ENHANCING HIGH SCHOOL STUDENT WRITING SKILLS
WITH FLORIDA BIODIVERSITY EDUCATION

By

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by
Jeanette M. Randall
Dedicated to Don and Sally Randall, Michelle Clark, Sarah Hall, and Anthony Wilson.
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Abstract of Thesis Presented to the Graduate School
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ENHANCING HIGH SCHOOL STUDENT ACHIEVEMENT
WITH FLORIDA BIODIVERSITY EDUCATION

By
Jeanette Marie Randall

May 2001
Chair: Martha C. Monroe
Major Department: School of Forest Resources and Conservation

With the evolution and implementation of education reform across the United
States, teachers are compelled to address the state curriculum standards and prepare
students for state assessment tests. These pressures lead educators to teach-to-the-test
and to spend less time on experiential education; consequently the use of environmental
education (EE) has declined. In Florida, teachers comment that they have no time or
energy to focus on anything other than addressing standards and helping students practice
for the assessment tests.

The first part of this thesis explains how scientific experts can develop
educational materials successfully by overcoming technology and standards-based
education reform barriers. To do this, it explores the following questions: 1) how can
reasonable access to scientific data for non-experts be created? and 2) what process of
curriculum development enables ideal collaboration among all stakeholders? The second
part of this thesis is an evaluation of a curriculum guide that overcomes these technology
and education barriers through use of a database interface that utilizes a web query agent to disseminate information and through lessons designed to address education reform goals in Florida.

This study evaluates classroom curriculum designed to meet the specific standards of ninth and tenth grade high school biological science in Florida. Curriculum developers designed the curriculum around an Internet database interface that uses collection records from the Florida Museum of Natural History and documents from other Florida environmental agencies. It contains five lessons: four refer to biodiversity, and one focuses on writing skills. These lessons reinforce five science and five language arts Sunshine State Standards (SSS) and enable students to practice for the writing portion of the Florida Comprehensive Assessment Test (FCAT) while learning about their environment. This design helps educators meet reform goals, provides students with interesting lessons, and disseminates the data and information of scientific experts.

Paired t-tests and descriptive statistics were used to evaluate knowledge, attitudes, and writing skills. One hundred and thirty-two high school students from the classes of two teachers in Gainesville, Florida completed the study. The data reveal that students increased their knowledge significantly in one of four knowledge components and demonstrated a significant score increase for fifty percent of the attitude items. Scores assigned using the FCAT Writing Rubric are significantly higher on the last writing assignment than on the first writing assignment. This evaluation indicates that supplemental environmental education curriculum can be designed to support state standards and its use can improve skills measured by the state assessment test.
CHAPTER 1
INTRODUCTION

In 1970, in response to alarming public and government concern for the state of the environment, the United States Congress passed, along with the Clean Air Act and the National Environmental Policy Act, the first Environmental Education Act. Public pressures were strong during this time of environmental controversies, and Environmental education (EE) was seen as one tool to improve public participation in decision-making. Concern for the environment continued throughout the decade prompting the implementation of the Endangered Species Act of 1973, the Clean Water Act of 1977, and the Superfund Act of 1980.

Defining Environmental Education

Environmental calamities around the world helped create new awareness about our “spaceship earth” and prompted educators and conservationists to work on a novel approach to education–environmental education. The first article in the Journal of Environmental Education by William Stapp (1969) and the reports from the United Nations Educational, Scientific, and Cultural Organization (UNESCO) meetings on environmental education, such as the 1976 Belgrade Charter and the 1978 Tbilisi Intergovernmental Conference, defined environmental education (EE) as a process of developing a world population that is aware of and concerned about the total environment and its associated problems, and which has the knowledge, skills, attitudes, motivation and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones. (UNESCO, 1978, p. 23)
Unlike science education or nature study, EE is a learning process that leads people along a continuum from awareness to action; the steps in its progression include awareness, knowledge, attitudes, skills, and participation (UNESCO, 1978). Ideally, this awareness to action goal increases the possibility that students will be able to take informed action, and that they will carry their intentions through to completion.

Over the years, leaders in the field elaborated on the goals of EE. Hungerford, Peyton, and Wilke (1980) developed a curriculum framework that would help educators enable their students to become environmentally responsible citizens. The framework included the following four levels of environmental literacy: 1) Ecological Foundations Level; 2) Conceptual Awareness Level-Issues and Values; 3) Investigation and Evaluation Level; and 4) Environmental Action Skills Level-Training and Application. Each of these goals fits neatly into at least one level of UNESCO’s awareness to action continuum. Experts agree that all four of these levels are useful for environmental literacy to be achieved (Disinger and Monroe, 1994; National Environmental Education Advisory Council, 1996).

In a broad view, EE can appeal to conservation agencies as well as to educators. Disinger and Monroe (1994) suggest ways that programs can be developed or improved: 1) include all environments from economic to aesthetic; 2) involve learners throughout their lives; 3) be interdisciplinary; 4) look at all issues, from local to international; 5) look at present and future issues while keeping the past in perspective; 6) emphasize effective communication between groups from local to international; 7) allow students to have an active part in the learning experience; 8) give students the opportunity to identify and attempt to solve environmental issues on their own; 9) show students that environmental
issues are not black and white; and 10) utilize a variety of teaching methods. These principles help a great variety of educators to deliver more effective environmental education.

Global Concern for the Environment

Concern for the environment was not limited to the United States. The charge made at the 1972 United Nations conference in Stockholm on Human Environment: “to defend and improve the environment for present and future generations has become an imperative goal for mankind” provided the impetus for their environmental recommendations (quoted from UNESCO, 1978). Participants at the 1978 UN convention on the environment agreed that environmental education (EE) was an integral part of healing and protecting the global environment (UNESCO, 1978).

In the 1980’s the World Conservation Strategy advocated the importance of world conservation and deemed both public participation and education as vital in improving environmental conditions (International Union for the Conservation of Nature and Natural Resources (IUCN), 1980). The United Nations called on the World Commission on the Environment and Development to create “A Global Agenda for Change.” Led by Gro Harlem Brundtland of Norway, the commission defined sustainability and devised an avenue for achieving it. One key element of their plan is the inclusion of education about the environment and sustainability (The World Commission on Environment and Development, 1987). This need for education about the environment was reaffirmed in 1992 at the United Nations Earth Rio Summit in Agenda 21 for Planet Sustainability. In 1995, the U.S. President’s Council on Sustainable Development presented a report at the National Forum on Partnerships Supporting Education about the Environment entitled
“Education for Sustainability: An Agenda for Action” (National Forum, 1996). It asserts the need to educate citizens about environmental sustainability using environmental education tools. These strategies and agendas are an appropriate foundation for educating citizens about the environment, but there must be extensive planning and programming at the regional and local levels for any of them to make a difference.

**Environmental Education in the United States**

President George H. Bush signed the second Environmental Education Act in 1990, renewing the Federal government’s commitment to environmental education in

The National Environmental Education Advisory Council stated:

Environmental education is critical and relevant to the daily lives of all Americans. Environmental education is critical because complex environmental challenges require a well-trained environmental workforce and an educated public who have the knowledge and skills to fully and actively participate in solving these problems. Environmental education is relevant because it can help to ensure the health and welfare of the nation by protecting human health, advancing quality education, expanding employment opportunities, promoting sustainable development, and protecting our natural heritage. (National Environmental Education Advisory Council, 1996, p. i)

The Council must ensure that educators in all fifty states implement EE in classrooms, curricula, and schools. The Act includes funding for training programs, EE grants, internship and fellowship programs for students and teachers, an EE awards program, a federal task force, and the national advisory council (National EE Advisory Council, 1996).

There is broad support for EE among the general public. Many studies have shown that students have deep concerns about the environment. Gambro and Switzky (1996) assessed high school students’ environmental knowledge. They found the majority of the students had positive feelings toward protecting the environment and a
low level of environmental knowledge. Adults demonstrate this same trend. In 1991, the Wall Street Journal reported the results of a poll that showed that even though 80% of Americans consider themselves environmentalists, nearly 55% could not remember buying one product over another for its environmental value in the last six months (National EE Advisory Council, 1996, p. 3). The Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) (1993) concluded:

Environmental education and training can help bridge the gap between the public’s heightened awareness of and interest in protecting the environment and their need to become more knowledgeable about the scientific concepts that will enable them to more effectively respond to their concerns. (as quoted in National EE Advisory Council, 1996, p. 4)

Some politicians and academics also support greater attention toward environmental education. Senator John H. Chafee (1995) stated, “We cannot hope to implement solutions to our environmental threats without the involvement of an educated and scientifically literate public. Only then will the political debate and direction of environmental policy focus on real risks and not anecdotes that make catchy news copy. Education is the key.” Similarly, Northern Illinois University professor, Bora Simmons, testifies, “the state of the environment affects our quality of life . . . for that reason, environmental education is an essential part of the curriculum” (Rasmussen, 2000). Until people are given the knowledge and skill to make intelligent choices about the environment we cannot expect responsible behavior from the general public.

**Bringing Environmental Education to Students**

Despite the fact that all Americans are in great need of environmental education, the political support for EE today is for youth education. Because youth are involved in organized activities like school, clubs, scouts, and other programs, they are easier to
reach and to educate than adults. These existing organizations offer a mode of delivering environmental messages.

Even when educators have the interest and good intention to address EE in their programs, they may not have the requisite knowledge to carry that conviction to reality. Thus, conservation agencies, scientific experts, and environmental organizations play an important role in providing current information and curricula to educators. There are two challenges that must be overcome to create good EE curricula: 1) materials must be interesting, geared to appropriate content and reading levels, and relevant to the learner’s world; and 2) materials must meet the specific educational goals and objectives of their audience by addressing state and local curriculum objectives and student assessment goals. This thesis will explore both of these challenges. Chapter 2 provides an example of how scientific experts and educators overcame technology and standards-based education reform barriers to meet both challenges and create curriculum that teachers were able to use. Chapter 3 measures the quantitative success of the curriculum by answering the research question, “Does an environmental curriculum designed to meet the needs of educators and scientists increase writing skills as measured by the state assessment rubric?”
CHAPTER 2  
WRITING AND MUSEUMS, BIODIVERSITY AND COMPUTERS: MEETING SCIENTIFIC AND EDUCATIONAL GOALS WITH NOVEL CURRICULUM

Science is a process of discovering and understanding the world around us. Teaching science involves exposing students to not only the information that is already known or assumed about the world but also to the scientific process of discovering new things. As the amount of new information generated by science grows, it becomes more difficult for most educators to achieve much more than help youngsters know how to retrieve the information they need and sparking in them the interest to look for it.

