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Using Music and Storytelling as Strategies for Conservation Education

Frances Hincks

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Certificate of Approval

Using Music and Storytelling as Strategies for Conservation Education

Frances Hincks
May 2023

Approved to fulfill the
requirements of HON 437

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Department of Biological Sciences

Approved to fulfill the
Honors Thesis requirement
of the Murray State Honors
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Using Music and Storytelling as Strategies for Conservation Education

Submitted in partial fulfillment
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ABSTRACT

Given the frequently negative effects each person imposes on their environment (e.g., resource consumption, use of private and public land, and waste production), the public needs to be included in conservation messaging to sustain a healthy, functioning planet. People are generally not informed about conservation topics, which creates difficulties in creating a conservation mindset. Moreover, there is a disconnect between conservation research and presenting conservation related topics to the public in a coherent, accessible format. Thus, conservation education messaging strategies need to be evaluated to determine which are most effective. The objective of this research was to determine the effectiveness of using different strategies related to messaging format and music to teach conservation topics. Specifically, I used a 2 x 2 factorial design with messaging type (traditional lecture versus storytelling) and song inclusion (included or not) as factors and taught four sections of sixth or seventh grade students about invasive species at two different schools (n = 2 per treatment combination; 8 total sections). A pre-survey was given to the students before the lesson to determine their prior knowledge and perceptions of invasive plants. Following the pre-survey, the lesson about invasive plants was completed. Additionally, a separate survey was given to students to assess how they felt about the messaging strategy used. The surveys were analyzed to measure the effectiveness of messaging type and the use of music on student learning gains. The lecture lesson was best for the students with no prior knowledge of invasive species while learning gains were greatest with the story + song lesson for students with prior knowledge of invasive species. The students' enjoyment of each of the lesson types did not differ, though males enjoyed all lesson types less than females. Ultimately, a combined messaging strategy approach to teaching conservation topics such as invasive plants may be most effective to student learning. My study

will ultimately contribute to our understanding of how to communicate conservation messages to middle school aged children.

TABLE OF CONTENTS

Acknowledgements	vi
Abstract	Error! Bookmark not defined.
List of Illustrations	Error! Bookmark not defined.
Introduction	1
Methods	3
Results	7
Discussion	11
Literature Cited	16
Appendix A. The Invasive Plant Lecture	18
Appendix B The Invasive Plant Story Slides and Story	20
Appendix C The Invasive Species Song	26
Appendix D Part I Pre- and Post- Survey	27
Appendix E Survey Part II	29
Appendix F Survey Part III	31

LIST OF ILLUSTRATIONS

Figure 1. The level of enjoyment (1 - 5 with 5 being the greatest) for each lesson type and gender.....8

Figure 2. The change in male and female students’ perceived knowledge of invasive species pre- and post-lesson for each lesson type.9

Figure 3. The change in students’ invasive species knowledge pre- and post-lesson for each lesson type based on the number of words written when asked to write about what they knew about invasive species.10

Figure 4. Change in the number of invasive plant species known for each lesson type.....11

INTRODUCTION

Conservation efforts will not be successful without the support of the public. For the public to support conservation, they need to be made aware of the problems the environment is facing (Xue-Hong et al., 2016). While the public's understanding is critical, conservation information is not always disseminated properly. Scientists do not always have the resources to share their findings with the public, and a connection between science and the public is lost (Brewer 2002). Public outreach events at nature stations, parks, and zoos need constant development to reach multiple audiences in a variety of ways (Nygren 2018). Even within universities, conservation education needs improvement (Ryan and Campa 1998). To improve accessibility of conservation information, messaging strategies need to be evaluated and improved.

Middle school students are an important audience to reach with conservation messaging because they have just reached an age where they are likely considering future career options and forming their world views, and they are being taught career readiness within their classrooms (KDE 2022). If they can be reached with conservation messages, they may gain an interest in conservation jobs, volunteering with conservation related organizations, or supporting conservation efforts that are needed to sustain our natural resources in other ways. Middle school students are also likely to share what they learn in school with their parents (Grodzinska-Jurczak et al., 2010). Thus, parents of middle school students may be inspired to participate in conservation as well.

During middle school, it can be difficult for students to stay motivated and engaged with their classroom learning, which is why teaching strategies should be improved (McCammon,

2008). Storytelling as a teaching strategy can improve engagement and increase learning of conservation topics (Fernandez-Llamazares and Cabeza 2017). Additionally, most middle school students listen to music outside of the classroom, making music another potential tool that can be used to engage students in their learning (McCammon, 2008). Teachers have successfully used music in their classrooms to teach core curriculum subjects (Governor et al. 2013). Yoon and Kim (2017) demonstrated that student learning gains and positive attitudes towards science-related topics increased when song was incorporated into the classroom. Students do not only become more engaged and motivated when music is incorporated; they also retain knowledge better and score higher on tests (Hadi 2019). Thus, if storytelling and/or music are used in the classroom to implement conservation topics, middle school students may have more positive mindsets towards conservation and retain what they learn better (Yoon and Kim 2017).

