ON BIOLOGY KNOWLEDGE GAIN AMONG FOURTH- AND FIFTH-GRADE STUDENTS

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ABSTRACT

Encounters with live animals are found throughout modern society in the form of zoos, aquariums, petting zoos, class pets, and wildlife education programs. These live animal encounters had only begun to be studied for the impact they might have on learners. This quasi-experimental mixed-methods study investigated the impact live animals had on biology knowledge gain in fourth- and fifth-grade students utilizing a pre- and post-program, self-designed, survey. The programs included a live animal program and an animal artifact program. The results indicated that live animals did have a slight impact on knowledge gain, but the impact was not statistically significant. Past experience with wildlife education programs had a much bigger impact on knowledge gain than the presence/absence of live animals.

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CHAPTER 1.

INTRODUCTION AND STATEMENT OF THE PROBLEM

Relevance of the Study

Encounters with live animals are found throughout modern-day society in the form of zoos, aquariums, petting zoos, class pets, and wildlife education programs. The impact of these live animal experiences had only recently been studied as zoos and aquariums are becoming more focused on education (Falk, Reinhard, Vernon, Bronnenkant, & Heimlich, 2007; Packer & Ballantyne, 2010; World Association of Zoos and Aquariums [WAZA], 2005). Experiential education values experience followed by guided reflection and the impact it has on individual and corporate growth and learning (Gass, Gillis, & Russel, 2012). Therefore the experience of an encounter with a live animal could have a profound effect on learners if guided reflection follows.

Many different aspects of experiential education philosophy can be found in environmental education. Environmental education aims to instill environmentally conscious attitudes from education programs, but utilizes many experiential opportunities such as live animal encounters, animal artifacts (skins, shells, and antlers), or hands-on projects (North American Association of Environmental Education [NAAEE], 2016; United Nations Educational, Scientific, and Cultural Organization/ United Nations Environmental Program [UNESCO/UNEP], 1978). Wildlife education's main objective is to educate about local wildlife, conservation, and ecology with an end goal of affecting attitude change toward wildlife (Adams & Thomas, 1986; Morgan & Gramann, 1989). Because wildlife education is a new field of study, there has been little research about the impact these education programs have on learners (Fischesser, 2013).

Inconsistencies were identified early in the research on the impact of the use of live animals and continue to be present in the literature (Morgan, 1992). Some studies have shown the simple act of viewing or touching a live animal has a significant impact on the learners' knowledge gain (Stanford, 2014). Other studies have shown no difference between live animal programs and programs utilizing different teaching methods to cover the same information (Hummel & Randler, 2010; 2012). Anecdotal evidence provided by wildlife rehabilitators and zoo educators has shown that the presence of live animals intrigues and captures the attention of learners (Stanford, 2014). Although there are perceived impacts of wildlife education programs, there appears to be little research demonstrating the impact the live animal encounters have on biology knowledge gain (Schwartz, 2013).

Research Question

The purpose of this study was to investigate the impact of live animal education programs on biology knowledge gain in fourth- and fifth-grade students. This study's aim was to answer the question: "If wildlife education programs have an impact on biology knowledge gain, is that impact greater when live animals are used than when animal artifacts and pictures are used in programming?"

Definitions of Key Terms

Experiential education is defined as "challenge and experience followed by reflection leading to growth and learning" (Gass, Gillis, & Russel, 2012, para. 1).

Environmental education is defined as a discipline that "teaches children and adults how to learn about and investigate their environment, and to make intelligent, informed decisions about how they can take care of it" (NAAEE, 2016, para. 1).

Wildlife education includes **"**those teaching and learning processes that introduce information about specific wildlife resources, habitats, ecological interrelationships, conservation, and management strategies into public school and community education programs" (Adams & Thomas, 1986, p. 480).

Non-releasable wildlife consists of animals that have injuries or other conditions documented by a veterinarian that would prevent independent survival in the wild. The wildlife educator must obtain permits at the state level for mammals and reptiles, and both the state and federal level for birds kept as education animals (Lord, Nickerson, & Thrune, 2004).

CHAPTER 2.

LITERATURE REVIEW

Education has evolved tremendously in the last century and has become much more complex with different educational methodologies. Educational methods utilizing live animals can be connected with experiential education, environmental education, and wildlife education. Zoos and aquariums utilize live animals throughout their facilities and have been a great place to see the impact this method has on visitors. These educational methodologies and facilities have been instrumental in investigating different fields of education in relation to knowledge gain and have been discussed here in relation to education utilizing live animals.

Experiential Education

At the root of many educational methodologies and theories, experiential education is an integral part of wildlife education as it values the experience in addition to the learning. The act of seeing, touching, hearing, or interacting with a live animal is an experience that can be fostered into an educational opportunity. Experiential education is inherently concentrated on significant experience followed by guided reflection through which learning can be achieved (Gass, Gillis, & Russel, 2012). Dewey, an educational philosopher and pioneer of experiential education, described experience as the interaction of natural, interactive activities and decisions from which the learner gains meaning (Dewey, 1963). He believed that experience was only meaningful to the learner if he or she reflected on the activity's connections with other concepts to gain understanding. Guided reflection is an integral part of experiential education; facilitators, teachers, coaches, and counselors must carefully guide and support learners through the process to ensure the learners develop values and skills, expand knowledge, and foster community contribution (Gass, Gillis, & Russel, 2012; Kolb, 1984).

Kolb, another pioneer of experiential education, adapted ideas from the educational philosophies of Dewey and other prominent educators of his time into his own Experiential Learning Theory (ELT) called Kolb's Model of Experiential Learning. Kolb's ELT begins with the two foundational ideas: 1) learning is a continuous process that is grounded in experience, 2) all learning is relearning because each student has pre-existing ideas and beliefs about the topic being taught (Kolb, 1984). Resistance to new ideas might be related to a conflict between pre-existing ideas and new information, and it is part of the educator's duty to try to help the learner understand how to integrate these new ideas into his or her beliefs about the topic (Gass, Gillis, & Russel, 2012; Kolb, 1984). Kolb's ELT model can be described as a concrete experience followed by reflection in order to form abstract concepts that can be experimented on to achieve learning; this model is utilized extensively throughout the field of experiential education (Gass, Gillis, & Russel, 2012; Kolb, 1984). Many educators find that the best method to challenge learners and begin the cycle of Kolb's ELT is to conduct the first-hand experience outdoors, but experiential education has been utilized successfully by many educators in other environments (Gass, Gillis, & Russel, 2012).

The idea of experience-based learning is not a new concept and has been practiced since long before the 20th century; Dewey and Kolb, among others, formalized the idea into an educational philosophy. Research is still being conducted about the effect different teaching methods have on learners involving experiential education (Ives & Obenchain, 2006). Experiential education is an evolving field of study and, after a review of the literature, there seems to be a need for continued research into the application and effectiveness of this educational philosophy. This educational methodology has many applications, including education utilizing live animals and environmental education.

Environmental Education

Environmental education seems to be anchored in the experiential education framework. In fact, both experiential education and environmental education share many similar guiding principles including: enabling the learners to have a role in planning his or her learning experiences, accepting the consequences of their own decisions, and learning as a lifelong process that can be built on after each learning experience (Gass, Gillis, & Russel, 2012; NAAEE, 2016; UNESCO/UNEP, 1978). Environmental education focuses on the environment and facilitating learning about the natural and man-made environment in which we live, as well as on personal and group development as they relate to environmental problems (NAAEE, 2016; UNESCO/UNEP, 1978).

Environmental education strives to utilize diverse learning environments with a focus on first-hand experiences and practical activities (UNESCO/UNEP, 1978). The North American Association for Environmental Education (2016) states that environmental education is used in many different places in the United States including, but not limited to: traditional classrooms, zoos, parks, nature centers, museums, and communities. Environmental education can be implemented in many different ways, but the goal of developing an environmentally literate citizenry is found throughout the field (NAAEE, 2016; UNESCO/UNEP, 1978). Environmental education can be used in formal education and often reflects state and/or national education standards in many different subjects because of the interdisciplinary nature of this education field (NAAEE, 2016; UNESCO/UNEP, 1978).

Environmental education is being used more often in many different parts of the schooling experience, which seems to indicate the effectiveness of this educational methodology. Often, many instructors' lesson plans utilize environmental education to meet educational

objectives in subjects such as science, social studies, math, and others. Research has shown that students perform better on standardized tests, have fewer classroom problems, and increased enthusiasm for learning with curricula that is structured around the environment (Lieberman & Hoody, 1998).

Despite the relatively recent research conducted on the effectiveness of environmental education programs (Cheng, 2008), the literature is unclear as it relates to biology knowledge gain (Loubser, Noor Azlin, Dreyer, & Nik Azyyati, 2014). Most environmental education programs focus on increasing students' environmental awareness rather than structural knowledge, which supports the need for further research. Environmental education is becoming more commonplace in zoos and aquariums as the focus of animals in captivity is shifting from novelty to education. This represents a new field of research into environmental education in these contexts.