Science educators have worked hard to design laboratory exercises that teach students to use the process of inquiry. Every year, however, the amount of information accessible to scientists grows exponentially, increasing the gap between the experts and the citizenry. If students are to become scientifically literate, if youth are to be compelled to have a career as a scientist, if teachers are to be privy to scientific data, a process of converting scientific knowledge into teacher-friendly and student-interesting curriculum resources is needed.

This challenge can be restructured into two questions: 1) how can reasonable access to scientific data for non-experts be created? and 2) how can supporting curriculum be developed that can be used by teachers? The first question can be answered by technology; the second requires an understanding of educational goals and curriculum development. Both can be illustrated by a recent project in Florida. This
chapter will explain how scientists can overcome both database and curriculum barriers to reach students successfully.

Barriers and Solutions

Computer Technology

With the advent of new information technologies, the opportunities to provide students access to information and data are becoming limitless. Scientists now have the ability to share their research results through the Internet and the World Wide Web by digitizing and storing their information on a server (McCain 2000). But before scientists can begin to think about designing curricula that will help students use their data, they must make their databases user-friendly. Once information is on the web, many scientists feel they have done enough to make it accessible, but they forget that a novice will only be capable of using the database if it is simple and straightforward. The user must be able to enter simple terms and get back simple results. For example, if a user wants to find out more about a certain lizard in her yard, she should be able to enter the common or the scientific name of the lizard. It should be the job of the database to translate the query into the scientific name. Search outputs must be in a format that is clear and useful to a layperson.

Another way that scientists can make their data more accessible and useful is to coordinate with others in related fields to make their databases parallel and consistent so that someone searching in all of them will get compatible outputs. If possible, it is even more helpful if databases are joined with a web query response agent. Hanisch (2000) suggests that, “To bridge the differences between the various information services and databases, we require a common language for expressing queries that can at some stage
be translated into the specific languages used by each of the databases” (p. 180). Using this type of feature will simplify and enhance students’ use of all the databases.

**Education**

Educators looking for curricula that center on current scientific topics sometimes have trouble finding lessons or units that meet all of their needs. Even if there are scientists willing to create curriculum that focuses on their research, they are often too far removed from students and teachers to be able to present what they know in a simple and effective format. Without understanding learner needs, writing curriculum for kids is very difficult. The advent of education reform has made this challenge even greater.

When schools are held to tight state and national standards and are almost completely focused on preparing for assessment tests, there is no time to spend on curriculum that does not relate to the tests. For this reason, supplemental curricula must not only be educationally appropriate but must also meet accountability standards and provide students with preparation for assessment tests.

In Florida, curriculum developers found these accountability requirements particularly important. As of 2001, the Florida Comprehensive Achievement Test (FCAT) only covers the reading, writing, and math benchmarks of the Sunshine State Standards (SSS). Teachers at low-scoring schools are pressured to spend more and sometimes all of their time teaching reading, writing, and math skills. At low-scoring elementary schools, focus on preparing for the FCAT leaves teachers no time to teach any science at all. Science and social studies teachers at low-scoring secondary schools are expected not only to give writing assignments, but also to teach writing skills even though they have not been formally trained to do so (C. Cranford, personal
communication, Crown RSP, 1999). Therefore, supplemental curricular materials may only be used if they help teachers address reading, writing, or math standards.

Some of the more popular supplemental environmental education curricula, like Project Learning Tree (PLT), have declined in use because of these educational reform activities. In interviews and focus groups for a statewide study of the use of PLT, teachers expressed significant barriers to using PLT that resulted directly from the standards and tests. Teachers in several schools are so busy making sure that they cover the SSS and prepare their students for the FCAT that they have little planning or classroom time for other exercises (Monroe et al., 1999). The Florida PLT Steering Committee has recently responded by restructuring their workshops and creating a guide to show teachers how PLT can help them meet the SSS.

Clearly, supplemental curricula must meet the needs of both scientists and educators. A good curriculum must address the educational constraints and opportunities of the school system as well as the scientific community to assemble a product that is scientifically accurate, conveys the information that scientists want to share, is age appropriate, utilizes sound teaching methods, is interesting and relevant to students, and addresses state standards. Good curriculum developers should be able to work with these multiple requirements to make all of the components come together in a cohesive and effective way.

An Example

Linking Florida’s Natural Heritage: A Database Interface

A grant from the Institute of Museum and Library Sciences (IMLS) enabled the Florida Museum of Natural History, the University System of Florida Libraries, and other
scientific agencies to connect their databases with a common web query agent, known as Z3950, to develop the “Linking Florida’s Natural Heritage” interface. The databases differ in many ways, but all contain information on Florida’s natural history and biodiversity. Each database contains specimen records, references, electronic books or articles, or links to web sites about Florida species and habitats. The Linking Interface allows users to query all databases from one web site with a single search.

The Linking Interface may be expanded, but currently it includes the following databases:

**Library collections:**

- Everglades Online: Historical documents, letters, citations, and other electronic resources
- Florida Environments Online (FEOL): Eight merged research bibliographies augmented with records contributed by scientists and state agencies throughout Florida
- FORMIS Ant Bibliography: Citations of publications and research on ants
- Linking Florida’s Natural Heritage (LFNH) Core Collection: Key publications about the ecology and environment of Florida (digital full-text format)
- Sea Turtle Bibliography: References on all aspects of sea turtle biology, conservation, and management
- State University System of Florida (SUS) Library Catalogs: Print and electronic holdings of libraries at Florida A&M University, Florida Atlantic University, Florida Gulf Coast University, Florida International University, Florida State University, the University of Central Florida, the University of Florida, the
University of North Florida, the University of South Florida, and the University of West Florida

**Museum collections:**

- Ichthyology Collection, Florida Museum of Natural History: Records of the more than 325 taxa of freshwater and marine fishes held at the museum
- Herpetology Collection, Florida Museum of Natural History: Records of approximately 149,000 specimens of reptiles and amphibians held at the museum
- Bird Specimen Collection, Tall Timbers Research Station: Records of approximately 3900 bird specimens held at the research station
- Bryophytes and Lichens Collection, Camp Blanding: Records of bryophyte and lichen specimens found in Clay County, Florida.

**Interface Benefits**

The Linking interface helps the project overcome the barriers of providing citizen assessment to independently developed scientific databases. The interface allows people to search one or more of the databases at one web site; users do not have to jump to each database for information. Through one search query, users receive an output containing records from multiple databases. This feature gives users the ability to work on a project more quickly and efficiently. Because each database uses different fields and names for the same kind of data, another important benefit of the interface is its ability to translate the language of each database to the user. The interface can translate the user’s query to each database, and then translate the results back into the language of the user. For example, if a user searches for “turtle,” the interface translates this query into scientific names for turtles, searches all of the databases for both the common and the scientific
names, and then sends the user an output that contains any collection records, citations, or full-text documents that include these names. See http://susdl.fcla.edu/lfnh for the Linking Interface.

**The Linking Interface Biodiversity Curriculum Guide**

To enable youth to access the museum and library data in the Linking Interface, a curriculum guide that covers the natural history and biodiversity of Florida was created. The curriculum development process followed the commonly accepted procedures for creating educational materials: 1) conduct a needs and goals assessment, 2) plan and design, 3) evaluate and revise, and 4) implement (Monroe and Day, 2000; Bennett, 1988/1989).

**Needs assessment**

The overarching goal of the curriculum is to enable students to utilize the interface not only to complete the curriculum, but also to further their own investigations and research projects. To make sense out of the complexities of the databases, the curriculum also provides students with an understanding of scientific research, taxonomy, and the purpose of a museum of natural history. To make the information relevant and interesting to youth, several lessons also explore Florida’s natural history and the relationships between species and their habitats.

Because of the complexity of the information in the database interface, the curriculum is targeted to high school students, who are best able to utilize as much of the database interface as possible. Since the content of the database focuses on natural history and biodiversity, it lends itself to lessons appropriate for biological science classes usually taught in ninth and tenth grades.
To increase interest level among students, the components written for students were produced for the computer screen with graphics, photographs, and links to additional information. The curriculum addresses different learning and teaching styles by including in each lesson: 1) written background, 2) an exercise using the interface, 3) a writing assignment, and 4) editing and revising practice.

Since developers selected high school biological science classes as the group most appropriate for use of the database, they gauged the needs of the teachers of those classes. Conversations with teachers and educational experts revealed that teachers wanted something that would fit as many of their existing curriculum objectives as possible and would help them teaching writing skills. This combination of characteristics helps teachers continue to meet their subject-oriented goals while still giving their students practice for the FCAT writing test.

Curriculum plan and design

The various stakeholder needs were combined in a rough design of the curriculum. Meetings with the Linking Interface team helped to ensure that the final interface used would contain information needed by curriculum activities. Conversations with resource staff confirmed the importance of addressing FCAT skills.

The curriculum developers brainstormed ideas for activities based on the Linking Interface databases that might meet teacher objectives. Out of these, they selected the four most meaningful and cohesive activities to include in the curriculum. Supporting student text that matched the Linking project goals was written to go with each activity. A writing assignment similar to those on the FCAT was developed for each text and activity (Table 2.1). These three components are educationally sound because they give students the opportunity to read about a topic, to do an activity that gives them experience
applying what they read, and then to reflect on what they have learned through the
writing assignment. This type of design aids students in learning and remembering
(Gagne and Briggs, 1979). Giving students the opportunity to have different experiences
with a subject reinforces what they have learned. A fifth lesson on writing was
developed to help the students learn about and practice effective writing. Students use
the editing form from this lesson to edit and revise the essay from each content lesson.
Repeating these writing skills with each lesson gives the students practice for the FCAT.

Curriculum evaluation

At several stages in the curriculum design process, the developers had teachers,
scientists, and students from around Florida review the lessons to make sure that the
curriculum was educationally appropriate and scientifically accurate. Activities were
tested with teachers at a conference and students at a youth camp. A number of
recommendations and edits were incorporated into the material: teachers made
suggestions about readability, content appropriateness, and format; scientists added
additional content, made scientific concepts more accurate, and gave format suggestions,
students gave suggestions about format, interestingness, and readability. Six teachers
agreed to pilot test the curriculum with their students. Each teacher attended one of two
workshops to introduce them to the material.

All of the teachers who completed the pilot test report they plan to use the
curriculum again. Two said they felt that their students were more on task than usual
when using the lessons. One teacher mentioned the database activities are “very cool!”
The teachers felt the curriculum challenged their students and helped prepare them for the
state writing assessment test. Also, students enjoyed using the Linking Interface.
Another teacher reported that a colleague in her school’s English department asked to use
the writing lesson. Feedback from the Florida Regional Service Projects (RSPs) – the EE consultants for teachers – has also been positive. They feel that this curriculum is exactly the type that their teachers need.

