

## Biodiversity Curriculum that Supports Education Reform

Jeanette Randall Wilson, *University of Florida, Gainesville, FL, USA*

Martha C. Monroe, *University of Florida, Gainesville, FL, USA*

The demands of education reform in many states are constraining the time teachers have to prepare and teach new activities. Therefore, it would behoove environmental educators developing supplemental curricular materials to use their concepts to augment state reform goals. This study suggests that a biodiversity curriculum guide, using the *Linking Florida's Natural Heritage* database, successfully infuses environmental concepts with the writing benchmarks of Florida's Sunshine State Standards (SSS). When measured by the same rubric used for the Florida Comprehensive Achievement Test (FCAT), writing skills rose significantly after students used the five lesson biodiversity supplement.

### EDUCATION REFORM AND ENVIRONMENTAL EDUCATION

In 1983, when *A Nation at Risk: The Imperative for Educational Reform* was published by the

The authors thank the teachers in Florida who made this study possible: Scott Flamand, Leigh Larsen, Marcia Bisnett, and Norma Wilson. We owe a great deal to their students who were gracious about working out the kinks in the curriculum and the Linking Interface. We recognize Elise Cassie, Vicki Crisp, and Cindy Cranford for their help with SSS and FCAT and thank the teachers and scientists who gave us feedback on the curriculum: Stephanie Haas, Wayne King, Pat Burkett, Nancy Griffin, C.J. Miles, Sandi Schlichting, Susan Glynn, and Olga Cicco. We also want to thank Gabriella Scollo and Alison Bowers for assistance with data analysis. This research was funded in part by the Institute of Museum and Library Services, and is Florida Agricultural Research Station and Journal Series No. R-10200.

Address correspondence to **Jeanette Wilson**, 905 Broad Street, LaGrange, GA 30240.  
E-mail: jeanette\_randall@yahoo.com

National Commission on Excellence in Education, it lit a long fuse that sparked education reform throughout the United States (Hunt & Staton, 1996). Administrators responded to the public and political demand for accountability in a number of ways, many of which placed an increased burden on the shoulders of teachers. Across the country, states developed curricular guidelines to standardize teaching. States also designed performance tests to measure student achievement and how well teachers convey the standardized curricula. Some schools required teachers to justify what they taught by recording all of the standards they met in each of their lessons. As teachers responded to the pressures of these standards and tests, some reported they had little time to explore projects and activities that took the students beyond the standard requirements (Easton & Monroe, 2000).

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, environmental education, which typically emphasizes inquiry methods, problem solving skills, student-centered learning, attention to the affective domain, field studies, and experiential learning (Disinger & Monroe, 1994), could potentially lose its foothold in the classroom because of education reform. 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 some educators to use supplemental EE materials.

Prior to the widespread implementation of reform initiatives, Ham and Sewing (1988) found that the two biggest barriers preventing teachers from conducting EE were a lack of preparation time and lack of available class time to use EE activities. Fifteen years later, because states have increased restrictions on teachers, there is even less time to prepare for and actually use EE activities.

---

## EDUCATION REFORM IN FLORIDA

---

In Florida, environmental education has been challenged by 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 (SSS) and the Florida Comprehensive Achievement Test (FCAT) (Easton & Monroe 2002). 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" (Easton & Monroe, 2000).

In 2001, the FCAT evaluated students on the reading, writing, and math benchmarks

of the state standards. Teachers at low-scoring schools spent most of their time teaching reading, writing, and math skills and familiarizing students with the style of test questions. This focus on preparing for the FCAT left many teachers no time to teach science or environmental education. Science and social studies teachers at some low-scoring secondary schools were expected not only to give writing assignments, but also to teach writing skills and evaluate writing even though they have not been formally trained to do so (C. Cranford, personal communication, October, 1999). If EE is to survive in the present educational climate, it must accommodate this emphasis on basic skills.

---

## EE CAN HELP TEACHERS MEET EDUCATION REFORM GOALS

---

Lieberman (1995) states that reform and environmental education each have something to offer the other, and that EE leaders should provide teachers with specially designed EE materials that reinforce standards. Others agree that environmental education can help teachers meet curricular and reform goals, in part because both have similar aims, such as providing students with the skills needed to be effective citizens (Carlson, 1988; Braus, 1999; Kaspar, 1999; Sussman, 1999).

Furthermore, environmental subject matter can be easily adapted to fit basic skills training. For example, if 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, and is an effective method of enabling teachers to use EE materials (Braus & Wood, 1993; Cantrell & Barron, 1994; Engleson, 1985; Monroe & Cappaert, 1994; Ruskey & Wilke, 1994). Despite the fact that these links to existing curricula are obvious to environmental educators, there is little evidence that teachers have the time and ability to create the connections between environmental content and their curriculum. They require teaching resources that make the links for them. In states where specific curriculum standards and benchmarks guide public school curriculum, those connections must be to the required state curriculum, not to a national set of standards.