Zoo and Aquarium Educational Strategies

In the past, zoos and aquariums have focused on the novel aspect of viewing and observing live animals from around the world, but as recent as the late 1960s, zoos and aquariums have shifted their focus from entertainment to wildlife and habitat conservation (Falk et al., 2007; Packer & Ballantyne, 2010; WAZA, 2005). A visit to a zoo or aquarium might be the only place an increasingly urbanized culture can experience wildlife and connect with nature; therefore, zoos and aquariums have a unique opportunity to make a difference (Falk et al., 2007; Packer & Ballantyne, 2010; Stanford, 2014; WAZA, 2005). Exhibit or program design has been shown to have a profound impact on what visitors remember after a visit to one of these institutions (De Young et al., 2011). If visitors remember uninformative and bland exhibits, they might not remember what they learned during their visit to the institution.

Zoos and aquariums today are designing more exhibits that are innovative and resemble the animal's home environment in order to appeal to multiple senses, provide a new perspective and allow the visitors get as close as possible to the animal (Packer & Ballantyne, 2010; WAZA, 2005). Interactive signage and ample educational opportunities have also helped zoos make this transition from entertainment to conservation. Zoo educators provide many hands-on activities for visitors such as: portable displays with snakes, lizards, and other live animals available for the visitors to touch and interact with without glass or a cage between them (Stanford, 2014). Other animal keeper interactions such as flight shows with birds of prey or other birds, animal feedings, and pony/camel rides offer visitors opportunities to interact with the experts and ask questions about the animals. Research has shown that educational experiences that allow the visitor to become actively involved in learning about animals have a greater impact on environmentally conscious behavior change than visitors who only passively read exhibit signage (Swanagan, 2000). Visitors have also indicated that they are prompted to reconsider their role in environmental problems and conservation action after an experience at a zoo (Falk et al., 2007; Packer & Ballantyne, 2010). One important part of the zoo education experience is the possibility of an emotional connection with a live animal. A zoo visitor may have a cognitive and/or emotional response to interacting, engaging, or observing the animals which may help them realize the impacts humans have on the environment (Falk et al., 2007; Packer & Ballantyne, 2010). The experience of visiting a zoo or aquarium for the first time has the potential to have a lasting impact on memories and environmental attitudes in the future. Despite emotional connections and improved environmental awareness following a zoo or aquarium visit, there seems to have been little research on the knowledge gain as a result of a visit to one of these institutions.

Elements of experiential education are evident throughout the zoo or aquarium experience. The act of viewing, hearing, or touching a live animal at a zoo or aquarium can encourage the visitor to reflect on self, community, or world action as it relates to the animal or habitat. Interactive signage/educational displays, strategic animal exhibits, and opportunities for action can inspire the learner to engage Kolb's Experiential Learning cycle (Packer & Ballantyne, 2010). It is important to emphasize that the entire experiential learning process cannot be completed while visiting a zoo or aquarium because the time needed for reflection and proper action often requires longer than a few hours during the visit.

Given zoo education's relatively recent change from entertaining to educating, more research is needed to understand the impacts of the education received while visiting a zoo or aquarium (Packer & Ballantyne, 2010). Previous studies have been limited in scope, which prevents generalization across the zoo education field (Falk et al., 2007). It seems that experiential learning is the prevalent educational philosophy being utilized in aquarium and zoo environments, but there may be other educational theories that would be beneficial to include in the zoo education experience. Because each visitor comes with previous experiences and attitudes related to wildlife and experiences other events after the visit, the impact of these pre- and post-visit factors on any environmental attitudes or biology knowledge gained while visiting a zoo or aquarium is unknown (Packer & Ballantyne, 2010). Since zoo education is largely unexplored, there are unanswered questions remaining around the impact of a zoo or aquarium visit.

Wildlife Education

The field of wildlife education has its roots in zoo education because many zoos and aquariums utilize native wildlife collections for educational programs. The educational

strategies for wildlife education are very similar to those found in zoo education with a few characteristic differences: wildlife education focuses on animals found naturally in the area, local conservation, awareness of human impact on local wildlife, and wildlife management strategies (Adams & Thomas, 1986; Morgan & Gramann, 1989). Adams and Thomas (1986) defined wildlife education as **"**those teaching and learning processes that introduce information about specific wildlife resources, habitats, ecological interrelationships, conservation, and management strategies into public school and community education programs" (p. 480). The goal of wildlife education is for the learner to have some positive change in knowledge and awareness of wildlife, as well as change in attitudes and actions toward wildlife (Morgan & Gramann, 1989).

Educational methods found in wildlife education vary by educator but can include anything from lectures to in-depth experiential education methods, which encompasses hands-on activities followed by reflection. Like zoo education, the experience of viewing a live animal up-close can be a catalyst to stimulate many learners to reflect on personal choices and human impacts on wildlife as a whole (Schwartz, 2013). The National Wildlife Rehabilitators Association emphasizes the need to reach the most learners by incorporating as many different learning styles as possible into wildlife education programs (Lord et al., 2004). Allowing the learners to touch or interact with live animals during a wildlife program and learner-educator interaction are a few of the methods used by wildlife educators to incorporate as many learning styles as possible in their programs (Lord et al., 2004).

In many cases, the wildlife rehabilitator and the wildlife educator are one in the same, which contributes to the information being covered during wildlife programs (Lord et al., 2004). The wildlife rehabilitator comes into contact with wild animals daily and must learn how to care for many different types of wildlife. This experience gained during the wildlife rehabilitation

process significantly impacts the biology knowledge being covered during the program. Because the live animals are typically the focus of wildlife-related events and programs, many wildlife rehabilitators use live animals that are deemed non-releasable by a veterinarian. Non-releasable wildlife can be defined as animals that have one or more conditions that would prevent independent survival in the wild (Lord et al, 2004). To be utilized in education programs, the animals used by wildlife rehabilitators have to be licensed by the state wildlife agency, the United States Fish and Wildlife Service, or both.

One key part of wildlife education includes the possibility of an emotional connection made between the live animals being presented and the viewers (Schwartz, 2013). Many wildlife educators believe that this connection is present during their programs and some wildlife tourists have reported an emotional connection with the wildlife they have observed (Packer, Ballantyne, & Falk, 2010). The perceived impact of these live animals, especially live raptors (hawks, owls, falcons, eagles), in wildlife education is that the learner gains knowledge, experience, and memories during a wildlife education program (Schwartz, 2013). Other wildlife educators state a perceived impact of connecting children with wild animals at a young age that enables them to appreciate the animals that share our world (Fischesser, 2013). Wildlife educators have provided anecdotal evidence of the impact of the programs, but further research is needed to confirm a positive impact on knowledge and attitudes.

Wildlife educators provide programs to many different community groups such as school groups, festivals, private programs, service groups, and many others (Seimer, Brown, Martin, & Stumvoll, 1991). Wildlife educators in New York estimated they educated up to 60,000 people in 1990 through programs covering topics including: how to tell if an animal needs help or not, basic wildlife ecology and natural history of common wildlife, laws against keeping wild animals

as pets, and the importance of habitat conservation (Seimer et al., 1991). Concerned citizens also tend to contact wildlife rehabilitators with questions regarding how to deal with a pest animal and the communication, however short, gives the educator an opportunity to give the caller a few bits of information about the animal (Fischesser, 2013; Lord et al., 2004).

Wildlife educators have the potential to reach thousands (if not hundreds of thousands) of people in the United States and are ready and willing to educate the public (Seimer et al., 1991). Attitudes toward the environment and wildlife have recently been shifting from primarily consumptive uses to more conservative ideas, and wildlife educators are perfectly suited to be a catalyst in this shift (Morgan & Gramann, 1989). Questions remain around the impact wildlife education might have on this attitude shift toward wildlife and the current impact on environmental attitudes. Wildlife education, by definition, is a type of informal education, but many educators also present to formal education audiences. The use of these live animal encounters in formal and informal education to facilitate learning is an emerging field of study that has the potential to engage and inspire learners (Uttley, 2013).

Integration of Live Animals in other Educational Settings

Live animals used in education can range from mice or hamsters as class pets to tigers and elephants seen at a zoo. The simple act of seeing or touching a live animal can have a positive impact on students' views of the animals and with the right kind of presentation, preferably direct contact with a live animal, even generally unpopular animals can become more liked by students (Morgan & Gramann, 1989; Randler, Hummel, & Prokop, 2012; Stanford, 2014). Mere exposure to live animals without modeling or information/interaction of some kind seems to lack enough impact to encourage a change in attitude toward that animal (Morgan & Gramann, 1989),

but constant exposure to a live animal without modeling can have a partial effect on attitude (Morgan, 1992).

While studies on the educational effectiveness of live animals as they relate to knowledge gain are inconsistent (Morgan, 1992), research has shown significant improvements in students' attitudes toward unpopular animals such as snakes, rats, mice, and snails after proper instructional presentations (Hummel & Randler, 2012; Morgan & Gramann, 1989; Stanford, 2014). Research also appears to show that live animals have a positive impact on student feelings, emotional connections, and attitudes despite the educational context (Bixby, Carnes & Church, 2010; Hummel & Randler, 2010; Stanford, 2014). Emotional connection seems to be another important factor influencing students' attitudes toward wildlife, and hands-on animal centered activities can have a positive effect on students' empathy and compassion toward animals (Hummel & Randler, 2010; Lust, 2006; Uttley, 2013). More favorable attitudes toward an animal might be a catalyst for increased learning opportunities about that animal. Many classroom teachers use class pets in support of their curriculum objectives, as well as a method of emotional connection with their students (Uttley, 2013).