Table 2.1: Linking Interface Curriculum Summary

<table>
<thead>
<tr>
<th>Lesson 1: The Collection Connection: Museums of Natural History and Libraries</th>
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| **Theme:** Museums collect a variety of artifacts and specimens for research. Collections have been used over the years to catalog species and change. Museums have similarities to libraries in that they both collect and store information for others to use, and often libraries have articles on museum data.  
**Activity:** The students complete a worksheet on museums and databases by linking to several web sites and by searching in the Linking Interface.  
**FCAT-like Writing Prompt:** Students imagine they are the head curator of the museum and write a letter to the state legislature explaining why they should continue to fully fund the museum of natural history. |

<table>
<thead>
<tr>
<th>Lesson 2: Writing for Science</th>
</tr>
</thead>
</table>
| **Theme:** Good writing contains strong organization, transitions, support, conventions, sentence structure, focus, and word choice.  
**Activity:** Students use a modified version of the FCAT rubric to fill out a worksheet analyzing and editing their partner’s essay from Lesson 1.  
**Writing:** Students edit their own essay based on their partner’s evaluation. |

<table>
<thead>
<tr>
<th>Lesson 3: Taxonomy: What’s in A Name?</th>
</tr>
</thead>
</table>
| **Theme:** The history of taxonomy begins with the story of Linnaeus and continues by explaining the benefits of the binomial naming system.  
**Activity:** Students use the Ichthyology database to identify the common names for several fish and organize them in a classification matrix based on taxonomic relationships.  
**FCAT-like Writing Prompt:** Students imagine they have discovered a new species, make up an appropriate, yet creative, scientific name, and write a description of their discovery to share with other scientists. Students edit a partner’s essay and then revise their own. |

<table>
<thead>
<tr>
<th>Lesson 4: Introduced Species: Harmless Immigrants or Armed Invaders?</th>
</tr>
</thead>
</table>
| **Theme:** Introduced species can be beneficial or can wreak havoc in an ecosystem. Students are introduced to the methods of species introduction, their benefits and the problems they can cause.  
**Activity:** Students use the museum herpetology database to access records of the brown anole in Florida. They track the northern invasion of the species over time.  
**FCAT-like Writing Prompt:** Students choose a federal policy on exotic species introduction and write an essay to persuade the reader of their views. Students edit a partner’s essay and then revise their own. |

<table>
<thead>
<tr>
<th>Lesson 5: The Biodiversity Dilemma</th>
</tr>
</thead>
</table>
| **Theme:** Biodiversity is important at several levels and has extensive benefits for humans. Some scientists suggest that saving a keystone species in its natural habitat will benefit the ecosystem and all the species living in it.  
**Activity:** Students use the FLNH core collection database to find full-text records on scrub. They read an article about the Florida scrub jay and create a field guide entry about the bird.  
**FCAT-like Writing Prompt:** Students write an essay to persuade the reader why Florida should change the state bird from the mocking bird to the Florida Scrub Jay because its new status will help protect the scrub jay and its habitat. Students edit and revise their own essay. |
All of the teachers who completed the pilot test report they plan to use the curriculum again. Two said they felt that their students were more on task than usual when using the lessons. One teacher mentioned the database activities are “very cool!” The teachers felt the curriculum challenged their students and helped prepare them for the state writing assessment test. Also, students enjoyed using the Linking Interface. Another teacher reported that a colleague in her school’s English department asked to use the writing lesson. Feedback from the Florida Regional Service Projects (RSPs) – the EE consultants for teachers – has also been positive. They feel that this curriculum is exactly the type that their teachers need.

**Curriculum implementation**

The Linking Interface curriculum is currently available for use on the Interface web site. Teachers can begin using it and the databases at any time.

**Conclusion**

Scientists have a great deal of knowledge and data that can enhance school lessons. This information must be conveyed to teachers in a format that enables them to address state curriculum standards and assist students. The Linking Project is a good example of the process that can be used to generate such a curriculum. The following questions can help guide others in determining the nature and direction of their curriculum development.

**Database:**

- Is your database simple and straightforward?
- Do people need prior knowledge to use it?
- Is it compatible with related databases?
Can you link with other databases and generate an interface that serves to enhance all of them?

Education:

- What do you want students to learn about your data?
- How can they use these data in their world?
- How old should they be to understand the information?
- Within that grade level, what subject areas best fit your information?
- Are you targeting one school, a school system, state, or nation?
- What are their educational goals?
- What curriculum standards can your information address?
- What skills can students gain by conducting activities that use your data?
- What activities would enhance learning?
- How can you reinforce learning?

These questions will help guide scientists, database designers, and educators as they create a curriculum to meet a variety of needs. They cover the basics of how reasonable access to scientific data for non-experts can be created through the use of web query agents and other technological features, and how supplemental science curriculum can be developed that meets general teaching goals and standards-based education reform goals of teachers.
Supplemental educational resources are important tools that enrich the classroom experiences of students. In this fast-moving and technologically advanced culture, teachers cannot be expected to know the latest research and developments in every field they cover and need supplemental resources to ensure their students’ success in learning. Particularly as scientific research becomes more specific, the translation of this new knowledge to citizens becomes the domain of those with scientific, rather than educational, expertise.

To translate this new knowledge to students successfully, it is essential for scientists to support teachers in fulfilling the educational needs of the students. Consulting with curriculum specialists or even hiring someone to write curricula will help scientists transform their knowledge into a format that utilizes proven educational practices. Expert help in developing curricula is particularly important now that education reform has expanded education goals. Supplemental curriculum resources must also now help teachers meet state education standards and prepare their students to take assessment tests. If curriculum does not implement sound educational practices and meet state education standards, teachers will not use it, no matter how interesting its subject matter or activities might be.

This study evaluates an environmental education (EE) curriculum guide designed to help high school science teachers in Florida meet the Sunshine State Standards (SSS)
for science and language arts and provide students with practice for taking the Florida Comprehensive Assessment Test (FCAT). The evaluation will measure change in knowledge, attitudes, and writing skills from pre- to post-curriculum. The more effectively a supplemental educational resource can meet these goals, the more likely teachers will be to use these materials in the classroom.

**Literature Review**

In 1983, when *A Nation at Risk: The Imperative for Educational Reform* was published by the National Commission on Excellence in Education, it lit a fuse that sparked education reform throughout the United States (Hunt and Staton, 1996). Administrators responded to the public and political demand for accountability by placing more restrictions on their teachers. Across the country, states began to implement their own statewide curricular guidelines to standardize teaching. States also developed performance tests as accountability tools to measure how well teachers convey the standardized curricula. Some schools even required teachers to record all of the standards they met in every one of their lessons to justify what they taught. As teachers responded to the pressures of these standards and tests, many felt they had little time to explore projects and activities that took the students beyond the standard requirements.

Although there are advantages to increased accountability, standards-based education reform may not lead to improved teaching. As Bentley (2000) points out, “In many schools standards-based reform has resulted in a renewed interest in academics, but the down side of standards-based reform includes a re-emphasis on direct teaching methods, more teaching-to-the-test, less attention to the non-cognitive domains, and a retreat from experiential education and field studies” (p. 1). Unfortunately, the field of
environmental education, which traditionally includes teaching methods that are almost the opposite of the re-emphasis to which Bentley refers, could potentially lose its foothold in the classroom because of education reform. Disinger and Monroe (1994) describe the essence of EE as including:

…a human component in the exploration of environmental problems and solutions[,]…a foundation of knowledge about social and ecological systems[,]…the affective domain: the attitudes, values, and commitments necessary to build a sustainable society[, and]…opportunities to build skills that-solving abilities. (p.3)

The pressure to demonstrate student achievement, which in many states means covering key concepts and improving test-taking skills, makes it challenging and unrewarding for educators to use EE materials.

Prior to the widespread implementation of reform initiatives, Ham and Sewing (1988) found that the two biggest barriers teachers have to conducting EE were a lack of preparation time and lack of time during the day to use EE. As states have stepped up accountability restrictions on teachers, they have even less time to prepare for and actually use EE than they did at the time of Ham and Sewing’s study.

Education Reform in Florida

In Florida, environmental education has suffered under recent school reform efforts. In a focus group for a state-wide study of teachers’ use of Project Learning Tree (PLT), a commonly used supplemental EE resource, teachers expressed significant barriers to its use that were the direct result of the Sunshine State Standards. One teacher expressed, “FCAT and SSS are all we can deal with right now, and they definitely keep me from using PLT or any programs like it” (Monroe, et al. 1999).

As of 2001, the Florida Comprehensive Achievement Test (FCAT) only evaluates students on the reading, writing, and math benchmarks of the Sunshine State Standards
(SSS). This means that teachers at low-scoring schools are spending almost all of their
time teaching reading, writing, and math skills. This focus on preparing for the FCAT
leaves teachers no time to teach any science, let alone environmental education. Science
and social studies teachers at some low-scoring secondary schools are pressured not only
to give writing assignments, but also to teach writing skills even though they have not
been formally trained to do so (C. Cranford, personal communication, Crown RSP,
1999). If EE is to survive in the present educational climate, it must accommodate a
system that revolves primarily around skills not traditionally taught in environmental or
science curricula.

How EE Can Help Teachers and Students Meet Education Reform Goals

Lieberman (1995) states that reform and environmental education each have
something to offer the other, but that EE leaders should take the first step and help
teachers meet classroom and education reform goals through specially designed EE
education can help teachers meet curricular and reform goals, in part because education
reform and environmental education have similar aims such as providing students with
the knowledge and skills needed to be effective citizens (Sussman, 1999). Good EE
includes many disciplines and can build basic skills in problem solving and citizenship,
both basic education goals. Further, environmental subject matter can be easily adapted
to fit into basic skill-oriented training. Students have to read and write about something;
they can read and write about the environment. Similarly, math problems can incorporate
environmental components such as water conservation or population change. Ramsey,
Hungerford, and Volk (1992) demonstrate how EE can be infused into the existing
curricula in the areas of science, health, social studies, math, language arts, home
economics, and agriculture. The process of infusion makes environmental education an integral part of the curricula rather than a self-contained addition to the curricula (Monroe and Cappaert, 1994). Infusing environmental education into the already existing curricula is an effective method to enable teachers to use EE materials (Braus and Wood, 1993; Cantrell, 1994; Engleson, 1985; Monroe and Cappaert, 1994; Ruskey and Wilke, 1994). Such materials assist teachers in two ways: they spend less time planning how they meet state standards and they accomplish multiple objectives when they teach each lesson in the classroom. Braus (1999), Carlson (1988), and Lieberman (1995) agree that infusing environmental education into existing curriculum is a meaningful and practical strategy to achieve both curricular and reform goals. Infusion enhances basic education rather than taking time away from it.