Despite the potential of storytelling and music to increase student engagement and motivation, to our knowledge, no studies have considered the effects of using music or storytelling to improve conservation messaging outcomes. Moreover, messaging strategies should be evaluated to determine what is most effective for the group they are being presented to (Thomas et al. 2019). Thus, the objective of my research was to assess the effects of using different teaching formats, including traditional lecturing and storytelling, and music on the knowledge acquisition and short-term retention of information related to a conservation related issue in middle school students. I hypothesized that music would increase learning gains associated with a conservation related topic in middle school students and that these increases would be greatest with storytelling. My study will fill a knowledge gap in our understanding of how to best teach middle school aged students about conservation related topics. Though my study is focused on the topic of invasive species, if the incorporation of music and storytelling

into teaching this content improves student knowledge, changes their perceptions, and/or motivates them to want to learn more and/or be involved, this would support the incorporation of storytelling and music into teaching multiple topics to middle school aged children.

METHODS

Study Locations

Study participants included sixth and seventh grade students at two middle schools: Calloway County Middle School and Graves County Middle School. These middle schools are near Murray State and composed of students living in more rural environments. Four class sections of students were taught at each school.

Study Participants

Sixth and seventh grade students were chosen for this study because they are at an age where they have learned curriculum about the environment and ecosystems in their regular class settings (KDE 2015). Moreover, they typically learn and retain more in-depth material compared to elementary aged students.

Messaging Strategies

Two different messaging strategies were used in this study: lecture and storytelling. I used a 2 x 2 factorial design with messaging type (traditional lecture versus storytelling) and song inclusion (included or not) as factors such that students were presented lessons in one of four formats; lecture with no song (n = 69), lecture + song (n = 34), storytelling with no song (n = 43), and storytelling with song (n = 46). The classes were assigned to a particular treatment with a random number generator to minimize the effects of time of the day on the enjoyment or the learning gains associated with each lesson type.

Lesson Topic

Each lesson included information describing what invasive species are, their effects on the environment, and how to mitigate them. The lessons were written to present the information at the audience's level of understanding. The subject of invasive plants is pertinent as they are an increasing problem nationally and globally. Specifically, invasive plants negatively influence the environment (e.g. taking space, water, and sunlight from native plants, taking away resources from native wildlife, and decreasing biodiversity) and humans (e.g. economic loss and land degradation) (Kelley et al. 2006). Despite these negative consequences, invasive plants are still transported and planted because of a lack of education. If the public can be reached about the negative effects of invasive plants through conservation education in memorable, dynamic ways, this could aid in conservation efforts (Colton and Alpert 1998).

Lesson Description

The lecture lesson (Appendix A) and story lesson (Appendix B) were both created for this study. The purpose of the lecture was to introduce the topic of invasive plants and how they have changed native ecosystems and to promote conservation efforts to restore native ecosystems. Keywords highlighted throughout the lecture for the students to learn and remember were invasive, native, ecosystem, and conservation. During the lecture, I defined native, non-native, and invasive plants and described how each interacted with the rest of the ecosystem. I explained how invasive plants cause harm to the ecosystem because they use up resources that are used by native plants such as space, water, and sunlight. During the lecture, I also explained that invasive plants rapidly spread and grow and provided examples of invasive plants in western Kentucky. I concluded the lecture with a description of how to remove invasive plants to conserve native plants and thus the rest of the ecosystem. A visual aid, which was a PowerPoint

presentation with pictures and descriptive text, was used to present the lecture (Appendix A). The presentation was 10 slides in length and lasted approximately 8 minutes.

The story consisted of the same main ideas as the lecture with the same objectives and keywords included within the story for the students to learn. To make the story more relevant, the characters in the story were personified tree characters in middle school. The two main characters of the story were named Lina Sumac and Annie Stinktree, which were the native and invasive plant species mentioned in the lecture presentation, respectively. The other invasive species provided in the lecture presentation were also mentioned in the story. The story contained a visual aid with a PowerPoint consisting of 10 slides and included images of the characters throughout the slides (Appendix B). The story lasted about 8 minutes when read out loud.

The song (Appendix C) covered the basic themes of invasive plants mentioned in both the lecture lesson and the story lesson presentations. It was projected for the students to be able to read the lyrics and sing along. I sang the song to the students, and they chose to sing along. The song was presented and sung once if it was included in the treatment.

Data Collection

Before the lesson was taught, the students took a pre-survey that evaluated their prior knowledge of invasive plants. This pre-survey included two parts. The goal of part I was to obtain information on student knowledge of invasive plants before the lecture that could be compared to post-lecture knowledge (Appendix D). This information was obtained using open-ended responses and was given before part II so questions that mentioned invasive species within part II did not bias their answers to part I. Students received part II immediately after they received part I (Appendix E). Part II did not use open-ended responses and instead largely asked

students to consider their understanding of or feelings towards certain topics on a scale. Some questions related to their knowledge (or perceived knowledge: Question 1) on invasive species, while others were asked to collect information on student characteristics that could influence results (e.g., gender and how they view the natural environment and music). Students were timed and given 10 minutes to complete part I but did not receive a time limit for part II.

After the lesson was completed, the students immediately took a post-survey. Post-survey part I was the same as pre-survey part I, but they were not asked the question about where they have heard about invasive species before. Following the 10 minutes given to complete part I, students were given part II. Part II was the same survey they were given pre-survey. Part III was only given post-lesson to assess the students' enjoyment of the lesson (i.e. how engaging they thought the lesson was) (Appendix F).