Classroom teachers have the potential for positively influencing students' attitudes toward animals and the environment with the use of class pets and other live animals (Hummel & Randler, 2010; Morgan, 1992; Randler et al., 2012). Fish, amphibians, and reptiles are the most common early childhood classroom pets. Some educators have shown anecdotal evidence that a strong emotional connection between the students and the animals provides many learning opportunities in the classroom (Uttley, 2013).

There are also gaps in the literature regarding the impact different animals have on learning such as mammals versus reptiles (Hummel & Randler, 2012). Researchers have also

questioned the possibility that closer interaction with animals might have an even greater impact on the students' attitudes toward those animals (Randler et al., 2012). An emotional connection with a live animal can be a catalyst for increased knowledge gain as well as behavior change. Wildlife education, environmental education, and education utilizing live animals all have a core goal of behavior change stemming, in part, from knowledge gain. Time-efficient methods (lecture, workbooks, other non-experiential methods) do not seem to foster the higher order thinking skills that typically are the aim of experiential education (Ives & Obenchain, 2006). Relatively new methods of education involving experiences, connections to the real world, and live animals have the potential to have a stronger impact on learner attitudes and behavior change.

Lack of consistent research in this relatively new field of study indicates a need for continued research. The growing occurrence of animal encounters also points to a need for a greater understanding of the learning impact animal encounters might have on the students. The purpose of this study was to investigate the impacts that live animals have on biology knowledge gain. By addressing the apparent gap in the literature, this research could influence how wildlife educators, and other educators, integrate the use of live animals to maximize biology knowledge gain among fourth- and fifth-grade students. The guiding research question for this study was "If wildlife education programs have an impact on biology knowledge gain, is that impact greater when live animals are used than when animal artifacts and pictures are used in programming?"

CHAPTER 3.

METHODOLOGY

Research Question

The purpose of this study was to investigate the impact live animals might have on biology knowledge gain in fourth- and fifth-grade students. The research question investigated during this study was "If wildlife education programs have an impact on biology knowledge gain, is that impact greater when live animals are used than when animal artifacts and pictures are used in programming?"

Research Design

This study utilized a quasi-experimental mixed-methods survey design (Creswell, 2014). A mixed-methods approach (Creswell, 2014) allowed quantitative data to be collected and tested for significance while also collecting qualitative data about each participant and the personal impacts the wildlife program may have had on each participant. Comparisons were then made between the quantitative and qualitative data for a more complete picture of the impact of live animals on biology knowledge gain. One of the many advantages of this research design is the quantitative data can be explained or strengthened by the qualitative data. The personal impact wildlife education may have on students can influence the amount of learning that may also take place in both positive and negative ways. The mixed-methods approach seems to provide a much more complete understanding of the possible learning impacts wildlife education has on students.

This study was conducted utilizing the fourth- and fifth-grade classes from three schools located in two counties in North Carolina. County names and school names have been omitted to protect school anonymity. These classes were assigned to receive one of two options for a

wildlife education program using a method called group matching (Creswell, 2014), which reduced the impact the use of existing participant groups had on the research. There were a similar number of classes from each county in the treatment group and the waitlisted control group (Weiner, Schinka, & Velicer, 2003). Option one, which was given to the treatment group, was a live animal program featuring the non-releasable wildlife located at Lees-McRae College's May Wildlife Rehabilitation Center. Option two, which was given to the waitlisted control group, included animal artifacts and life-sized pictures with no live animals. The information presented in these two programs was the same but was presented in two different ways and covered much more information than was found on the surveys. The classes in the waitlisted control group were given a live animal presentation after the study's completion in order to prevent these students from being deprived of the genuine live-animal encounter.

Program

A wildlife education program, lasting one hour, was given at each school included in the study during normal class time. The live wildlife program given to the treatment group included six live animals: Red-tailed Hawk, Eastern Screech-Owl, Blue Jay, Virginia Opossum, Eastern Box Turtle, and Corn Snake. The participants were allowed to touch the opossum, turtle, and snake at the end of the program. The waitlisted control group was given a wildlife education program utilizing life-sized pictures and animal artifacts rather than live animals. Control group participants were able to touch skulls, feathers, fur, and preserved talons. The educator covered the same information in both programs in order to reduce the variable of presenter error. The information given in the programs focused on each animal's habitat, food choices (favorite type of food), how the animal finds or catches its food (adaptations), and when the animal is active (nocturnal/diurnal). The wildlife educator practiced the same program script for both wildlife

programs, and no special emphasis was given to the information found in the pre- and post-program surveys. This program was chosen because of the availability of live animals, the researcher's experience with the species included, and the commonality of the species in the local environment.

Individual teachers were contacted prior to the study in order to determine if there was any connection to the curriculum being covered in class before or after the wildlife program. After reviewing the NC Department of Public Instruction (n.d.) Science Standards for fourth-grade, the standard that was most closely aligned to the information that was covered in the wildlife program was "4.L.1 Understand the effects of environmental changes, adaptations and behaviors that enable animals (including humans) to survive in changing habitats". A review of the Science Standards for fifth-grade determined one standard that was most closely aligned to the information that was covered: "5.L.2 Understand the interdependence of plants and animals with their ecosystem" (NC Department of Public Instruction, n.d.). Each teacher can cover these standards using very different methods, and additional information could be added. This warrants interview of each individual teacher to review any connection with their lesson plans and the information that was covered in the wildlife program. Teacher interviews were conducted prior to the study in order to obtain information about when, or if, they planned to cover material related to information in the wildlife program. Teacher interviews were recorded using a voice recorder only for the researcher to review the information covered. Refer to Appendix A for a sample teacher interview script.

The wildlife education program included a short activity to review the information covered during the program after completion of the post-program survey. The game was called Animal Olympics and the students "competed" against animal abilities such as carrying five

balls at a time from one place to another like a Blue Jay carries five acorns in their beak at a time. Another example was the students would try to get a knee-high panty hose off their forearm without using their other hand to simulate a snake shedding its skin. The students were not required to participate in the activity, but were encouraged to do so. The activity lasted around 15 minutes and was conducted after completion of the post-program survey. Almost all students participated in the activity regardless of participation in the study, but time restraints limited some of the activity participation in some classes.

Participants

The study participants included the fourth- and fifth-grade students attending three schools in two different counties in North Carolina. These schools have been named School A, School C, and School D. These schools were intentionally selected in part because of their location and ease of travel for the researcher but mostly because they represented the full spectrum related to the variable of past experience with wildlife education. The May Wildlife Rehabilitation Center (MWRC) located at Lees-McRae College was the researcher's base of operations and provided access to live animals as well as supplies for animal artifacts. All animals and animal artifacts belonged to the May Wildlife Rehabilitation Center and the primary researcher borrowed them with permission. The primary researcher had previous experience volunteering at this wildlife center and used these specific animals in past education programs. Schools in County 1 received wildlife education programs from the MWRC regularly while schools in County 2 did not received these regular programs. Most of students in schools in County 1 had much more experience with wildlife education programs, while those students in County 2 had not.

Participants' past experiences can have a profound effect on the outcomes of a study, and inclusion of both levels (those with past experience and those without) of experience allowed the researcher to compare the data and determine what kind of impact was present (Ewert & Sibthorp, 2009). The variable of past experience was addressed with the inclusion of schools from both the experienced group (County 1) and the inexperienced group (County 2). The variable was further addressed through the group matching (Creswell, 2014) from each school in the treatment and wait-listed control groups receiving the live-animal program and the animal artifact program, respectively. Past experience cannot be completely controlled for in this sample, but was acknowledged. Further information was gathered regarding past experience with wildlife education programs through a question on the pre-program survey addressing this variable.

The population of fourth- and fifth-grade students at the selected schools included 193 students. From the population size with a significance level of $p = .05$ and a population of 193, this study would have needed a minimum of 129 students completing both the pre-program and the post-program surveys. The actual number of students that brought back consent forms and completed both the pre-program and post-program survey was 158, much higher than the number needed for this study. The population included 84 girls and 74 boys with ages ranging from 8 to 12 years old averaging 9.7 years old.

Purposeful sampling (Creswell, 2014) was used to select these fourth- and fifth-grade classes over other grades because of location, average reading and writing levels as compared to younger grades, and correlation to curriculum. Program material was more relevant to these grades because the standard science curriculum for North Carolina 4^{th} and 5^{th} grades focuses on animal adaptations and animals in their ecosystems. This study required that students have a

more advanced reading and writing level because the knowledge survey was a written survey with open-ended questions that necessitated writing in full sentences or at least writing in complete thoughts. Each question was read aloud to all classes, but students were required to read and chose the answer to multiple-choice questions and form complete answers to open-ended questions on the surveys. Other participant criteria for inclusion in the study included parental, individual student, and teacher consent, as well as completion of both the pre- and post-program surveys. Only those students and parents who provided full consent were given surveys and included in the study and only those participants who returned both the pre- and post-program surveys were included in data analysis. Refer to Appendix B for a sample Parent/Guardian consent form for child participation in the study. The students were briefed prior to the start of the surveys and program about the purpose of this study and the expectations of the order of the events during the study time. The students voluntarily participated in the study with a clear understanding that the outcome of the surveys would not affect their class grades.