**Education Reform and Environmental Education at Different Levels**

Environmental education can support education reform effectively at two levels: the school level and the classroom level. The State Education and Environment Roundtable (SEER) recently completed two leading studies that examine the use of the environment as an integrating context for learning (EIC) across the school. The first study identified forty schools across the country using EIC in very different ways. All showed improvement in standardized test scores (Lieberman and Hoody, 1998). The second study, *The California Student Assessment Project: The Effects of Environment-based Education on Student Achievement*, compared eight EIC schools to eight non-EIC schools and found that the students at the EIC schools scored higher on standardized tests than did the control group (State Education and Environment Roundtable, 2000). Over the last decade, eight schools in Washington State have participated in a program called “Model Links-Linking Environmental Education and School Improvement.” This
program’s basic principles follow the recommendations of the National Curriculum Reform. After monitoring the schools for several years, they found that using environmental education was effective in facilitating school improvement (Model Links, 1999). The results of the EIC and Model Links studies show that environmental education can work very effectively to improve schools as they work to meet education reform goals.

In addition to the large-scale infusion described above, environmental education can also be infused at the classroom level to fulfill education reform goals. Since teachers need to be able to connect their daily lessons with curriculum standards and enable their students to gain the performance skills measured by the state assessment tests, they often need assistance in connecting curriculum materials with standards and skills. Many national programs have correlated their curriculum with national standards, but this does little to help teachers who must justify the curricula with state standards to appease their administration. An expert in every state must adapt national programs to meet their state goals. The Florida Project Learning Tree Steering Committee has developed a guide demonstrating how teachers in Florida can use PLT to meet the Sunshine State Standards and are restructuring workshops to demonstrate how PLT activities can help students prepare for assessment tests.

The Florida Department of Education sponsored a project to help Florida teachers meet the state achievement standards (the Sunshine State Standards) through environmental education. The Office of Environmental Education (OEE) developed *Teaching Naturally: Using the Environment to Improve Teaching and Learning*, “an interdisciplinary guide to the Standards with environment as an integrating concept”
(Ballas and Abrams, 1997). *Teaching Naturally* is both a how-to resource guide and an inspiration for teachers. A Florida principal who supports the use of EE in education reform claims:

An important element of making education work is making it interesting and relevant to our students. Becoming an EE Model School has helped us bring the real world into the classroom. We found our students tested better, making significant improvement in their writing and language arts skills because they were choosing to write about what interested them, which was the environment. In writing about the environment, their writing had meaning to them. (Ballas and Abrams, 1997, p. 3)

The guide gives teachers and principals help implementing EE to meet reform goals at all levels, from individual teachers who want to do one activity with their students, to whole schools that want to take an EIC type approach.

One other way to help teachers meet reform goals through infusing EE is to provide them with state or even regionally specific curriculum designed with their state standards in mind. Unfortunately, probably because this type of reform is new at the curriculum level, research to show that the union of EE and reform in this specific way has not been located. When such curriculum becomes available, it must be evaluated to measure its ability to improve students’ performance on standardized tests.

There is a need in Florida to show that environmental curricula can provide teachers with ways to include environmental education while still helping them show student achievement on the FCAT. This study used a short supplemental curriculum on biodiversity that was written to meet both science and writing standards at the high school level. The study was designed to measure change in knowledge and attitude about environmental science and improvement in writing skills as a result of exposure to the curriculum.
Research Question and Hypotheses

This study sought the answer to the research question, “Does an environmental curriculum designed to meet the needs of educators and scientists increase writing skills as measured by the state assessment rubric?” To accomplish this, the researcher designed the study to measure the effect of a curriculum guide that infuses writing and environmental concepts into ninth and tenth grade biological science courses in Florida on students’ environmental knowledge, attitude, and writing skills. The null hypotheses were that students who take part in the curriculum would: 1) not show a significant improvement in their writing skills; 2) not show a significant increase in environmental knowledge; and 3) not show a significant change in the direction of environmentally desirable attitudes.

The Curriculum

A specific curriculum addressing Florida biodiversity was selected for the basis of this study. It is particularly appropriate because it was designed to enable teachers to meet the SSS for science and language arts and to practice FCAT writing skills. Ninth and tenth grades are significant because tenth grade is the last year that students in Florida take the FCAT. Teachers at this level, especially science teachers are pressured to teach writing skills, may be seeking curricula to help their students prepare for the test.

The curriculum guide is designed around an Internet database that utilizes collection records from the Florida Museum of Natural History and documents from other Florida environmental agencies. The curriculum contains five lessons: four refer to museum-related content, and one focuses on writing skills. Through reading text on the computer, the students learn about the history and role of museums, the study of
taxonomy and how it affects scientific research, introduced species and how they affect an ecosystem, and the importance of biodiversity and how it affects their community.

The activity assignments in each lesson provide students with the opportunity to work with real scientific data and documents in the database interface. Students are able to use the collection records of the Florida Museum of Natural History and important scientific documents to discover what types of species live in their county, trends in species invasion, how taxonomy explains the relationships of similar species, and how protecting the Florida Scrub Jay affects the future of an important ecosystem in the state through searches in the Linking Interface.

Each of the four content lessons includes a writing assignment that helps students to focus on real-world environmental situations. In these essays, the students try to convince the state legislature to continue funding the Museum of Natural History, write a mock journal article describing a newly discovered species, explain their position on bringing a new species into the US, or convince someone why the Florida state bird should be changed from the mockingbird to the Florida scrub jay, depending on the lesson.

At the end of each lesson, the students complete an additional short lesson on writing to reinforce their understanding of effective writing and to give them practice editing and revising their papers. The lesson is structured around the FCAT writing rubric so that students gain a clear understanding of what graders for the writing portion of the FCAT will look for and how they generate a score for each student. The students read an explanation of what good writing is, examples of good and bad transitions, and examples of good and bad focus. Then, after completing the writing assignment for each
content lesson, they fill out a form based on either a partners essay or their own. This form helps the students evaluate the essay based on focus, support, organization, transitions, and conventions (see Appendix E for examples of scored writing samples). Even though the students write about science concepts in the lessons, they do not include content accuracy in the score because the rubric includes a skill analysis, rather than a content analysis. The skill analysis is based on presence and quality of writing attributes such as grammar, sentence structure, word choice, focus, transitional devices, and organization. (Lessons can be found at http://susdl.fcla.edu).

Methods

The following assessment tools were developed to measure change in attitudes, knowledge, and writing skills.

1. A pre-test (Appendix A) measures students’ attitudes about and knowledge of the environmental concepts covered in the guide. It includes ten multiple choice and four true/false questions to measure knowledge and six Likert scale questions to measure attitude. Several of the multiple-choice questions had multiple answers.

2. A post-test (Appendix B) measures students’ understanding of the database and their attitudes about and knowledge of the environmental concepts covered in the guide. The post-test contains the same questions as the pretest, and includes five additional questions about the use and contents of the database interface. These include two multiple choice and three true/false.

3. Improvement in writing was measured by using the FCAT rubric (Appendix C). The researcher applied the rubric to the first and last writing samples to determine pre- and post-curriculum score.
4. Teacher journals documented their progress and gave candid reactions of the curriculum, the study, and student involvement.

Table 3.1: Pre- and Post- FCAT-like Writing Prompts

<table>
<thead>
<tr>
<th>The Collection Connection: Museums of Natural History and Libraries</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Writing Situation:</strong> Museums of natural history have many important roles and serve a variety of audiences. <strong>Directions for Writing:</strong> Before you begin writing, think about the benefits and importance of natural history museums. Imagine that you are the head curator of the museum. You are about to lose a portion of your state funding. Write a letter to the state legislature explaining why they should continue to fully fund the museum.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The Biodiversity Dilemma</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Writing Situation:</strong> The mockingbird is Florida's current state bird. It receives special attention due to this status. The endangered Florida scrub jay is an important part of the biodiversity of the Florida sand pine scrub ecosystem. <strong>Directions for Writing:</strong> Before you begin writing, think about the importance of saving the Florida scrub jay and how it might help conserve more acres of important sand pine scrub in Florida. Now persuade the reader that changing the Florida state bird from the mockingbird to the scrub jay might help protect the scrub jay and the sand pine scrub.</td>
</tr>
</tbody>
</table>

Teacher Selection

Teachers were encouraged to volunteer for the study through several means. The researcher presented the curriculum at the annual conference of the League of Environmental Educators of Florida (LEEF), published an announcement in the LEEF newsletter, sent information to science teachers in Alachua county, and asked a Regional Service Project (RSP) representative to hand out fliers to potential participants. Six ninth and tenth grade biological science teachers in Florida volunteered to participate in the study – three from Miami and three from Gainesville. The teachers were offered a stipend of $150 for completing the study, a training manual, and ongoing support from the researcher.

Teacher Workshops

Two training sessions were held for participating teachers, one in Miami and one in Gainesville. These sessions were designed to facilitate the teachers use of the
computer database, to familiarize them with the curriculum guide, to make sure they understood the order of the activities, and to build their skills in teaching for the FCAT writing rubric. The teachers went through all of the lessons and discussed how to help students. Details of the data collection procedure were explained, as were the requirements of voluntary consent for student participation. The teachers were given an instruction manual to guide them through the study steps so that they would use the material consistently. Personal contact with the teachers was important to prepare them to use the guide with their students and increase their commitment to proper data collection procedures.

**Assessment Design**

Since there was no reasonable control available, the pre-test/post-test design was chosen to measure the curriculum’s effect on students’ abilities. A control class would necessitate that the teachers lead two different units simultaneously. The sample for the pre- and post-tests included all of the students in each class who gave verbal consent, whose parents consented to their participation, and who completed all components of the project. A smaller sample was randomly chosen from this population of students for the writing portion of the study due to the time-consuming task of grading two writing samples for each student.

To insure that any changes in the students’ writing skills and environmental knowledge and attitudes was the result of the *Linking* curriculum guide and not of other materials, the teachers were asked to complete the curriculum in four weeks. While this gives the teachers some flexibility, it lowers the chances that the results of this study will be skewed by other learning activities. Unfortunately, due to computer lab schedules and
database technical problems, all the teachers took much longer than four weeks; one teacher took four months. Possible effects of this are included in the discussion.

**Sampling**

Before the study began, the researcher gained approval from the University of Florida Institutional Review Board (IRB). IRB checks to make sure that a study will not cause any harm to participants and that the researcher is prepared to provide potential participants sufficient information before they agree to participate. Teachers signed a consent form, students agreed to a verbal consent statement, and parents provided a signed permission form. Only students who agreed to the verbal consent and provided the permission form were included in the study (Appendix D). Permission from the Alachua County Board of Education was also obtained to use Gainesville students in the study.