There are several strategies for achieving this melding of EE and education reform. Studies have documented the benefits of using EE to initiate school-wide improvement, resulting in improved student achievement (Lieberman & Hoody, 1998; State Education & Environment Roundtable, 2000; Model Links, 1999). In these cases, teams of teachers used real-world projects to cover several subject areas. In the push to show how existing EE programs can assist teachers in addressing state standards, many traditional EE resources (e.g., PLT, Project WILD, Project WET) have developed correlations to state standards. In this second strategy, matrices indicate which standards can be addressed by each activity and ease teacher preparation time as well as provide motivation for using the lessons. A third strategy melds EE and education reform by developing new EE materials with the explicit goal of improving basic skills while at the same time conveying environmental information. These new materials are designed so that students practice and master skill-based benchmarks and use environmental topics as the content rather than taking existing environmental education materials and determining what standards they address.

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 envi-

ronmental science and improvement in writing skills as a result of exposure to the curriculum. This article will report on only the results of the writing skill measure, as that is the most interesting contribution to the field.

---

## THE CURRICULUM

---

A curriculum of five lessons was written to make a searchable electronic interface of scientific databases—most of which are from the Florida Museum of Natural History collection records and environmental texts from the libraries of the University System of Florida—available to and useable by students and teachers in Florida as a new tool for biology education. Existing curricular resources on biodiversity do not use museum collection databases. See <http://susdl.fcla.edu/lfnh> for the Linking Interface. After exploring the state science standards, ninth and tenth grade biological science courses were identified as appropriate for this material, and the complementary writing benchmarks were incorporated into each lesson. The curriculum guide covers biodiversity, taxonomy, species interdependence, and human interactions with the environment, while providing students with practice in writing skills (see Table 1).

Full lessons can be found at <http://susdl.fcla.edu/lfnh/curmat/EdModindex.html>

---

## METHODS

---

The study was designed to measure the effect on students' writing skills of a curriculum guide that infuses writing and environmental concepts into ninth and tenth grade biological science courses. The null hypothesis of the study was that students who use the curriculum would not show a significant improvement in their writing skills.

Improvement in writing was measured by using the FCAT rubric (see Figure 1). Two

**Table 1**  
**Linking interface curriculum summary**

---

**Lesson 1. The Collection Connection: Museums of Natural History and Libraries**

**Theme:** Museums collect a variety of artifacts and specimens for research. Collections have been used to catalog species and change. Museums are similar to libraries in that they both collect and store information for others to use.

**Activity:** Students complete a worksheet on museums and databases by linking to several web sites and by searching in the Linking Interface.

**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.

**Lesson 2. Writing for Science**

**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.

**Lesson 3. Taxonomy: What's in A Name?**

**Theme:** The history of taxonomy begins with Linnaeus and explains 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.

**Writing Prompt:** Students imagine they have discovered a new species, make up an appropriate 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.

**Lesson 4. Introduced Species: Harmless Immigrants or Armed Invaders?**

**Theme:** Introduced species can be beneficial or can wreak havoc in an ecosystem. Students explore methods of species introduction, their benefits and the problems they can cause.

**Activity:** Students use the herpetology database to access records of the brown anole in Florida. They complete a worksheet tracking the northern invasion of the species over time.

**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.

**Lesson 5. The Biodiversity Dilemma**

**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 core collection database to find full-text records on the scrub ecosystem. They read an article about the Florida scrub jay and create a field guide entry about the bird.

**Writing Prompt:** Students write an essay to persuade the reader why Florida should change the state bird from the mockingbird 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.

---

reviewers applied the rubric to the first and last writing samples to determine pre- and postcurriculum score. Teachers documented their students' progress in journals and gave candid reactions of the curriculum, the study, and student involvement.

---

## TEACHER SELECTION AND TRAINING

---

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 representative to hand out flyers to potential participants. Six ninth and tenth grade biological science teachers volunteered to participate in the study—three from Miami and three from Gainesville. The teachers were given a training manual and ongoing support from the researcher as well as a stipend of \$150 for completing the study.

## SCORING METHOD AND RUBRIC USED IN 1999

<b>DEFINITION OF HOLISTIC SCORING</b>	<p>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.</p>
<b>Focus</b>	<p>Focus refers to how clearly the paper presents and maintains a main idea, theme, or unifying point.</p> <ul style="list-style-type: none"> <li>● Papers receiving lower and middle scores may contain information that is loosely related, extraneous, or both.</li> <li>● Papers receiving higher scores demonstrate a consistent awareness of the topic and avoid loosely related or extraneous information.</li> </ul>
<b>Organization</b>	<p>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.</p> <ul style="list-style-type: none"> <li>● Papers receiving lower scores may lack transitional devices and summary or concluding statements.</li> <li>● Papers receiving higher scores use transitional devices (signals of the text plan or structure) and developed conclusions.</li> </ul>
<b>Support</b>	<p>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.</p> <ul style="list-style-type: none"> <li>● 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.</li> <li>● Papers receiving higher scores provide elaborated examples and fully developed illustrations, and the relationship between the supporting ideas and the topic is clear.</li> </ul>

Fig. 1. FCAT Rubric (Continued).