Though some questions on the surveys were written by me, many of them were adapted from Oxley et al. (2016) and Pinkerton et al. (2019). Those that were original were written to be similar to the survey tool written by Oxley et al. (2016). Thus, there was already good support for the use of the questions on this survey for this study. The survey was approved by the Murray State University Institutional Review Board (IRB #23-104) and informed consent forms were completed by all students involved (Appendix G).

Data Analysis

For my honors thesis, I analyzed a subset of questions within each survey and responses to the remainder of the survey will be recorded and analyzed in the future. In survey Part I, I counted the number of words each student wrote related to what they knew about invasive species and the number of specific invasive species they indicated they knew. The number of words did not always correspond to how accurate the information written was. To account for

this, I counted the number of words that were correct and relevant. For example, if a student wrote the words, “I don’t know” for their answer, I counted the number of words as 0 instead of 3. Similarly, if a student wrote the words, “An invasive species is a species that has a population that is going extinct”, I counted the number of words as 0 instead of 14 because the information is incorrect. For part II, each student’s response to the first multiple-choice question and their scale responses for each question were recorded along with their gender. For part III, the scale responses related to each student’s enjoyment of the lesson were recorded.

Prior to analysis, I calculated the difference in the number of words students wrote about invasive species (part I), the number of invasive species students knew (part I), and how they ranked their understanding of invasive species (question 1 in part II) pre- and post-survey. I then assessed the effects of messaging format (lecture versus storytelling), song inclusion (included or not), and gender on the calculated differences in each metric and how they ranked their level of enjoyment of the presentation (Part III Question 1) using general linear mixed models. The school was included as a random variable to account for non-independence of samples within each school. The influence of prior knowledge on each metric was evaluated using a generalized linear mixed model with a binomial link and if a difference was found ($P < 0.05$) data were analyzed separately for each metric based on if students had prior knowledge of invasive species or not. Establishment of prior knowledge was based on their responses to question 1 in part I of the survey.

RESULTS

I found that females enjoyed the presentations more than males ($b = -0.44$, S.E. = 0.12, $t_{171} = -3.59$, $P = 0.0004$), regardless of lesson type (Figure 1). There was no difference in enjoyment of each of the lesson types for males or females ($P > 0.05$).

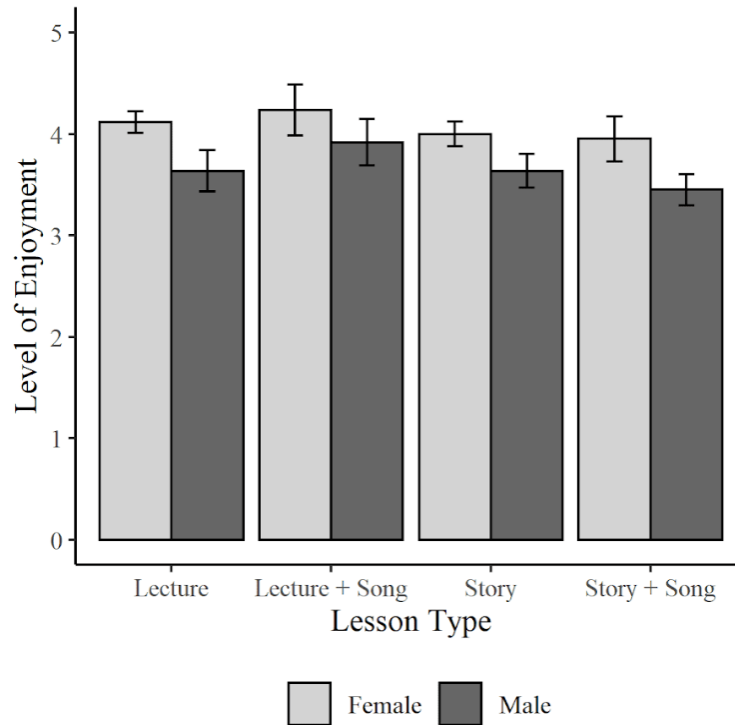


Figure 1. The level of enjoyment (1 - 5 with 5 being the greatest) for each lesson type and gender.

For females, there was a lower perceived increase in knowledge (survey part II question 1) with the story + song lesson compared to the lecture ($b = -0.37$, S.E. = 0.18, $t_{87} = -2.00$, $P = 0.049$) and lecture + song ($b = -0.46$, S.E. = 0.22, $t_{87} = -2.09$, $P = 0.04$) lessons (Figure 2). However, a female student's perceived increase in knowledge did not vary between the story + song lesson and the story lesson ($P > 0.05$). The change in a students' perceived knowledge of invasives was 1.6 times greater in females compared to males ($b = -0.25$, S.E. = 0.11, $t_{176} = -2.26$, $P = 0.03$; Figure 2). The change in the perceived knowledge of male participants did not vary across lesson formats ($P > 0.05$; Figure 2).