The study concluded with only two of the six original teachers. Two teachers from Miami were forced to drop out of the study due to a delay in the opening of a new computer lab. Two other teachers were eliminated from the study because they each provided complete data for fewer than ten students. The remaining two teachers were from Gainesville. All of their students were enrolled in the lowest level of mainstream ninth or tenth grade science. The ninth graders were in Integrated Science and the tenth grade students were in Biotech (a hands-on version of Biology One). All of the students who completed every part of the study were included in the content analysis (n=132). The sample is 61% Caucasian, 33% African American, 3% Hispanic, and 3% other, 48% male and 52% female, and closely resembles the entire population of their classes. Because of limited time to score the written essays, only ten students from each class (when available) were randomly selected for inclusion in the writing analysis (n=99).
Procedures

The teachers administered the pre-test (Appendix A), assisted the students as they completed all of the lessons, and then administered the post-test (Appendix B). The teachers submitted the parent permission forms, pre-tests, post-tests, the museum essay, and the biodiversity essay to the researcher. Once all of the data were collected, each student was assigned a code based on the teacher and the class period.

The researcher trained a consultant to use the FCAT rubric to score the writing essays. Both the researcher and the consultant scored all 198 essays for the 99 students selected for this part of the study. Possible scores range from 0 to 6 and are based on grammar, word choice, sentence structure, organization, transitional devices, support, and focus. The scores for each category were combined to come up with an average for each essay. For 73% of the essays, the researcher and consultant scored the essays the same. When the graders’ scores were different, they discussed all of the components and then negotiated a final score for the essay. (See Appendix E for examples of writing samples).

The researcher scored the knowledge questions by assigning a percentage to each combination of answers on a continuum from completely right to completely wrong. This method enabled a record of partial improvement. The figure below explains the way each type of question was scored (Table 3.2). The questions were divided into four themes that matched the four content lessons: museums, taxonomy, introduced species, and biodiversity. The scores for the questions in each theme were averaged to compute an overall theme score.
Table 3.2: Scoring Key for Multiple-Choice Questions on the Content Pre- and Post-test

<table>
<thead>
<tr>
<th>If One Right Answer</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>Right answer selected</td>
</tr>
<tr>
<td>75%</td>
<td>Right answer and 1 wrong answer selected</td>
</tr>
<tr>
<td>50%</td>
<td>Right answer and 2 wrong answers selected</td>
</tr>
<tr>
<td>25%</td>
<td>Right answer and 3 wrong answers selected</td>
</tr>
<tr>
<td>0%</td>
<td>1-3 wrong answers selected</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>If Two Right Answers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>Both right answers selected</td>
</tr>
<tr>
<td>83.35%</td>
<td>Both right and 1 wrong answer selected</td>
</tr>
<tr>
<td>66.7%</td>
<td>Both right and 2 wrong answers selected</td>
</tr>
<tr>
<td>50%</td>
<td>One right answer selected</td>
</tr>
<tr>
<td>33.3%</td>
<td>One right and 1 wrong answer selected</td>
</tr>
<tr>
<td>16.65%</td>
<td>One right and 2 wrong answers selected</td>
</tr>
<tr>
<td>0%</td>
<td>1-2 wrong answers selected</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>If Three Right Answers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>Three right answers selected</td>
</tr>
<tr>
<td>83.35%</td>
<td>Three right and 1 wrong answer selected</td>
</tr>
<tr>
<td>66.7%</td>
<td>Two right and 1 wrong answer selected</td>
</tr>
<tr>
<td>50%</td>
<td>Two right and 1 wrong answer selected</td>
</tr>
<tr>
<td>33.3%</td>
<td>One right answer selected</td>
</tr>
<tr>
<td>16.65%</td>
<td>One right and 1 wrong answer selected</td>
</tr>
<tr>
<td>0%</td>
<td>1 wrong answer selected</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>If Four Right Answers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>Four right answers selected</td>
</tr>
<tr>
<td>75%</td>
<td>Three right answers selected</td>
</tr>
<tr>
<td>50%</td>
<td>Two right answers selected</td>
</tr>
<tr>
<td>25%</td>
<td>One right answer selected</td>
</tr>
</tbody>
</table>

The data were entered into an Excel spreadsheet and then converted into SPSS version 10.0 (SPSS, 1999). Paired t-tests were used to detect significant change from pre- to post-test in writing skills, knowledge, and attitudes at the p < 0.05 level. Descriptive statistics were used to analyze the database questions.

**Results**

**Knowledge**

Results of the paired t-test show significant increase in knowledge for only the biodiversity theme (p<.000) (Table 3.3).
Table 3.3: Knowledge Scores, n=132

<table>
<thead>
<tr>
<th>Theme</th>
<th>Pre Mean (%)** (SD-%)</th>
<th>Post Mean (%)** (SD-%)</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Museums</td>
<td>71.42 (18.70)</td>
<td>73.69 (15.60)</td>
<td>-1.31</td>
<td>131</td>
<td>n.s.</td>
</tr>
<tr>
<td>Taxonomy</td>
<td>67.26 (27.47)</td>
<td>72.60 (24.31)</td>
<td>-170</td>
<td>131</td>
<td>n.s.</td>
</tr>
<tr>
<td>Introduced Species</td>
<td>40.55 (24.17)</td>
<td>43.64 (23.80)</td>
<td>-1.20</td>
<td>131</td>
<td>n.s.</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>54.69 (28.34)</td>
<td>73.32 (28.18)</td>
<td>-7.02</td>
<td>131</td>
<td>.000*</td>
</tr>
</tbody>
</table>

*Significant at the p<0.05 level
**Percentage correct out of 100%

Database

The post-test contains five questions that relate to the database, but the students only showed competence answering the question about searching for “turtle” in the Linking Interface (Table 3.4).

Table 3.4: Students Database Scores, n=132

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean Score (%)*</th>
<th>Type of Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>If you wanted to find out how many largemouth bass were collected in Florida during a certain year, which database would you use?</td>
<td>50.48</td>
<td>Multiple choice</td>
</tr>
<tr>
<td>Which of the following is information you will not find when you search the museum collection records in the Linking Database?</td>
<td>22.35</td>
<td>Multiple choice</td>
</tr>
<tr>
<td>You can search only one of the Linking databases at a time.</td>
<td>50.85</td>
<td>True/False</td>
</tr>
<tr>
<td>You must search by scientific name to get information from the full text records.</td>
<td>59.85</td>
<td>True/False</td>
</tr>
<tr>
<td>If you searched on “turtle” in the museum database, you would get just one species of turtle back in your results?</td>
<td>88.64</td>
<td>True/False</td>
</tr>
</tbody>
</table>

*Percentage correct out of 100%
Attitudes

Three of the six questions show a significant change from pre- to post-test (Table 3.5). All changed in the direction of more environmentally desirable attitudes.

<table>
<thead>
<tr>
<th>Attitude Questions</th>
<th>Pre Mean** (SD)</th>
<th>Post Mean** (SD)</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is OK for me to release a pet turtle into a pond even if this turtle is native to another part of the world.</td>
<td>.25 (.98)</td>
<td>.54 (.93)</td>
<td>-3.395</td>
<td>123</td>
<td>.001*</td>
</tr>
<tr>
<td>It is OK to plant an exotic species that you know will bring certain benefits as long as you keep it confined.</td>
<td>-.008 (.98)</td>
<td>.024 (.97)</td>
<td>-.334</td>
<td>123</td>
<td>n.s.</td>
</tr>
<tr>
<td>It would not be interesting to have a career as a scientist.</td>
<td>-.57 (1.10)</td>
<td>-.32 (1.16)</td>
<td>-2.268</td>
<td>123</td>
<td>.025*</td>
</tr>
<tr>
<td>It takes years and years of training to make contributions to science.</td>
<td>-.19 (1.09)</td>
<td>-.065 (1.17)</td>
<td>-1.11</td>
<td>123</td>
<td>n.s.</td>
</tr>
<tr>
<td>Scientific names are really confusing.</td>
<td>-.52 (1.16)</td>
<td>-.65 (1.09)</td>
<td>1.37</td>
<td>123</td>
<td>n.s.</td>
</tr>
<tr>
<td>There are many things I can do to protect biodiversity.</td>
<td>.56 (.76)</td>
<td>.75 (.72)</td>
<td>-2.870</td>
<td>123</td>
<td>.005*</td>
</tr>
</tbody>
</table>

*Significant at the p<0.05 level
**Score scale: +2=most ideal to –2=least ideal

Writing

The paired t-test revealed a significant difference between the pre- and post-test writing scores (p< 0.00) (Table 3.6). The students averaged an increase of .61 on a six-point scale that measures presence and quality of writing attributes such as grammar, sentence structure, word choice, focus, transitional devices, and organization.
Table 3.6: Student Writing Scores, n=99

<table>
<thead>
<tr>
<th>Pretreatment Mean** (SD)</th>
<th>Posttreatment Mean** (SD)</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.28 (.87)</td>
<td>2.89 (1.01)</td>
<td>-6.957</td>
<td>98</td>
<td>0.00*</td>
</tr>
</tbody>
</table>

*Significant at the p<0.05 level
**Possible scores range from 0 to 6

Discussion

Because teacher journals revealed that there were inconsistencies in the curriculum implementation, the researcher conducted an independent t-test to detect any difference between students taught by two teachers for all of the measures. There was a significant difference between the two teachers in two of the four knowledge pre-test themes and two of the four post-test themes (p < 0.00). This was judged to be an important difference, and therefore, the knowledge results for each teacher were analyzed individually for the sake of discussion.

Teacher A’s students show a significant gain in knowledge from pre- to post-test in the museum, taxonomy, and biodiversity themes, but no significant difference was found for the introduced species theme (Table 3.7).