There was the possibility that mentally or physically challenged individuals were included in the sample, and these participants were not excluded from the research. The researcher interviewed the teachers to find out if the class had any challenged students; some teachers made recommended accommodations for these participants. The accommodations included the teacher assisting a student in writing answers to open-ended questions. The researcher read aloud each question to the entire class for all classes (no other accommodations were necessary).

Data Collection

Demographic information collected from the students included name, age and gender. The names were collected for the sole purpose of correlating pre-program surveys with post-program surveys, and the primary researcher was the only one with access to the surveys with participant names. After the pre- and post-program surveys were connected using a participant number and the demographic data, the names were omitted and gender, age, and the unique participant number were the sole identifiers included in the data. Both surveys were designed specifically for this study because the primary researcher was unable to find established surveys that adequately addressed the research question. A panel of experts reviewed the surveys for face validity (Salkind, 2010) and concluded that only small minor wording changes were needed before the beginning of the study.

The study programs were conducted between September 9th and October 1st, 2015 on days convenient for both the researcher and teacher. The pre-program survey was given to the participants immediately before the wildlife education program to measure the students' pre-existing knowledge about wildlife and prior exposure to live wildlife programs. The post-program survey was given to the students immediately after the program to investigate biology knowledge following the wildlife program and to give the students an opportunity to react to the program. The knowledge surveys included at least one question from information on each type of animal used in the program: Red-tailed Hawk, Blue Jay, Eastern Screech-owl, Virginia Opossum, Eastern Box Turtle, and Corn Snake. An example of a multiple choice knowledge question on the survey was the following: Which is the favorite food of Blue Jays? A. Insects B. Plants C. Acorns D. Fruit E. I don't know. The correct answer would be C. Acorns because that is typically a favorite food of wild Blue Jays (see Appendix C for a sample pre-program

survey). An example of an open-ended question included on the post-program survey was the following: What was your favorite part of the program? (see Appendix D for a sample post-program survey). The questions included in the pre- and post-program surveys were chosen because they cover the topics discussed in the program as completely as possible. Open-ended questions are included in the survey design to allow for rich, personal answers and to enable the participant to add information he or she would like to include about the wildlife program (post-program survey) as well as measure past wildlife program experience. The method of using a pre- and post-program survey was adapted from Bixby, Carnes, and Church (2010) and Stanford (2014). Pictures were included of each of the animals that were going to be discussed during the program. The pictures were included so that students that may have never previously seen or learned about these animals would be able to answer the question "Which of these do you like most? Why?" at the end of the pre-program survey.

Data Analysis

Quantitative data analysis. Three sets of data were analyzed to best answer the research question. First, the survey results comparing pre- and post-tests of individual participants; second, an analysis between the treatment and control groups; and finally, between the experienced and inexperienced groups. The within-group (individual participant) data was analyzed using the number of correct answers out of the ten questions in the multiple-choice section of the survey. A paired sample t-test (Easton & McColl, 1997) was used to determine if the amount of knowledge gain seen by each participant was significant in both the treatment and wait-listed control independently. An ANCOVA (Rausch, Maxwell, & Kelley, 2003) was used to compare the amount of knowledge gain seen by each group: treatment and wait-listed control, experienced and inexperienced.

A paired sample t-test allowed for comparison of the data that was collected in the pre-program surveys with the data from the post-program surveys of individuals. This test analyzed for significant difference between the outcomes of the pre- and post-program surveys of each individual participant (Easton & McColl, 1997), and determined if there was any biology knowledge gained by each individual as the result of the proposed wildlife program.

An Analysis of Covariance, ANCOVA model, controls for differences seen in the pre-survey results to explain post-survey results (Rausch et al., 2003). This method allowed for the data collected from each group to be compared while accounting for variables that are not important in the analysis of knowledge gain. This statistical model was used to determine if there was any difference in knowledge gain between treatment group and the control group, as well as between the experienced and inexperienced groups.

Data analysis was performed using the Statistical Package for the Social Science (SPSS) using both a one-way ANCOVA for within group and between group data, and a paired sample t-test for participant data. The independent variables were the type of program each class received (live animal or animal artifact program) and the county location of each school (experienced or inexperienced group). The dependent variables were the results of the pre-program and post-program survey.

Qualitative data analysis. The qualitative data collected from the knowledge surveys were read for emergent themes by the primary researcher. The primary researcher developed a code list for the transcripts based on the themes seen in the data. An inter-coder was provided with 100% of the data to code using the code list established by the primary researcher resulting in an inter-coder reliability score of 82% (Creswell, 2014). One-hundred percent of the data was provided to the inter-coder because of the small size of the data sets. The transcripts were

separated from the surveys and entered into Microsoft Excel for organization. This coding and inter-coding process attempted to address any pre-existing potential for bias by the primary researcher. Responses with less than 10% frequency of mention were not included in the results because of a lack of sufficient support.

CHAPTER 4.

RESULTS

Participants were given the pre-program survey immediately prior to the program and the post-program survey immediately after the wildlife program. The total time between surveys was a maximum of one hour, which was the length of the wildlife program. Each multiple-choice question was read aloud for all classes and the participants chose their answer. The questions answered "I don't know" were considered wrong answers when scores were calculated. When the data analyses were run, there was only a slight difference between the results of number correct out of attempted questions (omitting "I don't know" answers as questions that were not attempted) and the results of number correct out of ten.

Quantitative Results

Table 1 summarizes the Paired-sample T-test analysis of comparisons between the number correct out of ten on the pre- and post-program surveys. The treatment group received the live animal program while the control group received the animal artifact program. Both groups showed a significant amount of knowledge gain (*p* value: .000) from the pre-program survey to the post-program survey, see Table 1. The change in mean score from pre- to post-program survey was greater in the treatment group, which shows a larger increase in knowledge. Table 2 shows the pre- and post-score means for the experienced and inexperienced groups, which demonstrated higher scores by the experienced group participants on both surveys.

Table 1

Paired Sample T-test of the Treatment and Control Groups

Group	**Pre-score M**	**Post-score M**	**df**	**t**	***p*-value**
Treatment	.4561	.8982	56	-16.546	.000
Control	.4594	.857	100	-20.796	.000

Note: df= degrees of freedom.

Table 2

Pre- and Post-score Means of the Experienced and Inexperienced Groups

Group	**Pre-score M**	**Post-score M**
Experienced	.4966	.9133
Inexperienced	.4475	.8537

Analysis of Covariance (ANCOVA) were run on between-group data, treatment versus control group and experienced versus inexperienced group. Each ANCOVA statistical test run controlled for the pre-score values, which demonstrated the differences in the amount of knowledge gained in each group. Comparisons between the treatment and control group showed only marginally significant differences, $F(1,158)=3.52$, p value: .06, between the amount of knowledge gained in each group. This result confirmed that both groups gained a significant amount of knowledge but the treatment group gained slightly more knowledge than the control group. Results are shown in Table 3.

Table 3

ANCOVA Results Comparing Knowledge Gain of Treatment and Control groups

	df	**MS**	**F**	***p*-Value**
Pre-score	1	.285	15.939	.000
Treatment v. Control	1	.063	3.521	**.062**
Error	155	.016		
Total	158			

Note: Marginally significant result in boldface.

When comparing the amount of knowledge gained by School A, experienced group, with School C, inexperienced group, the analysis showed a significant difference, $F(1,102)=4.56$, p value: .03. School A is located in County A and receives wildlife programs in almost every class every year while School C rarely, or never, receives wildlife programs. Table 4 shows the results of the ANCOVA analysis between these schools. Figure 1, on page 31, shows the amount of past experience that each class had before the study. The table in Appendix F summarizes the places participants have participated in wildlife programs prior to the study. There were no significant differences between School A and School D when analyses were conducted.

Table 4

ANCOVA Results Comparing Knowledge Gain of School A (experienced group) and School C (inexperienced group)

	df	**MS**	**F**	***p*-Value**
Pre-score	1	.202	9.451	.003
Experience	1	.098	4.565	**.035**
Error	99	.021		
Total	102			

Note: Significant result in boldface.

School C participants were broken up into two fourth grade and two fifth grade classes. One class from each grade was placed into the treatment and control group, resulting in a simple comparison between the groups because each included one-fourth and one fifth grade class. Table 5 shows the ANCOVA analyses conducted between the treatment and control group within School C. There was a very significant difference between the amount of knowledge gained in each group within School C, $F(1,55)=24.987$, *p* value: .00, despite only marginally significant differences between the treatment and control groups as a whole.

Table 5

ANCOVA Results Comparing Knowledge Gain of Treatment and Control group within School C

	df	**MS**	**F**	***p*-Value**
Pre-score	1	.122	9.477	.003
Treatment v. Control	1	.321	24.987	**.000**
Error	52	.013		
Total	55			

Note: Significant result in boldface.

Participants were asked in Question 2 of the pre-program survey if they had previously participated in a wildlife program. As expected, School A had the highest level of past experience out of the schools included in this study, see Figure 1. Schools C and D had more than expected past experience with wildlife programs with all classes in School C reporting 50% or more students had participated in wildlife programs before the study. Figure 1 shows the results of each class's level of past experience and the Table located in Appendix F summarizes the locations of past wildlife program experiences.

Figure 1 Responses to Question: Have you every participated in a wildlife program before?