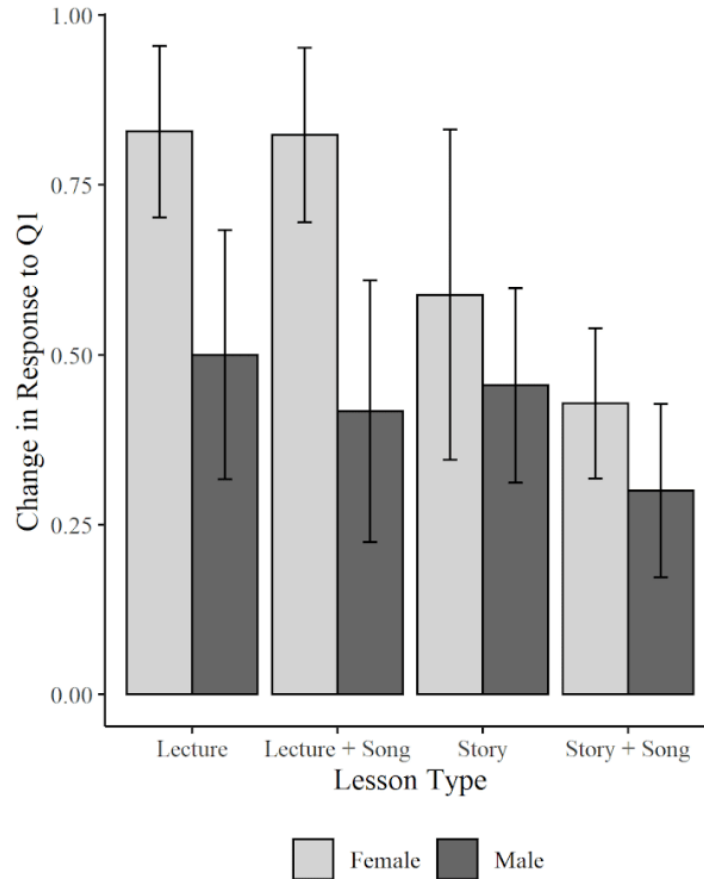


Figure 2. The change in male and female students' perceived knowledge of invasive species pre- and post-lesson for each lesson type.

Changes in the number of words written about invasive species in part I by students with prior knowledge ($\bar{x} = 0.58 \pm 1.1$) of invasive species were less than students with no prior knowledge ($\bar{x} = 15.8 \pm 1.3$; $b = -15.37$, S.E. = 1.74, $t_{184} = -8.84$, $P < 0.0001$). The difference in the number of words written after the story + song lesson was greater compared to the lecture lesson ($b = 5.84$, S.E. = 2.55, $t_{124} = 2.29$, $P = 0.02$) for students with prior knowledge of invasive species, but there were no differences between the other lesson types. If the students had no prior knowledge of invasive species, more words were written following the lecture lesson compared

to the lecture + song ($b = -8.10$, S.E. = 3.22, $t = 3.22$, $P = 0.02$), the story ($b = -8.37$, S.E. = 2.63, $t = -3.19$, $P = 0.0024$), and the story + song ($b = -8.67$, S.E. = 3.44, $t = -2.52$, $P = 0.01$) lessons (Figure 3). The increase in word count was greater in females without prior knowledge compared to males without prior knowledge ($b = -7.19$, S.E. = 2.57, $t = -2.80$, $P = 0.01$) but this difference was not present when students had prior knowledge of invasive species ($P > 0.05$; Figure 3).

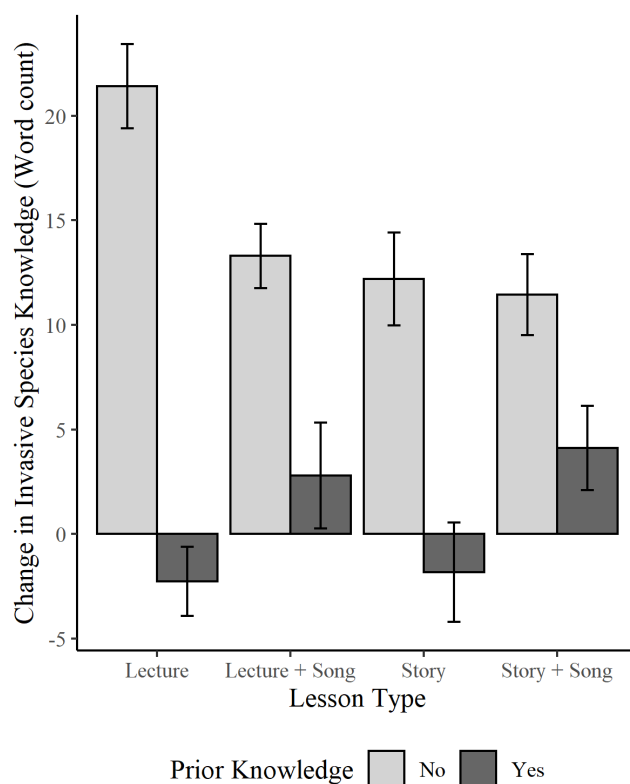


Figure 3. The change in students' invasive species knowledge pre- and post-lesson for each lesson type based on the number of words written when asked to write about what they knew about invasive species.

There was no difference between genders in the change in the number of invasive species known pre- and post-lesson ($P > 0.05$). However, the change in the number of invasive species

known for both lecture lesson types were approximately 2.2 and 4 times greater compared to the story + Song and Story lessons, respectively (Figure 4).