Table 3.7: Teacher A students’ knowledge scores, n=62

<table>
<thead>
<tr>
<th></th>
<th>Pre Mean (%) (SD-%)</th>
<th>Post Mean (%) (SD-%)</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Museums</td>
<td>66.13 (18.06)</td>
<td>71.69 (14.92)</td>
<td>-2.37</td>
<td>61</td>
<td>.021*</td>
</tr>
<tr>
<td>Taxonomy</td>
<td>59.33 (29.33)</td>
<td>79.17 (21.90)</td>
<td>-4.48</td>
<td>61</td>
<td>.000*</td>
</tr>
<tr>
<td>Introduced Species</td>
<td>41.35 (26.18)</td>
<td>47.31 (23.63)</td>
<td>-1.50</td>
<td>61</td>
<td>n.s.</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>56.67 (29.39)</td>
<td>86.43 (23.80)</td>
<td>-8.61</td>
<td>61</td>
<td>.000*</td>
</tr>
</tbody>
</table>

*Significant at the p<0.05 level

Teacher B’s students show a significant gain in knowledge from pre- to post-test only in the biodiversity theme (Table 3.8).
Table 3.8: Teacher B students’ knowledge scores, n=70

<table>
<thead>
<tr>
<th></th>
<th>Pre Mean (%) (SD-%)</th>
<th>Post Mean (%) (SD-%)</th>
<th>T</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Museums</td>
<td>76.11 (18.11)</td>
<td>75.46 (16.08)</td>
<td>0.26</td>
<td>69</td>
<td>n.s.</td>
</tr>
<tr>
<td>Taxonomy</td>
<td>74.29 (23.77)</td>
<td>66.79 (25.08)</td>
<td>1.88</td>
<td>69</td>
<td>n.s.</td>
</tr>
<tr>
<td>Introduced Species</td>
<td>39.84 (22.40)</td>
<td>40.40 (23.64)</td>
<td>-0.16</td>
<td>69</td>
<td>n.s.</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>52.93 (27.56)</td>
<td>61.70 (26.76)</td>
<td>-2.44</td>
<td>69</td>
<td>.017*</td>
</tr>
</tbody>
</table>

*Significant at the p<0.05 level

The variation in the way the two teachers’ classes completed the lessons no doubt accounts for variation in the students’ learning and therefore test scores. Teacher A’s classes had fewer technical problems with the database and therefore were exposed to the content and database activities more consistently and with fewer complications. She warned her students that they would have to take a test and let them review the reading materials to prepare for it. Teacher B’s experience was different. He started earlier in the year and was forced to stop the process while the database was improved; a period of four months elapsed between content lessons two and three. He did not intervene in the learning process, let the curriculum provide all the instruction, and did not return to the earlier lessons after the database was improved.

Because Teacher A’s student knowledge scores increased for the museum, taxonomy, and biodiversity themes and Teacher B’s scores increased for only the biodiversity theme, one can presume that classroom instruction played a role in student learning. The Biodiversity lesson was also the last lesson covered before the post-test. All of this implies that reading the computer screen for information may not be sufficient; teachers of the future will always be needed to instruct students and manage classrooms directly, and that lessons should be competed in a timely manner.
The low post-test scores on the database questions may be a reflection of several factors: 1) the challenges students faced using the Interface, 2) the lack of time using the Interface, 3) not enough emphasis in the curriculum on the Interface, or 4) the difficulty of the questions. Because the database was not finished when the questions were designed, the researcher was not able to pilot test them with students. Pilot testing the questions with students having used the curriculum might have reduced this problem.

Results of the six attitude questions indicate that significant change occurred with three items. These items relied on individual, subjective reaction to the statements and described fairly simple concepts. The items that did not have a significant change pre- to post- were more abstract and complex. For example, the first two questions deal with similar ideas, non-native species, but the one in which the students show more of an increase includes a reference to “me,” while the other refers to “you.” Also, for the more complex questions, it is possible that the more a student learns the more he or she realizes he or she does not know. For example, the student who is learning about scientific names for the first time may move toward a more negative response for the item “scientific names are confusing” because the he or she learns that a species has seven names rather than just one.

Providing students with interesting topics to write about, straightforward information about good writing, and practice editing and revising their papers helped these students improve their writing skills and may help them do better on the FCAT writing test. In the journals and in conversations with the researcher, the teachers expressed that they liked the writing assignments because they were interesting and applied directly to the lessons. Educators have long assumed that when students read
about relevant and interesting things, their attention and thoughtfulness increases (Anderson, Shirey, Wilson, and Fielding, 1987; Hidi and Baird, 1988; Hidi, Baird, and Hildyard, 1982). This is probably true with writing as well. Baer (1988) found that when students write about interesting topics, they had a better attitude toward writing. Interestingness, straightforward information, and practice all could have helped increase writing test scores in this study.

Limitations

This study has several limitations relating to teachers, students, the database interface, assessment tools, and general study design. Because teachers are so busy, it was difficult to find teachers who were willing or able to participate in the study. This limits the design of the study because those who volunteered were not randomly chosen; they all showed an interest in the curriculum. Difficulties in computer availability and student consent further reduced the sample, as did student absences and transfers.

Because the teachers were also pilot-testing the Linking Interface, they faced many technical difficulties that might have affected the results of the study. One teacher reported several system crashes when more than five students were using the Interface on-line. He gave up and waited for the system controllers to install new software that allows up to 100 users. His students did not return to the missed curricular material.

Although the pre- and post-tests were reviewed by ten students, there was no opportunity to pilot test the questions for readability, vocabulary, age appropriateness, and difficulty. Some of the questions may have been too difficult for the experience and the age group or may not have been covered sufficiently in the curriculum. According to an independent reviewer, five out of nineteen items were covered less thoroughly in the
curriculum than the others. This suggests that the subject matter covered by some questions may be relatively unfamiliar to students, reducing the likelihood of a significant improvement in knowledge scores.

It is difficult to write questions that accurately measure attitudes, and when this is possible, it is difficult to see a change in such a short time period. Since the researcher did not use qualitative measures, the evaluation for attitudes was limited.

The FCAT rubric was developed for scoring writing skills in the absence of meaningful content. The FCAT-like assignments in the curriculum required the students to include scientific information. As a result there is no way to score incorrect information. This made grading more difficult and subjective than scoring the FCAT would be with non-scientific prompts.

Future Research

It important that other curricula around the country are located that have been designed to meet education reform goals in a way similar to the biodiversity curriculum because of the needs it can fill. Someone should conduct other evaluations of the curricula that is located to develop a composite sketch indicating that curricula designed to meet localized standards does improve student achievement on assessment tests.

In this age of computers, we do not know enough about the impact they have or could have on learning. Based on the feedback from the teachers in the study, students enjoy the activities on computers, but did not enjoy reading the informational web pages. Studies that compared knowledge gained from reading text on a computer screen with knowledge gained from reading text in a book with equal teacher intervention would help improve the understanding of computers as a teaching tool.
Conclusion

As education reform alters the challenges teachers face, curriculum developers must provide curriculum materials that first and foremost help teachers accomplish their educational goals. This study provided a positive answer to the research question “Does an environmental curriculum designed to meet the needs of educators and scientists increase writing skills as measured by the state assessment rubric?” This biodiversity curriculum guide also provided a positive answer to the questions: 1) does combining writing and environmental content improve writing skills among ninth and tenth grade students? 2) will students increase their environmental knowledge? and 3) will students move toward the more environmentally desirable attitude?

Instead of requiring teachers to modify existing materials, the curriculum is designed to provide teachers with a series of lessons that accomplish both education reform and environmental education goals. Because the study found that this curriculum does improve writing skills while showing some increase in environmental knowledge and change in environmental attitudes, Florida teachers may be willing to use this curriculum guide. Since the study offers promise to EE in light of education reform, curriculum developers across the United States may be encouraged to use this guide as a model for other curriculum development efforts. This can lead to more curricula that meets standards-based education reform goals, and increase in environmental education, and thus, a more literate citizenry.
All over the country, in the classrooms of teachers struggling to improve teaching to meet new reform goals, environmental education (EE) is being pushed aside. Curriculum developers can design environmental curriculum, however, to help teachers achieve reform goals. Previous studies show that environmental curriculum can meet reform goals at the school level (Lieberman and Hoody, 1998; Model Links, 1999). This study shows that it is possible to meet education reform goals at the classroom level.

Standards and assessment tests vary from state to state. States with standards and assessment tests hold teachers accountable for quality education by checking lesson plans and student test scores. Therefore, considering the unique, state-imposed instructional needs of teachers is essential when designing and implementing supplemental environmental education curriculum materials.

Many supplemental curricula are designed around the research data of scientists. Scientists and other experts have a great deal to share with educators, but must be able to translate their information into curricula that help teachers meet their education reform goals. To put this type of information into a form that will successfully reach kids, scientists need to be part of a team with educators and curriculum developers. This collaboration of curriculum designers, educators, and scientists will increase the likelihood that reform goals, basic education goals, and scientific goals are met.

The development of the Linking biodiversity curriculum guide and the “Linking Florida’s Natural Heritage” Interface is a good example of scientists, educators, and
curriculum developers fulfilling the goals of all stakeholders to create effective supplemental curriculum. The curriculum contains five lessons: four that cover biodiversity content and one that emphasizes writing. Teachers felt the curriculum challenged their students and helped prepare them for the state writing assessment test, students enjoyed using the Linking Interface, and the agencies participating in the project were able to disseminate current and historical data.

Through a pre-/post-test design, students made significant gains in writing skills after using the curriculum. The researcher recommends that other curriculum developers follow a similar format when designing supplemental curriculum by: 1) designing lessons based on grade level standards, 2) including practice for skills assessed in state tests, 3) using a design team of all stakeholders, and 4) evaluating the curriculum to ensure that it addresses state reform goals. Since writing is a basic skill, any curriculum that helps improve writing should attract teachers’ interest. In the case of the Linking Interface, students not only improved writing, but also improved environmental knowledge and attitudes.

The first part of this thesis explains that scientific experts can reach students successfully by overcoming technology and curriculum barriers. To overcome these barriers they must use a web query agent and other technology features, and work with curriculum specialists and teachers to meets general teaching goals and standards-based education reform goals of teachers. The second part of this thesis shows that curriculum can be developed that improves writing skills while showing some increase in environmental knowledge and change in environmental attitudes through an evaluation of
a curriculum that uses a database interface that utilizes a web query agent to disseminate information and lessons designed to address education reform goals in Florida.
APPENDIX A

CONTENT PRE-TEST
Linking Florida's Natural Heritage
Biodiversity Survey

Multiple Choice (Circle the letter of the best answer(s))

1) Which of the following is not a role of a museum of natural history?
   a) Taming animals
   b) Conducting research
   c) Collecting specimens
   d) Educating people

2) Which scenario aids the invasion of an introduced species? (circle all that apply)
   a) Few predators
   b) Able to reproduce in its new habitat
   c) The presence of lots of other species to push out
   d) An empty place to live

3) Once they return to the museum, how do scientists keep track of plants and animals they find in the field? (circle all that apply)
   a) In hand written journals
   b) In a computer database
   c) In jars on shelves
   d) In their memory

4) What is an indigenous species? (circle all that apply)
   a) A species from India
   b) An introduced species
   c) A naturalized species
   d) A native species
5) Linnaeus’ is important because: (circle all that apply)
   a) He and his students gave scientific names to all plants and animals in
      the world.
   b) He came up with a binomial naming system for naming species of plants
      and animals.
   c) He invented the Latin language to name plant and animal specimens.
   d) He came up with the system for describing new plant and animal
      specimens.