<b>Conventions</b>	<p>Conventions refer to the punctuation, capitalization, spelling, and sentence structure. These conventions are basic writing skills included in Florida's Sunshine State Standards.</p> <ul style="list-style-type: none"> <li>● 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.</li> <li>● 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.</li> </ul>
<b>SCORE POINTS IN RUBRIC</b>	<p>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.</p>
<b>6 Points</b>	<p>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.</p>
<b>5 Points</b>	<p>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.</p>
<b>4 Points</b>	<p>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.</p>

**Fig. 1.** (Continued).

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 writing skills as measured by the FCAT

<b>3 Points</b>	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.
<b>2 Points</b>	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.
<b>1 Point</b>	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.
<b>Unscorable</b>	<p>The paper is unscorable because</p> <ul style="list-style-type: none"><li>● the response is not related to what the prompt requested the student to do,</li><li>● the response is simply a rewording of the prompt,</li><li>● the response is a copy of a published work,</li><li>● the student refused to write,</li><li>● the response is illegible,</li><li>● the response is written in a foreign language,</li><li>● the response is incomprehensible (words are arranged in such a way that no meaning is conveyed).</li><li>● the response contains an insufficient amount of writing to determine if the student was attempting to address the prompt, or</li><li>● the writing folder is blank.</li></ul>

Appendix G contains instructional implications for each score point.

Fig. 1. (Continued).

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 according to protocols approved by the University of Florida Institutional Review Board. 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 to increase their commitment to proper data collection procedures. Only students who gave verbal consent and provided the parental permission form were included in the study. Permission to use the Gainesville students was also obtained from the Alachua County Board of Education.

---

## ASSESSMENT DESIGN

---

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 even though they completed it because they each provided complete data for fewer than 10 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, either Integrated Science or a hands-on version of Biology One. The demographic makeup of the 132 students who completed every part of the study and provided complete consent closely resembles the class populations: 61% Caucasian, 33% African American, 3% Hispanic, and 3% other; 48% male and 52% female. Because of limited time to score the written essays, 10 students from each

class (when available) were randomly selected for inclusion in the writing analysis ( $n = 99$ ).

Since there was no reasonable control available (a control class would have necessitated that the teachers instruct two different units simultaneously), a pretest/posttest design was chosen to measure the curriculum's effect on students' abilities. To limit the impact of other learning activities, teachers were asked to complete the curriculum in four weeks. Unfortunately, due to computer lab schedules and database technical problems, both teachers took much longer than four weeks; one teacher took four months. Possible effects of this are included in the discussion.

---

## PROCEDURES

---

The teachers assisted the students as they completed all of the lessons. The teachers submitted the parent permission forms, the museum essay (pretest), and the biodiversity essay (posttest) 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 an assistant to use the FCAT rubric to score the writing essays. Both the researcher and the assistant scored all 198 essays for the 99 students selected. Possible scores range from 0 to 6 and are based on grammar, word choice, sentence structure, organization, transitional devices, support, and focus (see Figure 1). 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.

**Table 2**  
**Student writing scores (n = 99)**

Pre Mean <sup>**</sup> (SD)	Post Mean <sup>**</sup> (SD)	t	df	p
2.28 (.87)	2.89 (1.01)	-6.957	98	0.00 <sup>*</sup>

<sup>\*</sup>Significant at the  $p < 0.05$  level.

<sup>\*\*</sup>Possible scores range from 0 to 6.

## RESULTS

A paired t-test revealed a significant difference between the pre- and posttest writing scores ( $p < 0.00$ ). On a six point scale, the posttest scores averaged an increase of .61 over the pretest scores (see Table 2).

Student writing samples show a marked improvement in their organization of the text, transitions between concepts, and complexity of sentences and words (see Figures 2-5).

Student Writing Samples.

## TEACHER JOURNALS

All of the teachers who used the materials (the two who completed the study and the two with insufficient data— $n = 4$ ) reported 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 were “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.

## DISCUSSION

Providing students with interesting topics to write about, straightforward information about

*Dear. State Legislater*

*It is not nice to take the money Because if you do I can go out of Biness 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 dinesors 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.*

*Sincerley*

Fig. 2. Student A, Pre-test, Score: 1.

first we should not keep the making Birel. Because a lot of states have the making Bird as the state Bird. and The making 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 making Bird all over the place. In Big cities and in places were there is a lot of people. Also if we keep Biding houses all over the place the Scrub Jay will Be gone.

kindly if we keep Biding on them 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 making Bird as a Boring State Bird.