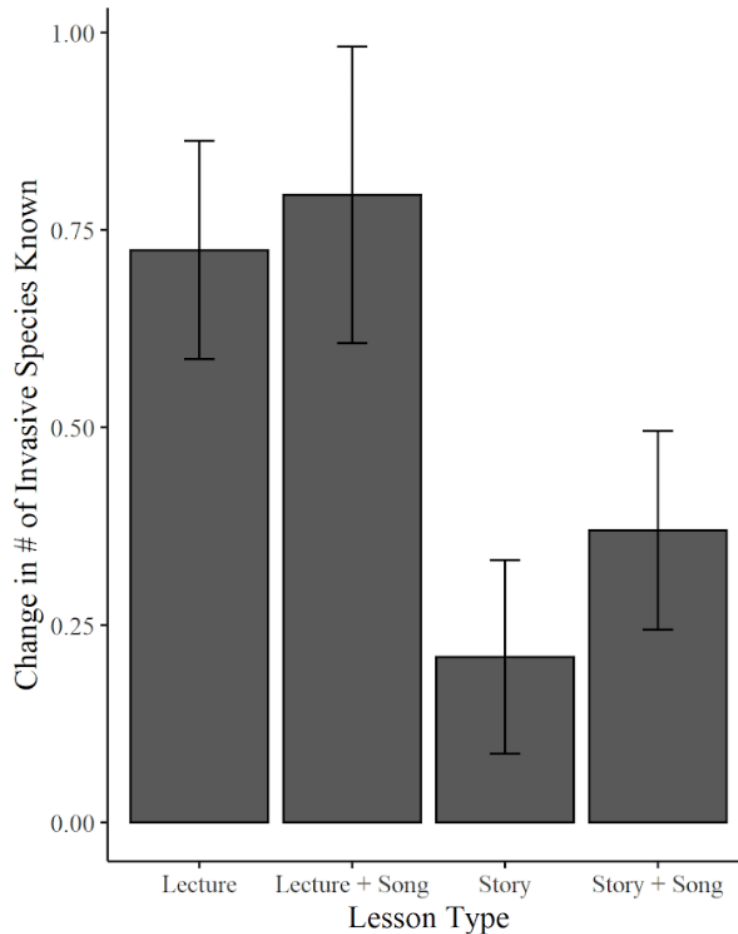


Figure 4. Change in the number of invasive plant species known for each lesson type.

DISCUSSION

Differences I observed in both the enjoyment of the lessons and the amount of knowledge gained between males and females were not unexpected given other studies considering gender and education. Females tend to outperform males in school as shown by their grades and test scores (DiPrete and Buchmann 2013). If females outperform males in the regular educational setting, they are more likely to understand and remember other educational content taught to

them such as what was taught in this study. Females also enjoyed all of the lesson types more than males, which could be due to females being more engaged in the classroom in general (Pyne 2020). Further research could be conducted to determine if there would be a difference in engagement and thus enjoyment if the lessons were presented by a male versus a female, as male students potentially could be more engaged with the lessons if a male was presenting. Males have demonstrated better performance in classrooms with male teachers because teacher attitudes and treatments towards the students can vary based on gender (DiPrete and Buchmann 2013).

I had expected differences in enjoyment between lesson types, which did not occur. Specifically, I predicted that the story lesson would be more enjoyable for the students because of its more creative format. The lack of differences in enjoyment of the lesson types could be due to multiple reasons. Students may have enjoyed the lecture lesson more because they are used to this teaching strategy within their normal classroom setting, and its familiarity could have improved their perception of the lesson. It could also be due to the fact that students learn better with different teaching styles on an individual level. Individuals can learn best with visual, auditory, and even kinesthetic teaching styles (Gilakjani 2012). While the lessons presented each contained both visual and auditory components, the style of the content was presented in different formats. Because enjoyment was similar across the lesson types, it would be beneficial for teachers to consider combining approaches when teaching a lesson to increase the amount of student engagement. However, student learning gains, which are discussed below, should be considered.

I predicted that the inclusion of a song would increase enjoyment of the lesson, but there were no differences observed between the lecture or the story's level of enjoyment when a song

was included versus excluded. The lack of improvement in engagement with a song could be due to the age group of the students participating in the study, as a song could be more beneficial to a younger group of participants or within a different setting, such as a camp. From observing the students when presenting the songs to them, most of them seemed too embarrassed to sing in front of their peers. Multiple students mentioned they liked the song on their surveys, but there was a general lack of enthusiasm for it within the classrooms. There were also no observable differences in the amount of information learned when a song was included or excluded from each of the lesson types. This could be due to the song only being sung one time. If it was repeated over the course of multiple lessons or days, the students could have potentially learned more information from it. The majority of the students were not familiar with the tune of the song (“On Top of Old Smokey”). The song could have potentially had a more positive influence on student engagement and learning if it was to a tune that they were familiar with and in the future a popular tune should be considered.