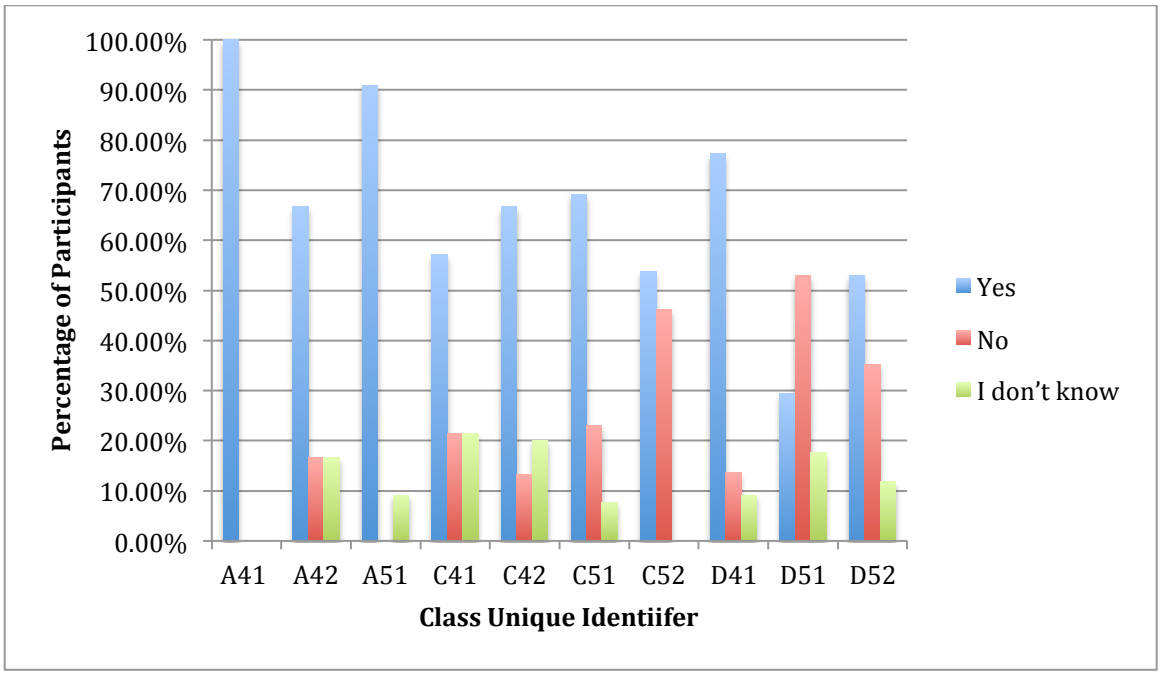

Figure 1. Participants were asked during the pre-program survey if they have participated in a wildlife program before this program. The Class Unique Identifier shows which county, County A=A and County B= C/D, and the grade level, 4 or 5, of each class included.

Qualitative Results

The open-ended questions included in the survey were analyzed as a separate part of the study, but the results were compared to the quantitative results. The responses were read for big ideas, and the same, or near the same, codes were used throughout the three sets of data, and finally codes were organized into themes. Themes that emerged from the data included emotional response/love, learning about the animals, touch/feel the animals, seeing the animals, and animal artifacts.

Question 2 asked participants to share their favorite part of the wildlife program and was read for themes as one set of data. 43% of participants in the treatment group mentioned that touching or feeling the animals was their favorite part of the program. This touching/feeling

response was mentioned by 11% of control group participants despite being offered the opportunity to touch or feel animal artifacts throughout the program. Learning about the animals in general, or listing a specific fact they learned about the animals, was mentioned by 23% of control group participants as their favorite part of the program, which is more than other responses seen in the data set. Table 6 summarizes the results comparing the treatment and control groups, and Table 7 separates the results by school for comparison.

Table 6

Responses to Question 2: What was your favorite part of the Wildlife Program?

	Frequency of Mention		
Favorite Part	**Treatment Group *n*=57**	**Control Group *n*=101**	**Example Quotes**
Feel or Touch	25 (43%)	12 (11%)	My favorite part of the wildlife program was the hands on part, because you got to see what certain parts of an animal body looked like what. (11 year old girl)
A Specific Animal	18 (31%)	13 (12%)	Owl because they are good at hunting at night and good at seeing and hearing (9 year old girl)
Learning Facts about the Animals	15 (26%)	24 (23%)	I liked when she was talking about the feathers and how one made more noise and one made not much at all (9 year old girl)
Seeing the Animals	11 (19%)	9 (8%)	I liked seeing the hawk artifacts because I personally liked to learn about that a lot (10 year old girl)
Emotional Response, Love	5 (8%)	14 (13%)	Mine was learning about the blue jay because I love blue and birds and there fascinating (10 year old girl)
Touching Artifacts	2 (3%)	12 (11%)	My favorite part was getting to touch the artifacts because I like hands on (10 year old boy)
Artifacts	1 (1%)	13 (12%)	My favorite part was the skulls because its not something you see everyday (9 year old girl)

Note: Not all responses were included and some were labeled with multiple codes. Therefore, totals do not equal total participants. Spelling was corrected for readability in quotes but grammar was not corrected. Quotes are from control group participants for consistency of participant experience in this table.

Table 7

Responses to Question 2: What was your favorite part of the Wildlife Program? Separated by School

	Frequency of Mention		
Favorite Part	**School A** ***n*=47**	**School C** ***n*=55**	**School D** ***n*=56**
Feel or Touch	12 (25%)	13 (24%)	10 (18%)
A Specific Animal	8 (17%)	14 (25%)	11 (19%)
Learning Facts about the Animals	8 (17%)	16 (29%)	18 (32%)
Seeing the Animals	8 (17%)	7 (13%)	3 (5%)
Emotional Response, Love	6 (13%)	5 (9%)	10 (18%)
Touching Artifacts	5 (11%)	4 (7%)	3 (5%)
Artifacts	3 (6%)	4 (7%)	9 (16%)

Note: Not all responses were included and some were labeled with multiple codes. Therefore, totals do not equal total participants.

Responses to Questions 4 and 6, which asked about things that helped the participants learn, are summarized in Table 8. More than half of the participants in both the treatment and control groups responded with a learn response. This response was characterized by the mention of a fact the participant learned during the program. Of the treatment group participants, 19% mentioned that seeing or touching a specific animal helped him or her to learn more during the program while 30% of control group participants mentioned that the animal artifacts were what helped them to learn. Some control group participants mentioned a specific artifact in their response, while others just mentioned the artifacts in general that helped them to learn. These questions were combined into one set of data because many students did not answer one or both

questions resulting in a fewer number of total responses and both questions asked for similar responses. Question 6 gave participants the opportunity to include more reactions to the wildlife program.

Table 8

Responses to Question 4: Was there anything that the instructor did during the Wildlife Program that most helped you learn? and Question 6: Please use the space below to say anything else about the Wildlife Program that helped you best learn about the animals.

	Frequency of Mention		
Helped You Learn	**Treatment Group *n*=57**	**Control Group *n*=101**	**Example Quotes**
Learn Specific Facts	33 (57%)	65 (64%)	She talked about all the different animals then asked us if we had any questions (9 year old girl)
Touching/ Seeing Specific Animals	11 (19%)	1 (1%)	She let us pet the corn snake, box turtle, and the opossum. Which helped me understand what the animals felt like (9 year old boy)
Artifacts	5 (8%)	31 (30%)	I loved to learn about the hawks feathers (11 year old boy)
Pictures	1 (1%)	13 (12%)	Something that the instructor did that help me to learn more about the animals was she showed how they catch their food/prey (11 year old girl)

Note: Not all responses were included and some were labeled with multiple codes. Therefore, totals do not equal total participants Spelling was corrected for readability in quotes but grammar was not corrected. Quotes are from treatment group participants for consistency of participant experience in this table.

Table 9 summarizes the "Why?" part of the responses to survey Question 10 which asked "Which animal is/was your favorite? Why?". Data from the multiple-choice favorite animal choice is included in Figure in Appendix E. In the pre-program survey, almost half of the

treatment group participants mentioned that the reason they chose an animal as their favorite was because it was cute or that they loved that species or individual animal, but that number fell in the post-program survey to only 33%. Control group participants mentioned a love/cute response to why they chose an animal as their favorite around the same frequency between the pre- and post-program survey. For the treatment group, the second most mentioned response, seeing or hearing the animals, jumped from 29% in the pre-program survey to 42% in the post-program survey as a result of experiencing the live animals in the program. Some students in both groups responded that the reason they chose an animal as their favorite was because of some past connection with that species in the pre-program survey. The number of participants that mentioned a past connection fell to almost none in the post-program survey, with frequencies of only 1% and 2%.

Table 9

Responses to Question 10: What is /was your favorite animal? Why?

Favorite Animal? Why?	Frequency of Mention: Treatment Group *n*=57 Pre	Treatment Group *n*=57 Post	Control Group *n*=101 Pre	Control Group *n*=101 Post	Example Quotes [a]
Love or Cute Emotional	27 (47%)	19 (33%)	39 (38%)	36 (35%)	They are cool to watch and they are cute (about box turtles) (10 year old boy)
See or Hear the Animals	20 (35%)	24 (42%)	30 (29%)	25 (24%)	I like red-tailed hawks are my favorite because they are really pretty animals (9 year old girl)
Learning about the Animals	17 (29%)	12 (21%)	27 (26%)	39 (38%)	Because I like to study turtles there very different then other animals (9 year old girl)
Past Connection with the Animals	12 (21%)	1 (1%)	18 (17%)	3 (2%)	I like turtles. When I go hiking I find a lot of them on the trail (9 year old boy)

Note: Not all responses were included and some were labeled with multiple codes. Therefore, totals do not equal total participants. Spelling was corrected for readability in quotes but grammar was not corrected.