6) Which of the following groups does the Florida Museum of Natural
   History serve? (circle all that apply)
   a) The general public
   b) Scientists
   c) Historians
   d) Students

7) Which of the following is the best definition of biodiversity?
   a) The variety of living organisms in an ecosystem
   b) The amount of organisms living in an ecosystem (even if they are the
      same species)
   c) The diversity of biomes in the world
   d) All the animals in a food web

8) A keystone species is one that:
   a) Lives in the center of an ecosystem
   b) Was the first species discovered in that ecosystem
   c) Lives under rocks
   d) Many other species are dependent upon

9) Which of the following are ways that scientists take a record of species
    found in the field back to the museum? (circle all that apply)
   a) Take a DNA sample
   b) Take a picture
   c) Take the actual plant or animal specimen
   d) Draw a picture
10) Circle the two most important causes of loss of biodiversity
   a) Road kill
   b) Habitat loss
   c) Disease
   d) Invasive species

**True/False Section**

Circle “T” if you feel the statement is Correct and “F” if you feel the statement is incorrect.

11) T/F The connecting link between the museum specimen and the library literature is the name of the specimen.

12) T/F We use Spanish as the official language for scientific names.

13) T/F The Florida panther is a distinct subspecies of the mountain lion even though they can interbreed.

14) T/F A species that takes over a new area through range extension is considered invasive by means of accidental introduction.

**Attitude Assessment**

There are NO right or wrong answers on this part of the survey. Read each question carefully. Circle the description that best matches how YOU FEEL about each statement.

15) It is OK for me to release a pet turtle into a pond even if this turtle is native to another part of the world.

   Strongly Disagree Neutral/ Agree Strongly Agree
   Disagree Not Sure

16) It is OK to plant an exotic species that you know will bring certain benefits as long as you keep it confined.

   Strongly Disagree Neutral/ Agree Strongly Agree
   Disagree Not Sure
17) It would **not** be interesting to have a career as a scientist.

<table>
<thead>
<tr>
<th>Strongly</th>
<th>Disagree</th>
<th>Neutral/Not Sure</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

18) It takes years and years of training to make contributions to science.

<table>
<thead>
<tr>
<th>Strongly</th>
<th>Disagree</th>
<th>Neutral/Not Sure</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

19) Scientific names are really confusing.

<table>
<thead>
<tr>
<th>Strongly</th>
<th>Disagree</th>
<th>Neutral/Not Sure</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>

20) There are many things I can do to protect biodiversity.

<table>
<thead>
<tr>
<th>Strongly</th>
<th>Disagree</th>
<th>Neutral/Not Sure</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
</table>
APPENDIX B

CONTENT POST-TEST
Multiple Choice  (Circle the letter of the best answer(s))

1) Which of the following is not a role of a museum of natural history?
   a) Taming animals
   b) Conducting research
   c) Collecting specimens
   d) Educating people

2) Which scenario aids the invasion of an introduced species? (circle all that apply)
   a) Few predators
   b) Able to reproduce in its new habitat
   c) The presence of lots of other species to push out
   d) An empty place to live

3) If you wanted to find out how many largemouth bass were collected in Florida during a certain year, which database would you use?
   a) Full texts
   b) Library
   c) Ichthyology
   d) Herpetology

4) Once they return to the museum, how do scientists keep track of plants and animals they find in the field? (circle all that apply)
   a) In hand written journals
   b) In a computer database
   c) In jars on shelves
   d) In their memory
5) What is an indigenous species? (circle all that apply)
   a) A species from India
   b) An introduced species
   c) A naturalized species
   d) A native species

6) Linnaeus’ is important because: (circle all that apply)
   a) He and his students gave scientific names to all plants and animals in the world.
   b) He came up with a binomial naming system for naming species of plants and animals.
   c) He invented the Latin language to name plant and animal specimens.
   d) He came up with the system for describing new plant and animal specimens.

7) Which of the following groups does the Florida Museum of Natural History serve? (circle all that apply)
   a) The general public
   b) Scientists
   c) Historians
   d) Students

8) Which of the following is the best definition of biodiversity?
   a) The variety of living organisms in an ecosystem
   b) The amount of organisms living in an ecosystem (even if they are the same species)
   c) The diversity of biomes in the world
   d) All the animals in a food web

9) A keystone species is one that:
   a) Lives in the center of an ecosystem
   b) Was the first species discovered in that ecosystem
   c) Lives under rocks
   d) Many other species are dependent upon
10) Which of the following are ways that scientists take a record of species found in the field back to the museum? (circle all that apply)
   a) Take a DNA sample
   b) Take a picture
   c) Take the actual plant or animal specimen
   d) Draw a picture

11) Circle the two most important causes of loss of biodiversity
   a) Road kill
   b) Habitat loss
   c) Disease
   d) Invasive species

12) Which of the following is information you will not find when you search the museum collection records in the Linking Database?
   a) The person who collected the specimen
   b) The state in which the specimen was found
   c) The city in which the specimen was found
   d) The common name of the specimen

**True/False Section**

Circle “T” if you feel the statement is Correct and “F” if you feel the statement is incorrect.

13)  T/F The connecting link between the museum specimen and the library literature is the name of the specimen.

14)  T/F You can search only one of the linking databases at a time.

15)  T/F We use Spanish as the official language for scientific names.

16)  T/F You must search by scientific name to get information from the full text records.

17)  T/F The Florida panther is a distinct subspecies of the mountain lion even though they can interbreed.
18) T/F If you searched on "turtle" in the museum database, you would get just one species of turtle back in your results?

19) T/F A species that takes over a new area through range extension is considered invasive by means of accidental introduction.

**Attitude Assessment**

There are NO right or wrong answers on this part of the survey. Read each question carefully. Circle the description that best matches how **YOU FEEL** about each statement.

20) It is **OK** for me to release a pet turtle into a pond even if this turtle is native to another part of the world.

   | Strongly Disagree | Neutral/Agree | Agree | Strongly Agree |
   | Strongly Disagree | Neutral/Not Sure | Agree | Agree |

21) It is **OK** to plant an exotic species that you know will bring certain benefits as long as you keep it confined.

   | Strongly Disagree | Neutral/Agree | Agree | Strongly Agree |
   | Strongly Disagree | Neutral/Not Sure | Agree | Agree |

22) It would **not** be interesting to have a career as a scientist.

   | Strongly Disagree | Neutral/Agree | Agree | Strongly Agree |
   | Strongly Disagree | Neutral/Not Sure | Agree | Agree |

23) It takes years and years of training to make contributions to science.

   | Strongly Disagree | Neutral/Agree | Agree | Strongly Agree |
   | Strongly Disagree | Neutral/Not Sure | Agree | Agree |

24) Scientific names are really confusing.

   | Strongly Disagree | Neutral/Agree | Agree | Strongly Agree |
   | Strongly Disagree | Neutral/Not Sure | Agree | Agree |

25) There are many things I can do to protect biodiversity.

   | Strongly Disagree | Neutral/Agree | Agree | Strongly Agree |
   | Strongly Disagree | Neutral/Not Sure | Agree | Agree |
APPENDIX C

FCAT WRITING RUBRIC
SCORING METHOD AND RUBRIC USED IN 1999

DEFINITION OF HOLISTIC SCORING

Holistic scoring is a method by which trained readers evaluate a piece of writing for its overall quality. The holistic method used in Florida requires readers to evaluate the work as a whole, while considering four elements: focus, organization, support, and conventions. This method is sometimes called focused holistic scoring. In this type of scoring, readers make a judgment about the entire response rather than focusing exclusively on any one aspect.

Focus

Focus refers to how clearly the paper presents and maintains a main idea, theme, or unifying point.

- Papers receiving lower and middle scores may contain information that is loosely related, extraneous, or both.
- Papers receiving higher scores demonstrate a consistent awareness of the topic and avoid loosely related or extraneous information.

Organization

Organization refers to the structure or plan of development (beginning, middle, and end) and the relationship of one point to another. Organization refers to the use of transitional devices (terms, phrases, and variations in sentence structure) to signal (1) the relationship of the supporting ideas to the main idea, theme, or unifying point and (2) the connections between and among sentences.

- Papers receiving lower scores may lack transitional devices and summary or concluding statements.
- Papers receiving higher scores use transitional devices (signals of the text plan or structure) and developed conclusions.

Support

Support refers to the quality of details used to explain, clarify, or define. The quality of the support depends on word choice, specificity, depth, credibility, and thoroughness.

- Papers receiving lower and middle scores may contain support that is a bare list of events or reasons, support that is extended by a detail, or both.
- Papers receiving higher scores provide elaborated examples and fully developed illustrations, and the relationship between the supporting ideas and the topic is clear.
<table>
<thead>
<tr>
<th>Conventions</th>
<th>Conventions refer to the punctuation, capitalization, spelling, and sentence structure. These conventions are basic writing skills included in Florida's Sunshine State Standards.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Papers receiving lower and middle scores may contain some or many errors in punctuation, capitalization, spelling, and sentence structure, and may have little variation in sentence structure.</td>
</tr>
<tr>
<td></td>
<td>• Papers receiving higher scores follow, with few exceptions, the conventions of punctuation, capitalization, and spelling, and use a variety of sentence structures to present ideas.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SCORE POINTS IN RUBRIC</th>
<th>The rubric further interprets the four major areas of consideration into levels of achievement. The rubric used to score papers in spring 1999 is shown below.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 Points</td>
<td>The writing is focused and purposeful, and it reflects insight into the writing situation. The organizational pattern provides for a logical progression of ideas. Effective use of transitional devices contributes to a sense of completeness. The development of the support is substantial, specific, relevant, and concrete. The writer shows commitment to and involvement with the subject and may use creative writing strategies. The writing demonstrates a mature command of language with freshness of expression. Sentence structure is varied, and few, if any, convention errors occur in mechanics, usage, punctuation, and spelling.</td>
</tr>
<tr>
<td>5 Points</td>
<td>The writing is focused on the topic, and its organizational pattern provides for a logical progression of ideas. Effective use of transitional devices contributes to a sense of completeness. The support is developed through ample use of specific details and examples. The writing demonstrates a mature command of language, and there is variation in sentence structure. The response generally follows the conventions of mechanics, usage, punctuation, and spelling.</td>
</tr>
<tr>
<td>4 Points</td>
<td>The writing is focused on the topic and includes few, if any, loosely related ideas. An organizational pattern is apparent, and it is strengthened by the use of transitional devices. The support is consistently developed, but it may lack specificity. Word choice is adequate, and variation in sentence structure is demonstrated. The response generally follows the conventions of mechanics, usage, punctuation, and spelling.</td>
</tr>
<tr>
<td>Points</td>
<td>Description</td>
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</tr>
<tr>
<td>3 Points</td>
<td>The writing is focused but may contain ideas that are loosely connected to the topic. An organizational pattern is demonstrated, but the response may lack a logical progression of ideas. Development of support is uneven. Word choice is adequate, and some variation in sentence structure is demonstrated. The response generally follows the conventions of mechanics, usage, punctuation, and spelling.</td>
</tr>
<tr>
<td>2 Points</td>
<td>The writing addresses the topic but may lose focus by including extraneous or loosely related ideas. The organizational pattern usually includes a beginning, middle, and ending, but these elements may be brief. The development of the support may be erratic and nonspecific, and ideas may be repeated. Word choice may be limited, predictable, or vague. Errors may occur in the basic conventions of sentence structure, mechanics, usage, and punctuation, but commonly used words are usually spelled correctly.</td>
</tr>
<tr>
<td>1 Point</td>
<td>The writing addresses the topic but may lose focus by including extraneous or loosely related ideas. The response may have an organizational pattern, but it may lack a sense of completeness or closure. There is little, if any, development of the supporting ideas, and the support may consist of generalizations or fragmentary lists. Limited or inappropriate word choice may obscure meaning. Frequent and blatant errors may occur in the basic conventions of sentence structure, mechanics, usage, and punctuation, and commonly used words may be misspelled.</td>
</tr>
<tr>
<td>Unscorable</td>
<td>The paper is unscorable because:</td>
</tr>
<tr>
<td></td>
<td>• the response is not related to what the prompt requested the student to do,</td>
</tr>
<tr>
<td></td>
<td>• the response is simply a rewording of the prompt,</td>
</tr>
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<td></td>
<td>• the response is a copy of a published work,</td>
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<td></td>
<td>• the student refused to write,</td>
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<td></td>
<td>• the response is illegible,</td>
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<td></td>
<td>• the response is written in a foreign language,</td>
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<td></td>
<td>• the response is incomprehensible (words are arranged in such a way that no meaning is conveyed),</td>
</tr>
<tr>
<td></td>
<td>• the response contains an insufficient amount of writing to determine if the student was attempting to address the prompt, or</td>
</tr>
<tr>
<td></td>
<td>• the writing folder is blank.</td>
</tr>
</tbody>
</table>
APPENDIX D