The students perceived gains in knowledge regarding invasive species (question 1 on survey part II) indicated that, at least for females, the story + song approach was the least informative from the students’ perspective. However, the number of words written about the knowledge of invasive species increased with the story + song lesson for those who had prior knowledge of invasive species. This may demonstrate that the story was most beneficial for students who were able to use their prior knowledge and combine it with the information that they could formulate from the story. However, I also observed that the number of words written decreased from the pre-survey to the post-survey in students with prior knowledge of invasive species. Though this is not what I expected, it was clear from reading responses that students with prior knowledge of invasive species tended to be less concise in their descriptions of what

invasive species were and their negative effects on the environment. Following the lessons, student responses were more concise and incorporated terminology that was more appropriate. Thus, in this group a decrease in words, such as those observed in response to the lecture lesson, may be more representative of knowledge gains and this should be considered in future studies.

Without prior knowledge of invasive species, the story did not increase knowledge as much as the lecture. The same was true for the number of invasive species known. Thus, initial presentation of the information to the students in a traditional lecture format may be necessary for the students to be able to absorb and understand it, but the story may be a beneficial learning aid once students have obtained an initial understanding of what invasive species are. Moreover, females who did not have prior knowledge learned more from all lessons compared to males who did not have prior knowledge. Thus, different approaches may be necessary to encompass the learning needs of males and females.

The ability of storytelling to encompass learning needs can also vary based on cultural dynamics. In a typical American public school classroom, storytelling as a teaching method is not widely used. Storytelling is a more common practice within indigenous communities, and it has been proven to increase understanding of conservation topics when they are a subject of the stories (Fernandez-Llamazares and Cabeza 2017). There is a relatively low amount of diversity within the two schools, with Calloway County Middle School having about 17% minority population of students with two students who identify as American Indian/Alaskan Native. Graves County Middle School has a 16% minority population of students and no students identify as American Indian/Alaskan Native (NCES 2022). Because there is a lack of cultural diversity within these schools, particularly with the number of American Indian/Alaskan Native students, the use of storytelling as a form of teaching about conservation topics is not as typical

for most students within the classroom. This could explain why storytelling did not lead as much improvement in student learning as the lecture lesson did. In the future, it would be interesting to consider if learning gains from storytelling (both presented by the teacher and created by the students) improved if it were more widely adopted as a teaching method within a school system.

Creative approaches to education are needed to maintain the engagement of younger generations in learning. Despite this, we did not find strong support for music or storytelling increasing student learning gains or how much they enjoyed the lessons. However, there is some evidence to suggest that storytelling may increase learning gains once students already have prior knowledge of invasive species. Thus, these strategies may be useful to augment traditional lectures. I hope our results will lead to more research on this topic to determine if similar outcomes occur with different educational topics or different approaches to the presentation of these lesson formats. Given our reliance on natural resources, improving conservation messaging as it relates to a student's understanding of conservation-related topics will be vital to sustaining our natural resources for current and future generations.

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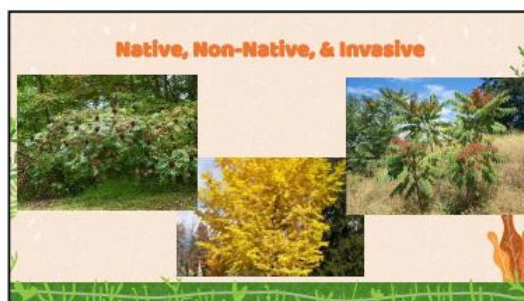
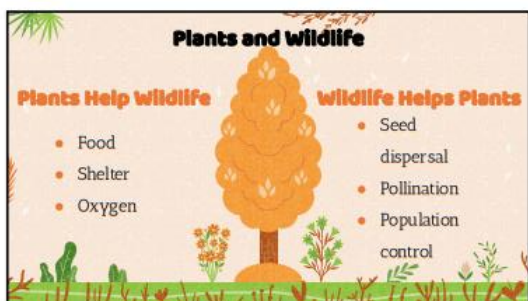
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APPENDIX A

The Invasive Plant Lecture



How?

- No natural predators or pests
- Reproduce quickly
- Can deal with climate changes better
- Can live in disturbed areas better



What do we do to stop them?



Remove them!

Stop planting them!

Tell others about them!

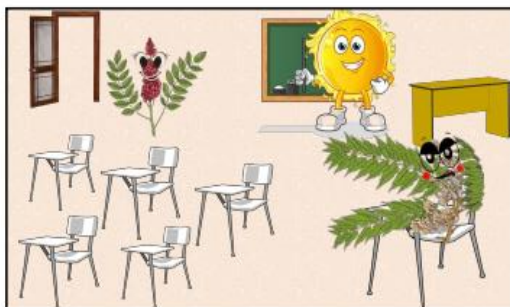
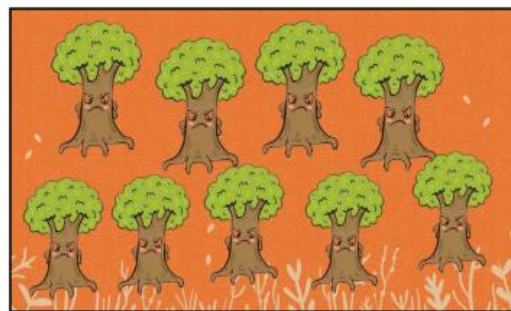