[a] Example quotes are from pre-program survey responses from both treatment and control group because no participants had experienced a program at time of taking survey. The quotes answer the question "Which of these do you like most?" with a list of the animals that were going to be discussed during the program.

In response to Question 10 why participants chose a specific animal as their favorite, 44% of participants in the experienced group (County A, ***n***=47) mentioned an emotional/love/cute response in the pre-program surveys and 34% of participants in the post-program surveys. Also in the experienced group, 19% of participants mentioned a learn response in the pre-program surveys but that number jumped to 48% of participants in the post-program

surveys. Of the participants in the inexperienced group (County B, ***n***=111) 40% mentioned an emotional/love response in the pre-program surveys, but that number reduced to 35% of participants in the post-program surveys. These results were near the same between both the experienced and inexperienced group; both groups had high frequency of mentions for the emotional/love/cute response from Question 10. In contrast to the experienced group's higher frequency of mention for a learn response, 31% of the inexperienced group participants mentioned a see or hear response in the pre-program surveys and 38% of participants in the post-program surveys.

53% of the students changed their choice for favorite animal from the pre-program survey to the post-program survey after learning more about the different animals included in the program.

CHAPTER 5.

DISCUSSION AND RECOMMENDATIONS

The purpose of this study was to help address a gap in the literature by investigating the effectiveness live animals have on biology knowledge gain in fourth- and fifth-grade students. This study aimed to answer the research question "If wildlife education programs have an impact on biology knowledge gain, is that impact greater when live animals are used than when animal artifacts and pictures are used in programming?"

Discussion of Quantitative Results

This study showed that live animals do have an effect on how much knowledge students gain but there are many factors that influence the amount of knowledge gain, which is in agreement with other studies (Falk et al., 2007; Packer & Ballantyne, 2010). The treatment group did gain more knowledge than the control group, but the difference was not statistically significant because of the different levels of past experience in each class, as demonstrated by Figure 1. In agreement with Ewert and Sibthorp's (2009) study, the results of this study showed that past experience has a considerable impact on the outcome of a study. When comparing the School A (experienced group) with School C (inexperienced group), School A scored higher on the surveys than School C, which is directly linked to the higher amount of past experience with wildlife education programs in School A. The experienced group demonstrated greater knowledge gain in the surveys, and this finding was further supported by the ANCOVA results showing a statistically significant difference between the groups. However, when comparing School C with School D, there was no significant difference between the results of the surveys. This result is tied to the fact that School D had received some exposure to wildlife programs in the past while School C had very minimal exposure to wildlife educational programming.

Within School C, the two classes in the treatment group scored higher on the surveys showing greater biology knowledge gain, which is supported by the ANCOVA results seen in Table 5. This result seems to support that because School C has a lower level of past experience, the treatment group participants in that school were able to gain more knowledge with the presence of live animals when compared to the control group.

Discussion of Qualitative Results

The results of open ended Question 2, which asked about the participant's favorite part of the program, also supports the evidence that past experience changes the outcome of a study (Ewert & Sibthorp, 2009). School A participants mentioned feeling or touching the animals more than other responses while School C and D both had the highest mentions for learning about the animals. This result seems to indicate that because School A participants had more experience with these animals and knew more information about them, they were less interested in learning about the wildlife while many participants in Schools C and D were learning about these animals for the first time. Seen in Figure 1, over half of students in all School A classes had participated in a wildlife program prior to the study, while less than half of the students in classes in Schools C and D had past experience with wildlife programs. These results- participants with past experience not being as interested in learning about the animals- represent what seems to be a new finding not represented in the literature.

Importance of Live Animals

The results also agree with the literature that experiencing a live animal up close and personal has a much more profound effect on emotional connection and knowledge gain (Falk et al., 2007). More participants in the treatment group responded to Question 10 about why they chose an animal as their favorite with an emotional or love response than participants in the

control group. This result seems to suggest that the presence of the live animal rather than preserved static animal artifacts gave a better opportunity to connect emotionally with the animal. Responses from the control group were more evenly distributed among the different responses with the three highest being emotional, learning, and seeing the animals in pictures.

Experience of Touching

Other researchers have also concluded that the possibility of an emotional connection and direct contact with a live animal can lead to a change in attitude or increase in knowledge about that animal (Morgan & Gramann, 1989; Randler, Hummel, & Prokop, 2012; Schwartz, 2013; Stanford, 2014). Many of the students mentioned feeling or touching throughout the study and this part of the program was the favorite for many participants. Hands-on and direct contact with live animals has been shown to have a positive effect on students' empathy and compassion toward animals (Hummel & Rander, 2010; Lust, 2006; Uttley, 2013), which directly leads to behavior change and knowledge gain (Cox, 2013). The results of this study reinforce the importance of hands-on animal contact, in agreement with Stanford's (2014) study. The qualitative and quantitative results both seem to support the finding that the presence and opportunity to touch live animals leads to greater knowledge gain.

Wildlife Education

Perceived impacts of wildlife education identified by Schwartz (2014) were confirmed in this study including learners' gained knowledge, experience, and memories as a result of a wildlife education program. The more experienced students at School A had past experience and memories of the animals being presented, which led to the students being less interested in learning, and more interested in touching or feeling the animals. This study's results also support the anecdotal evidence identified by many wildlife educators that having the live animals

in the programs helps to create stronger connections between the knowledge and the animal. Wildlife education has a very important place in society as an educational field, as shown by the results of this study. The presence of a live animal that learners have a chance of seeing in their backyard creates a better connection between the learner and their natural community. Experiencing a live animal is a great memory that helps learners to remember information and create an emotional connection with the animal (Schwartz, 2013). This past experience can then create a scaffolding that new information and experienced can build on.

Limitations

In designing this study, the primary researcher took the appropriate steps to reduce bias by using suitable sampling techniques, establishing an inter-coder reliability of 82%, using a wait-listed control so all participants experienced live animals, and a large sample size for the region. Although validity of this study was ensured to a certain degree through the steps taken, several other factors could be threats to validity and trustworthiness. This study included three small schools in the rural Southern Appalachian Mountains, which limited the number and diversity of students included in the study. The limited number of participants may not adequately represent all fourth- and fifth grade students in North Carolina. Also, those students that did not participate or did not provide signed Parent/Guardian Consent forms may differ from those who participated in the study; 158 out of 193 possible students participated.

Data collected was self-reported and was collected in one day for each class. The validity of this study could have been improved if the researcher collected data over a longer time. Multiple days or weeks could have been included to determine retention of the knowledge gained, or the researcher could have used a delayed-post design to retest students' biology knowledge. In addition, the primary researcher conducted all wildlife programs for the

participants and human error- such as variances in additional information shared in each program related to questions asked by participants- created slight differences in each program given. Information covered in the program was much more diverse than the questions asked on the survey in order to prevent 'teaching to the test'. This could have been improved if the program was recorded, or if the students could have all been at the exact same program. The primary researcher also developed the survey instrument, as well as conducted the programs. This survey was not tested for validity and reliability before the study.

Finally, a Pilot Test was not utilized as planned because of difficulties in finding a class that would participate. Time constraints also made this difficult.

Recommendations for Further Research

This study could be replicated with the following recommended changes:

- Pilot Test the wildlife program prior to data collection
- Collect data from a wider sample of geographic locations and age groups
- Use a survey instrument that has valid and reliable psychometric properties
- Extend data collection time to include a delayed-post design that can determine how long participants retain the knowledge gained during the program
- Use an educator with past experience handling and educating about local wildlife, then have a separate independent researcher develop and conduct the surveys
- Compare survey results between different participant genders
- Utilize different kinds of animals to compare the amount of knowledge gained from programs featuring reptiles, birds, or mammals

Recommendations for Practice

Utilizing live animals in education can be an important component and has the potential to create lasting connections if presented correctly. Educators wishing to foster emotional connections with live animals should employ experiential education theories including hands-on and guided reflection experiences, as well as the holistic methods found in environmental education. Educators should also present the live animals in a way that allows for questions and interaction with the learners. This interaction allows the learners to make connections with previous experience and knowledge and gives them time to understand or comprehend the new information being shared. Wildlife educators should utilize educational methods that cater to as many different learner types as possible, including visual, auditory, kinesthetic, and more (Lord et al., 2004). Catering to the different learner types allows everyone in the audience to feel comfortable and able to learn.

Conclusion

Using live animals in education programming has a profound impact on learning that has yet to be fully explored. This study attempted to quantify the impact live animals had on biology knowledge gain and qualify those results with open-ended questions. The use of a mixed-methods approach allowed for comparisons and greater support for the presence of live animals in wildlife education. Past experience also has a significant impact on the amount of knowledge gained and the reactions participants have to the wildlife programs. The emotional connection participants can form with live animals seems to improve the amount of knowledge those participants gained. Wildlife educators have many successful methods of educating learners that have been proven successful in this study.