INSTITUTIONAL REVIEW BOARD FORMS
Dear Educator:

I am a graduate student in the School of Forest Resources and Conservation at the University of Florida, conducting research on improving the writing skills of high school students through environmental education under the supervision of Dr. Martha Monroe. The purpose of this study is to assess whether or not using the environment as an inspiring topic along with a writing lesson can improve the writing skills of participants. The results of the study should help educators better understand how the curriculum guide can help educators improve writing skills.

Along with submitting the first and last writing samples and the pre- and post-test of each student, I'm requesting that you submit a log or journal of your experiences using the curriculum. This should include a record of which activities you used, your observations of the students, problems and successes they might have, your own challenges and successes, and suggestions for improvement of the database and the curriculum.

This log should also include, if applicable, how you changed the activities. (You won't be penalized for changing, but we will need to know what you do to keep accurate records.) You will not have to complete any part of the log you do not wish to complete. The implementation of the curriculum should take you approximately ten class periods.

Only I will have access to the journals. Your identity will be kept confidential to the extent provided by law. If any quoted are used in the report, your ideas will be identified by a code.

There are no anticipated risks to you as a participant in this study. You will receive a compensation of $200 for completing the study. You are free to withdraw your consent to participate and may discontinue your participation at any time without consequence.

If you have any questions about this research protocol, please contact me at 352-367-3787 or my faculty supervisor, Dr. Martha Monroe, at 352-846-0878. Questions or concerns about your rights as a research participant may be directed to the IRB office, University of Florida, Box 112250, Gainesville, FL 32611, and phone 352-352-0433.

If you wish to volunteer for this research, please sign this copy of the letter. A second copy is provided for your records. By signing this letter, you give me permission to report your responses anonymously in my thesis and other papers.

Jeanette Randall

I have read the procedure described above for the study of writing skills and the environment. I voluntarily agree to participate in the study and I have received a copy of this description.

Signature of participant Date

☐ I would like to receive a summary of the final report when it is available.

APPROVED BY

University of Florida
Institutional Review Board (IRB)
Protocol # 2660-012
For Use Through Aug 28, 2001
Assent Script

Teachers—Please read this to your class as you distribute the Parent Consent form.

“We will be testing a new unit on biodiversity that is part of Jeanette Randall’s graduate thesis at the University of Florida. Because all the assignments are part of class, you don’t have any choice in doing them, but you do have a choice about whether or not you allow me to submit your work to the researchers. There are no known risks or immediate benefits to you for participating in the study, and neither participating nor not participating will affect your grade in any way.

Your identity will be kept confidential to the extent provided by law. Your information will be assigned a code number. The list connecting your name to this number will be kept in a secure place. When the study is completed and the data have been analyzed, the list will be destroyed. Your name will not be used in any report.

I would like each one of you to come up and tell me whether or not you would like to participate in this study. If you say yes now, you have the right to withdraw from the study at any time. If you say no, there is no penalty.

Please take this form home and ask a parent to read and sign it.”
Dear Parent/Guardian,

I am a graduate student in the School of Forest Resources and Conservation at the University of Florida, conducting research on improving the writing skills of high school students through environmental education under the supervision of Dr. Martha Monroe. The purpose of this study is to assess if using activities about biodiversity along with a writing lesson can improve the writing skills of participants. The results of the study may help educators better understand how to make curriculum materials effective in improving writing skills. These results may not directly help your teenager today, but may benefit future students. With your permission, I would like to ask your student to volunteer for this research.

Your teenager's teacher has chosen to implement a ten-day unit on biodiversity. As part of this unit, students will access the Florida Museum of Natural History database and use it to explore Florida's biodiversity. My study will analyze a pre-test, post-test, and two writing exercises that relate to this unit. As an additional part of the study, the teacher will submit two samples of the students' writing from exercises on biodiversity. These will be evaluated to measure change in writing skills. Participating in the study will not require your student to do any additional work, it just means that he or she will allow the teacher to submit work already completed.

Although the students will be asked to write their names on the writing samples and pre- and post-tests for matching purposes, their identity will be kept confidential to the extent provided by law. We will replace their names with a code. Results will only be reported in the form of group data. Participation or non-participation in this study will not affect your student's grades or placement in any programs.

You and your teenager have the right to withdraw consent for his or her participation at any time without consequence. There are no known risks or immediate benefits to the participants. No compensation is offered for participation. Group results of this study will be available in January upon request.

If you have any questions about this research protocol, please contact me at 352-367-3787 or my faculty supervisor, Dr. Monroe, at 352-846-0878. Questions or concerns about your student's rights as research participant may be directed to the UFIRB office, University of Florida, Box 112250, Gainesville, FL 32611, 352-392-0433.

Thank you,
Jeanette Randall

I have read the procedure described above. I voluntarily give my consent for my child, __________________________________________________________, to participate in Jeanette Randall’s study on writing skills and the environment. I have received a copy of this description for me to study.

Parent / Guardian Date

APPROVED BY
University of Florida
Institutional Review Board (IRB 09)
Protocol # 2898-09
For Use Through AUG 2 2010

An Equal Opportunity / Affirmative Action Institution
Student A

Pre-test, Score: 1

Dear State Legislators

It is not nice to take the money because if you do I can go out of business and you will make people very mad and people can not come and see all the cool stuff in Side it and I can not buy stuff I need money to buy dinosaurs bones and mummies and I can not buy stuff for the museum because you took my money how would you like it if I took your money so you could not pay your bills for your house and that is why you should not take money from the museum.

Sincerely
Student A

Post-test, Score: 2

First, we should not keep the mocking bird. Because a lot of states have the mocking bird as their state bird, and the mocking bird is not instinked. The scrub jay is it would be more cooler if we had the scrub jay. As a state bird.

Next, because you see the mocking bird all over the place. In big cities and in places were there is a lot of people. Also, if we keep building houses all over the place the scrub jay will be gone.

Finally, if we keep building on their land little by little the scrub jays will be gone. And we can not change the state bird to the scrub jay. Also we will have to keep the mocking bird as a boring state bird.
Dear Legislature

I believe you should continue to fund our museum of Natural History because it is educational, and has many important things every generation could use.

Our museum collection document the world's Biota in space and time. They have collections of non-living specimens, e.g., geological specimens, fossils, and human artifacts.

Extinct species are best studied through the remains preserved in natural history museums.

The museums have research activities to help those who wish to learn more about history in itself or something specific like fossils.

Research projects are also enhanced by access to museum specimens and their records. Scientists are now using genetic techniques with museum specimens as well.

To sum it all up you should continue to fund our Natural History Museum for its educational and scientific research.
Student B

Post-test, Score: 5

To whom it may concern,

The mockingbird is currently Florida’s state bird. Due to this status, the mockingbird receives special attention. Meanwhile, the Florida scrub jay is an endangered species as well as an important part of the biodiversity of the Florida sand pine scrub ecosystem. I believe we should change our state bird to the Florida scrub jay. I hope that with the new attention it would receive for holding this title, we would also begin to protect the Florida sand pine scrub.

Think of it as a two for one deal: just by changing the state bird we will be protecting a new species of plant and bird. I mean, aren’t we trying to protect what little bit of animals we have left any way? This would just be one step closer to bringing both an ecosystem and an animal back into circulation. The Florida sand pine scrub has been around since before you and I were even thought of, like many other endangered species as well as extinct ones. To me this is all the more reason to protect it.

Now the Florida scrub jay is an animal that contributes to helping out the Florida sand pine ecosystem, that is why we should allow it to become our new state bird. The mockingbird is a great bird, but in no danger at all and it really doesn’t make Florida itself look very unique; the mocking bird is also another state’s bird. So I don’t think it would mind. The Florida scrub jay is not replacing the mockingbird with the scrub jay would not only make us seem unique, but it would also make Florida look like it cares about its ecosystems and animals.
In conclusion, I believe the legislature should seriously consider changing the state bird from the mockingbird to the Florida scrub jay so we can all begin to take part in saving these ecosystems and animals we claim to love. Maybe if we put forth the effort to change our state bird and we begin to protect it and the Florida sand pine scrub it loves so much, we will become an influence to other states to do the same. Thank you for your time.
LIST OF REFERENCES


BIOGRAPHICAL SKETCH

Jeanette Randall was born in Atlanta, Georgia, November 22, 1974. She grew up in a small town outside of Athens where she spent every waking moment either reading or playing in the dirt. During college, she worked with several of Atlanta’s environmental non-profit organizations: Zoo Atlanta, The Chattahoochee Nature Center, The Georgia Wildlife Federation, and The National Wildlife Federation. These experiences helped ignite her passion for the environment and for teaching. She received an undergraduate degree in environmental education from Oglethorpe University in Atlanta.

After traveling around the southeast for two years as an admission counselor for Oglethorpe, she decided it was time to get back into EE and sought a Master of Science degree from the University of Florida. Jeanette hopes to continue her career in environmental education by teaching and designing school programs that use the environment as a context for learning.