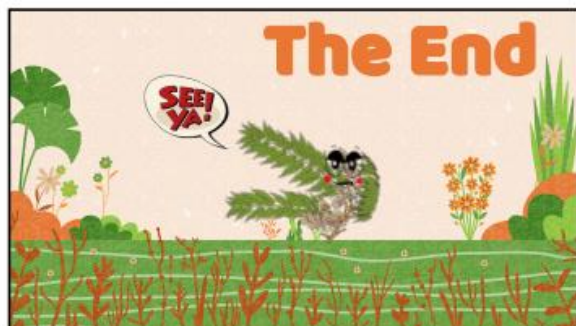
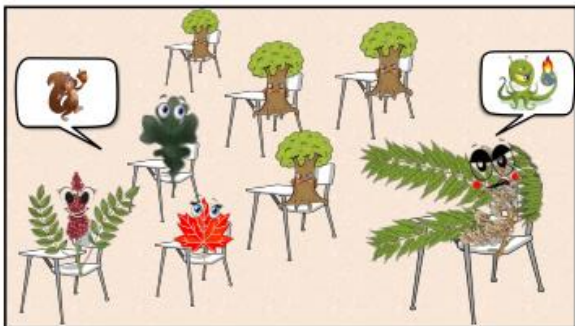
**Thank you
for
learning!**



APPENDIX B

The Invasive Plant Story Slides and Story





See the Forest for the Invasive Trees

Today, we are going to learn about invasive plants being harmful in an ecosystem. [Slide 2] In this story, you will meet two characters: Lina Sumac, a native tree, and Annie Stinktree, an invasive tree. While this story is a personification of two “trees” in middle school, it still will teach about the harm that invasive trees have on the environment. [Slide 3] By the end, see if you can answer these questions: What is an invasive plant, why are invasive plants harmful, why should we protect native plants, and how can we help get rid of invasive plants.

[Slide 4] When’s the last time someone got on your nerves? I mean really, really got on your nerves? Someone stole your friend from you, sat in your lunch spot, or coughed in your direction and you got the flu? Remember that feeling, and you’ll know exactly how Lina Sumac felt when Annie Stinktree showed up in the forest.

Right from the get-go, Annie made her presence known. On her first day at Green Tree Middle School, she strutted into class like she owned the place. [Slide 5] All eyes were on her as she sat front row, right next to the teacher, Mr. Sunlight’s, desk. Shortly after, Lina walked in and was horrified. That was *her* spot, and who was this random tree who decided she could sit there?

You see, Lina was a quiet but hardworking tree student who only cared about getting her work done and helping others. She didn’t ask for much, only friends who grew up with her and supported her. Lina and her friends dreamed of one day growing tall enough to help feed the birds of the forest, so they all worked hard in school together so they could learn all how to be the best tree they could be. One thing that Lina and her friend group did not like was when their tree classmates were rude and only seemed to care about themselves. Lina was thinking right away that this new tree in her spot was probably going to be rude considering how inconsiderate she was being by sitting in her spot, but she figured she’d give her a chance.

“Hey, I haven’t met you before,” Lina said after approaching Annie. “What is your name?”

Annie sighed and rolled her eyes. “It’s Annie Stinktree, but you can just call me the Tree of Heaven. Other trees back home like to call me that because they know I’m higher up and prettier than you.”

Lina was taken aback. “Um, okay,” she said nervously. “Well, just so you know, we do have assigned seats in this class.”

“Whatever, loser,” Annie scoffed as she tossed her shiny leaves over her shoulder. “You can go sit in the back of the class, this is *my* space now.”

Lina slunk to the back of the classroom, feeling dejected. She thought to herself that there was no way this new tree could get any worse. Guess what? Annie Stinktree got. even. worse. During class, Annie blurted out the answer to every single question. All of the teacher’s attention was on her the whole time, and no other tree in the class got to be noticed at all. They all felt like they were just in Annie’s shadow, and Mr. Sunlight couldn’t reach any of them at all.

[Slide 6] Once class was over, Lina headed over to the water fountain to fill up her bottle before class. As soon as she started filling her bottle up, Annie shoved her out of the way to get a drink. A line started forming behind her and she just kept drinking the water for what seemed like *forever*. The bell for the next class rang, and no one else was able to get any water.

[Slide 7] A couple more classes passed where Annie hogged all of the attention from Mrs. Soil and Mr. Pollinator. Lina and her friends, Ruby Mapletree and Stella Postoak, were so frustrated at how much of their school day Annie was ruining for them. They knew they would never be able to learn how to be providers for wildlife if she kept taking up everything around

them. They had even heard Annie say that she did not care about the forest wildlife at all, and her only goal in life was apparently to be disruptive and take up space.

So Lina, Ruby, and Stella decided to talk to Annie and see what her problem was. You see, what they wanted to do with trees like her was to cut them down or have them pulled out of the school and forest. They knew sometimes that the bad trees would come back to the forest and keep wreaking havoc, and these trees had to be locked up in the Herbicide Jail. They had heard of the notorious trees such as Mimosa Silktree and Bradford Peartree with their evil plant accomplices, Garlic Mustard, Kudzu, Stiltgrass, and Lespedeza. As angry as Lina was at Annie, she knew she was still a tree and her problematic behavior must be for a reason. She felt bad for her almost because she knew it must be hard to stand out and be out of place.

“Hey Annie,” Lina started, “I just wanted to get to know you a little bit better since we have all of our classes together. Why’d you move to a new school?”