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APPENDIX A

PARENT/GUARDIAN CONSENT FORM

PARENT/LEGAL GUARDIAN PERMISSION FORM FOR CHILD'S RESEARCH PARTICIPATION

Study Title:
An Investigation of the Impact of Live Animals on Biology Knowledge Gain among Fourth- and Fifth-Grade Students

Principal Investigator: Lauren Lampley, a graduate student completing part of the requirements for a Master's of Science in Environmental Education from Montreat College

Your child is being asked to take part in a research study. This form has important information about the reason for doing this study, what we will ask your child to do, and the way we would like to use information about your child if you choose to allow your child to be in the study.

Why are you doing this study?
The purpose of the study is to further understand the effects that live animals have on biology knowledge gain as compared to programs without live animals. Your child is being asked to participate in a research study about possible knowledge gain resulting from a live animal or animal artifact wildlife education program. A wildlife education program consists of an educational experience focused on live animals or animal artifact with material covered in the program focused on these animals in the wild. The live animals being used in these programs include a Red-tailed Hawk, Eastern Screech Owl, Blue Jay, Virginia Opossum, Eastern Box Turtle, and a Corn Snake. The programs using animal artifacts will have preserved parts of animals that could not be saved and your child will have the option to touch or hold some of the artifacts such as feathers, feet, fur, etc.

What will my child be asked to do if my child participates in this study?
Your child will be asked to complete a short pre-program survey, participate in a wildlife education program, then complete a post-program survey. General demographic information will be requested from your child, which includes questions about gender, age, and name. Names are requested on the surveys only to connect the pre-program surveys with the post-program surveys and as soon as the connection between the documents can be made names will be omitted. Participation should take a maximum of two hours time during class time spread over at least one day including time for survey completion and program time. If your child is in one of the classes that has been chosen at random to receive a wildlife education program not using live animals, the time needed for this study will increase one hour as a second program will be given to these classes featuring live animals after the study is completed.

Optional Study Elements
Your child will have the option to physically touch the Virginia Opossum, Eastern Box Turtle, and the Corn Snake at the end of the wildlife education program or in the event of the animal

artifact Wildlife Program your child will have the option to touch or hold some of the preserved animals parts. Hand Sanitizer will be immediately administered in order to prevent the slight possibility of transmission of disease. Children and the general public touch these animals regularly and we have never had any illnesses as a result of this part of the program. Verbal consent will be gained from your child prior to touching of the animal.

What are the possible risks or discomforts to my child?

Despite the absence of problems in the past with this kind of wildlife education program, your child's participation in this study may involve a variety of risks. The following are those possible risks: exposure to diseases carried by wildlife, allergic reaction to live wildlife, rare chance of physical injury caused by live animals, emotional trauma if the child is afraid of one or more of the animals in the program, and/or an emotional reaction to seeing or touching preserved animals parts. ALL POSSIBLE SAFETY MEASURES WILL BE TAKEN TO ENSURE THE SAFETY OF YOUR CHILD AND EVERYONE INVOLVED IN THIS STUDY. With the permission of your child's teacher, parents will be allowed to attend the program if you choose to do so. The teacher and the primary researcher will be in the room the entire time the live animals and the animal artifacts are being handled or touched by the children or handled by the primary researcher. If your child has any allergies please list them in the space provided below.

What are the possible benefits for my child or others?

The possible benefits to your child from this study include the novel experience of being in close proximity to live wildlife, the opportunity to touch live wildlife in a controlled setting, and education regarding wildlife that are found in "your backyard" or in your region of North Carolina.

How will you protect the information you collect about my child, and how will that information be shared?

Results of this study may be used in publications and presentations, however your child's name or personal information will never be used. All forms will be secured in a locked cabinet and names will be omitted from the surveys as soon as a unique identifier can be applied to both surveys. The primary researcher will be the only person with access to the forms containing names before they are omitted.

Financial Information

Participation in this study will involve no cost to you or your child. Your child will not be paid for participating in this study

What are my child's rights as a research participant?

Participation in this study is voluntary. Your child may withdraw from this study at any time -- you and your child will not be penalized in any way or lose any sort of benefits for deciding to stop participation. If you and your child decide not to participate in this study, this will not

affect the relationship you and your child have with your child's school in any way. Your child's grades will not be affected if you choose not to let your child participate in this study.

If your child decides to withdraw from this study, the researcher will not use any information already collected from your child.

Who can I contact if I have questions or concerns about this research study?
If you or your child have any questions, you may contact the researcher, Lauren Lampley at llampley13@montreat.edu (864) 982-0119, or the Faculty Advisor for this study, Dr. Brad Daniel at bdaniel@montreat.edu.

The Institutional Review Board at Montreat College has approved this research study.
If you have any questions about your child's rights as a participant in this research, you can contact the following office at Montreat College:

Montreat College Outdoor Education
P.O. Box 809
310 Gaither Circle
Montreat, NC 28757

Or email Dr. Brad Daniel at bdaniel@montreat.edu

Parent/Legal Guardian Permission for Child's Participation in Research

I have read this form, and the research study has been explained in writing to me. I have been given the means to ask questions and I have been told whom to contact. By signing this form, I give permission for my child to participate in the research study described above and will receive a copy of this Parental Permission form after I sign it, if requested.

_____ _____
Parent/Legal Guardian's Name (printed) and Signature Date

_____
Child's Name

_____
Child's Allergies, if any

Parents, please be aware that under the Protection of Pupils Rights Act (20 U.S.C. Section 1232(c)(1)(A)), you have the right to review a copy of the questions asked or materials that will be used with students. If you would like to do so, you should contact Lauren Lampley at llampley13@montreat.edu to obtain a copy of the questions or materials.

APPENDIX B

SAMPLE TEACHER INTERVIEW SCRIPT

Interview Script for Teachers of Classes Involved in this Study.

The interviews will be conducted through email, phone or in person. In-person and phone interviews will be recorded using a voice recorder and transcribed by the primary researcher. Email correspondence will be saved to a document off-line for reference.

Introduction: *Hi, Mr./Ms./Mrs. (teacher name). My name is Lauren Lampley. I am a graduate student in the Master's of Science in Environmental Education at Montreat College. I am conducting a study on what kinds of impact wildlife education programs have on biology knowledge gain in 4th and 5th grade students. I will ask you some questions regarding your class, students, lesson plans, and curriculum and you have the option to decline to answer any of these questions. I am asking these questions in order to learn a little more about each class and what the students already know about wildlife biology. I would like permission to record this in person or phone conversation, email correspondence will automatically be saved. I would also like to use some of your class time for this study for program time and completion of pre-program and post-program surveys. The programs will be an hour long and I estimate around 30 minutes for each survey to be completed. The programs have been designed to apply to the NC Standards for Science as much as possible by meeting the standards for studying "animal adaptations".*

Question 1: *What grade do you teach and at what school?*

Question 2: *How many students are in your class or classes?*

Question 3: *These programs have the potential to be catered to many different learning styles and adapted to meet the needs of many different abilities. Do any of your students have mental or physical disabilities or have severe learning difficulties? If so, please explain how you meet his/her needs during class, and how I could possibly meet his/her needs during my program(s).*

Question 4: *At the end of the program, there will be the option for the students to touch a live animal or some animal artifacts, which will require sanitizing of the students' hands to reduce the possibility of disease transmission. There has never been an issue in the past, but as of today do know if any of your students have allergies to animals (birds, opossum) or hand sanitizer? Please explain any known allergies, if possible.*

Question 5: *In order to understand your class and the attention level of the students participating in my study, I would like to know a little more about how the daily schedule works. Do you teach all subjects to your class or do your students move from teacher to teacher for each subject?*

Question 6: *This Wildlife Program will be covering specific information regarding local wildlife, habitat, ecosystems, predation/prey, adaptations, and the food web. Do your lesson plans before or after the program cover this material?*

Question 7: *I would like to understand a little more about the students' current knowledge of wildlife and what they will learn in the future during school. Do you know what the students learned last year in school? What do you plan to teach about wildlife this year?*

Question 8: *This wildlife program will make local connections for the students and is focusing on animals that they have already seen or have the potential to see in the wild at home or school. If you are covering material involving local wildlife, what kinds of local connections will you make during your class?*

Question 9: *I will be covering information about local wildlife (hawks, owls, snakes, turtles, opossums, and Blue Jays) such as: food choices of these animals, where they live, when each species is active, special adaptations each species has for survival, and where each animal falls in the food web. After my program, will you review the information with the students or use it in your teaching?*

Question 10: *Is there anything else you would like to share about your class, lesson plans, or curriculum?*

Question 11: *Do you have any questions regarding my study?*

APPENDIX C

PRE-PROGRAM SURVEY INSTRUMENT

Biology Knowledge Survey

Name: _____ Date: _____
(Your name is included in this survey for data collection and will be removed after data collection is complete)

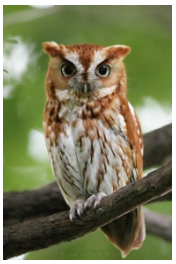
The purpose of this survey is to measure how much you know about wildlife before the wildlife program. This survey will not be graded.

Part I: Read each question carefully and choose the answer that you believe is correct. After choosing your answer print the letter of your choice on the line at the beginning of the question. It is better to answer "I don't know" than to guess.

1. _____ When are Red-tailed Hawks awake?

   A. Daytime
   B. Nighttime
   C. I don't know

2. _____ When are Eastern Screech-Owls awake?



   A. Daytime
   B. Nighttime
   C. I don't know

3. _____ Which is the favorite food of Red-tailed Hawks?
   A. Squirrels
   B. Mice
   C. Snakes
   D. I don't know

4. _____ What do Eastern Box Turtles eat?

   A. Insects
   B. Plants
   C. Fruit
   D. All of the above
   E. I don't know

5. _____ Which is the favorite food of Blue Jays?

   A. Insects
   B. Plants
   C. Acorns
   D. Fruit
   E. I don't know

6. _____ What do Virginia Opossums eat?

   A. Insects
   B. Mice
   C. Fruit
   D. All of the above
   E. I don't know

7. _____ What do Corn Snakes eat?

   A. Mice
   B. Birds
   C. Frogs
   D. I don't know

8. _____ Where do Red-tailed Hawks typically live?
    A. In Fields
    B. In Forests
    C. Near lakes and rivers
    D. I don't know

9. _____ Where do Blue Jays typically live?
    A. In forests with lots of pine trees
    B. In fields lots of grass
    C. In forests with lots of oak trees
    D. I don't know

10. _____ What do Virginia Opossums use their tail for?
    A. Balance while climbing
    B. Pulling leaves/straw into their den
    C. Hanging upside down
    D. I don't know

11. _____ Which of these do you like most?
    A. Red-tailed Hawk
    B. Blue Jay
    C. Eastern Screech-Owl
    D. Corn Snake
    E. Eastern Box Turtle
    F. Virginia Opossum

    Why?

Part II Directions: Read each question carefully.

1. How old are you? _____ Are you a boy or a girl? _____

2. A Wildlife Program is a program that involves live wildlife (hawks, owls, opossums, snakes, etc.) or animal artifacts (snake skins, feathers, etc.). Wildlife Programs talk about where these animals live, what they eat, and other information about wildlife. Have you ever participated in a wildlife program?

    a. Yes
    b. No
    c. I don't know

    If you answered Yes, tell about it: Do you remember where it was?

    Check the box where you participated in a Wildlife Program.

    □ Here at school
    □ At a festival. Which festival?: _____
    □ At the May Wildlife Rehabilitation Center
    □ Other: _____

    If you remember what kinds of animals you saw, can you list them?

    What did you learn from the Wildlife Program?

APPENDIX D

POST-PROGRAM SURVEY INSTRUMENT

Biology Knowledge Post-Survey

Name: _____ Date: _____ (Your name is included in this survey for data collection and will be removed after data collection is complete)

The purpose of this survey is to measure how much you know about wildlife after the Wildlife Program. This survey will not be graded.

Part I: Read each question carefully and choose the answer that you believe is correct. After choosing your answer print the letter of your choice on the line at the beginning of the question. It is better to answer "I don't know" than to guess.

1. _____ When are Red-tailed Hawks awake?
   A. Daytime
   B. Nighttime
   C. I don't know

2. _____ When are Eastern Screech-Owls awake?
   A. Daytime
   B. Nighttime
   C. I don't know

3. _____ Which is the favorite food of Red-tailed Hawks?
   A. Squirrels
   B. Mice
   C. Snakes
   D. I don't know

4. _____ What do Eastern Box Turtles eat?

   A. Insects
   B. Plants
   C. Fruit
   D. All of the above
   E. I don't know

5. _____ Which is the favorite food of Blue Jays?

   A. Insects
   B. Plants
   C. Acorns
   D. Fruit
   E. I don't know

6. _____ What do Virginia Opossums eat?

   A. Insects
   B. Mice
   C. Fruit
   D. All of the above
   E. I don't know

7. _____ What do Corn Snakes eat?

   A. Mice
   B. Birds
   C. Frogs
   D. I don't know

8. _____ Where do Red-tailed hawks typically live?
    A. In fields
    B. In forests
    C. Near lakes and rivers
    D. I don't know

9. _____ Where do Blue Jays typically live?
    A. In forests with lots of pine trees
    B. In fields lots of grass
    C. In forests with lots of oak trees
    D. I don't know

10. _____ What do Virginia Opossums use their tail for?
    A. Balance while climbing
    B. Pulling leaves/straw into their den
    C. Hanging upside down
    D. I don't know

11. _____ Which of these was your favorite from the program?
    A. Red-tailed Hawk
    B. Blue Jay
    C. Eastern Screech-Owl
    D. Corn Snake
    E. Eastern Box Turtle
    F. Virginia Opossum

    Why?

Part II: Read each question carefully and answer to the best of your ability.

1. How old are you? _____ Are you a boy or a girl? _____
2. What was your favorite part of this Wildlife Program? Please explain why.

3. What was your least favorite part of this Wildlife Program? Please explain why.

4. Was there anything that the instructor did during the Wildlife Program that most helped you learn about a particular animal?

5. Did you touch the live animals or animal artifacts? Check the ones you touched.
   - □ Red-tailed Hawk feather
   - □ Eastern-screech Owl feather
   - □ Box Turtle or shell
   - □ Corn Snake or snake shed
   - □ Opossum or opossum fur

   If you chose not to touch one or more of these, please explain why.

6. Please use the space below to say anything else about the Wildlife Program that helped you best learn about the animals.

APPENDIX E

FAVORITE ANIMAL CHOICES BY PARTICIPANTS

Figure: Participants' Choices for Favorite Animal on Both Pre- and Post-program Survey

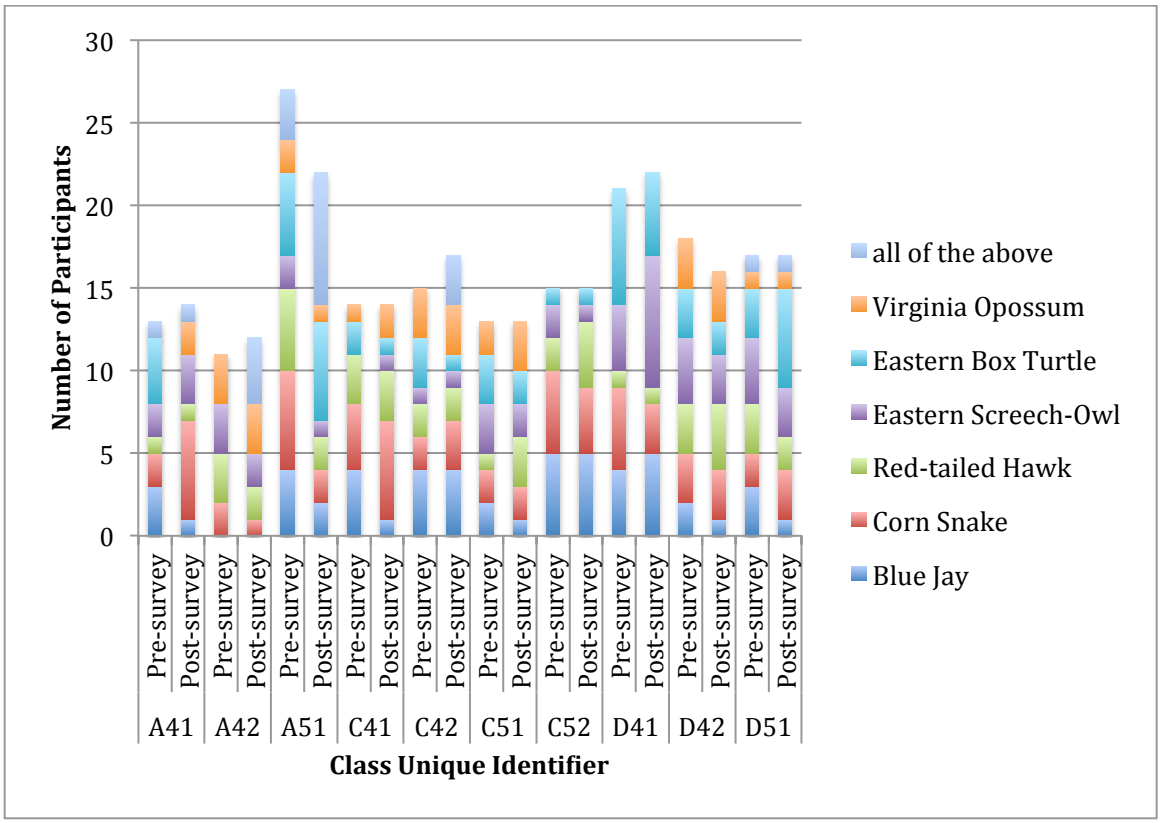


Figure. Comparison of how many students chose each animal as their favorite from pre-program to post-program survey. Many students chose more than one animal as their favorite therefore the number of responses may fluctuate between pre- and post-program surveys even within the same class.

APPENDIX F

LOCATIONS OF PREVIOUS WILDLIFE PROGRAM EXPERIENCE

Table. Locations where students have participated in wildlife programs previously

Location	**County A** (***n***=47)	**County B** (***n***=111)
At School	67%	9%
May Wildlife Rehabilitation Center	21%	5%
Grandfather Mountain	10%	7%
A Festival	2%	5%
Greensboro Science Center	-	9%
Total	89%, 42 students out of 47	35%, 39 students out of 111