“Ugh, well, if you must know, I’m from, like, really far away but my stupid parents decided to move me to this forest because they knew I could rise above everyone else here,” Annie responded.

“Wow, that must be hard to move from so far away to a new place, especially since you have the pressure to outcompete everyone now,” Lina said, trying to stay sympathetic and not get angry.

“Yeah, to be honest, the animals here are worthless to me. I miss the ones back home who actually supported me. I could care less about anything or anyone here,” said Annie.

[Slide 8] Lina and her friends tried to convince Annie that she should support the wildlife in the forest around Green Tree Middle School, since that is where she lived now. Annie wanted nothing to do with it, except for saying that she did in fact care about the spotted lanternflies

because they were buddies. Lina was mortified because spotted lanternflies were invading from out of town too, and they were destroying the forest! Lina could not change Annie's mind and teach her how to become a better tree for the forest because all Annie was focused on was her own rapid growth and negative influence on everyone around her.

Lina and her friends decided that if they couldn't make Annie coexist with them in their school and forest, they were going to have to try to outgrow her. **[Slide 9]** They needed to be able to pursue their studies and grow together without a tree like Annie getting in the way. They studied extra hard and got all they could from Mr. Sunlight, Mrs. Soil, and Mr. Pollinator. They started to get the best scores on their tests again, and they were all leaders of the wildlife clubs.

Annie and her parents were upset that she was not able to outshine all of the other trees at her school anymore. After threatening all of the teachers, they took her out of Green Tree Middle School. **[Slide 10]** On her last day, Annie announced to the class that she was leaving and going back to live where she grew up, which of course was just "ten times better than this stupid forest is." She said it with a lot of arrogance, but Lina could tell that she was just excited to go back to a place where she felt like she belonged.

APPENDIX C

The Invasive Species Song

On Top of Invasives

to the tune of “On Top of Old Smokey”

In Western Kentucky,
Native plants are sad.
There are lots of invasives,
and that’s really bad.

Invasive were brought here
from states and countries.
They spread way too quickly
among all the trees.

These bad plants take water,
sunlight, and space.
They may kill the natives
if that is the case.

Let’s remove the invasives
with our own two hands,
and teach others about them
so they understand.

APPENDIX D

Part I Pre- and Post-Survey

Survey Part I (pre-lecture)

Please answer these questions as fully and honestly as you can. Remember, you are not being graded on this so there are no right and wrong answers. Thank you for your participation!

Student number: _____

What do you know about invasive species? (Have more to say? You can write on the back.)

Where have you heard about invasive species? (On this survey does not count!)

List the names of any invasive species you know here.

Survey Part I (post-lecture)

Please answer these questions as fully and honestly as you can. Remember, you are not being graded on this so there are no right and wrong answers. Thank you for your participation!

Student number: _____

What do you know about invasive species? (Have more to say? You can write on the back.)

List the names of any invasive species you know here.

**Cut surveys above this line so the same amount of space is given for responses to the same questions in the pre- and post-survey

APPENDIX E

Survey Part II

Part II

Please answer these questions as fully as you can. Remember, you are not being graded on this so there are no right and wrong answers!

Student number: _____

What is your gender (check one)?

- Male Female Non-binary Prefer not to say

Rate your level of comfort with providing a response to the following statement: "Define an Invasive Species". Select one option.

- Wait, what is an invasive species?
 I am only slightly comfortable but want to know more.
 I can jot down a few good bullet points
 Very confident, I could write an essay on invasive species!

Please rank the following statements. Select one option on each row.

	Fully disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Fully agree
Humans have the right to modify the natural environment the way they please.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The balance of nature is very delicate and easily upset.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Plants and animals have as much of a right to exist as humans.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nature is something we should appreciate and protect.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Invasive species should be controlled when they negatively influence native animal species.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Invasive species should be controlled when they negatively influence native plant species.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Invasive species should be controlled when they negatively influence human health.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Invasive species should be controlled when they negatively influence human economics.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please rank the following statements. Select one option on each row.

	Fully disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Fully agree
Humans are responsible for controlling invasive species.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I can make a difference when it comes to invasive species.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would like to actively play a role in controlling invasive species.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Native plants are important to wildlife.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would like to learn more about invasive species.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I enjoy listening to music.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I enjoy listening to stories.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I enjoy being outside.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I enjoy singing.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I enjoy reading.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

APPENDIX F

Survey Part III

Part III

Please answer these questions as fully as you can. Remember, you are not being graded on this so there are no right and wrong answers!

Student number:

How much did you enjoy the presentation on invasive species (check one option below)?

1 (I hated it)	2 (I thought it was okay...)	3 (I'm neutral)	4 (I liked it a lot)	5 (I loved it!)
→	→	→	→	→

I would use the following terms to describe the presentation (check all that apply):

→ Exciting → Informative → Serious → Understandable

→ Boring → Unimportant → Fun → Unclear

	Learned almost nothing	Learn some	Learned a lot
What an invasive species is	→	→	→
Invasive species in your region	→	→	→
How invasive plants influence the environment	→	→	→
How you can play a role in getting rid of invasive species	→	→	→

Please rank how much you learned about the following (pick one on each row):

What was your favorite part of the presentation (use back if needed)?

What was your least favorite part of the presentation (use back if needed)?

Do you have any further questions related to invasive species (use back if needed)?