Fig. 3. Student A, Post-test, Score: 2.

good writing skills, and practice editing and revising their papers helped these students improve their writing skills and may help them do better on the actual FCAT writing test. In the journals and in conversations with the researcher, the teachers reported that the writing assignments enhanced the science

lessons, were interesting, and applied directly to the concepts that were covered. Florida's EE consultants for teachers have also provided positive feedback. They feel this curriculum is exactly what their teachers need. Educators have long assumed that when students read about relevant and interesting things,

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 collections 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.

Fig. 4. Student B, Pre-test, Score: 3.

their attention and thoughtfulness increases (Anderson, Shirey, Wilson, & Fielding, 1987; Hidi & Baird, 1988; Hidi, Baird, & Hildyard, 1982). This may be 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.

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 in 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 anyway? 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 mockingbird 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.

Fig. 5. Student B, Post-test, Score: 5.

---

## 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 prior to volunteering. 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 stopped using the lessons and waited for the system controllers to install new software allowing up to 100 users. His students did not return to the missed lesson but continued with the next.

The FCAT rubric was developed for scoring writing skills in the absence of meaningful content. The FCAT-like assignments in the Linking curriculum require 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 actual FCAT, which uses creative writing prompts.

---

## CONCLUSION

---

Through a pre-/posttest design, this study indicates that students significantly improved their writing skills after using a five-lesson biodiversity curriculum. The important point, however, is that this was not a typical biodiversity curriculum. It included one lesson on writing skills and every lesson involved a writing assignment, an opportunity for each student to edit another

student's paper, and the chance to rewrite his or her own paper. This combination of learning and practicing writing skills in the context of an interesting environmental topic creates a program that meets teachers' needs for student achievement environmental educators goals for environmental content.

This study shows that it is possible to help students achieve basic skill goals while continuing to support the goals of environmental education. The development of new educational materials should follow the Guidelines for Excellence promoted by the North American Association for Environmental Education (see [www.naace.org](http://www.naace.org)), but there are several specific steps that we believe will help in the production of resources that are as successful as this biodiversity curriculum. First, develop and maintain a relationship with as many stakeholders as possible. Use them throughout the entire process to ensure that your materials are continuously meeting their instructional needs. These stakeholders might include but are not limited to students, teachers, content experts, and administrators. Second, design lessons that will help students practice and master skill-based benchmarks at the appropriate grade level. Incorporate what you learned from the stakeholders. Emphasize exercises that teach the skills that will be assessed in the state tests. Finally, evaluate the curriculum according to state or national assessment tools. Find out if the lessons do indeed help students learn content and master skills that will help them succeed. These three tips will help insure that EE curriculum will be attractive, meaningful, and useful to teachers and students.

---

## REFERENCES

---

- Anderson, R. C., Shirey, L. L., Wilson, P. T., & Fielding, L. G. (1987). *Introduction to literature: Stories*. (3rd ed.). NY: Macmillan.
- Baer, V. (1988). Computers as compositions tools: A case study of student attitudes. *Journal of Computer Based Instruction*, 15(4), 144-148.

- Bentley, M. (2000). Proceedings of the NAAEE '99: *How Standards-based Reform Hurts Environmental Education: From the 1998-2000 Conference Proceedings CD ROM*. Washington D.C., North American Association for Environmental Education, 2000.
- Braus, J. (1999). Powerful pedagogy: Using EE to achieve your education goals. *EEducator*, Spring, 1999, Special Issue, 17-24.
- Braus, J., & Wood, D. (1993). *Environmental education in the schools: Creating a program that works*. Manual M0044. Washington, D.C.: Peace Corps Information Collection and Exchange.
- Cantrell, D. C., & Barron, P. A. (1994). *Integrating environmental education and science*. Newark, OH: Environmental Education Council of Ohio.
- Carlson, S. (1988). *Learning by doing and the youth-driven model. The Center: Today's 4-11 connects youth to the world*. St. Paul: University of Minnesota. Winter 1998, pp. 289-292.
- Disinger, J. F., & Monroe, M. C. (1994). *Defining environmental education*. Workshop Resource Manual, EE Toolbox. Ann Arbor, MI: National Consortium for Environmental Education and Training (NCEET), University of Michigan.
- Easton, J. O., & Monroe, M. C. (2000). *Project learning Tree teacher assessment survey*. Final report submitted to the PLI Steering Committee and the Florida Forestry Foundation. University of Florida, Nov. 2000.
- Easton, J. O., & Monroe, M. C. (2002). Project Learning Tree Teacher Assessment Survey. *Applied Environmental Education and Communication*, 1(4), 229-231.
- Engleson, D. C. (1985). *A guide to curriculum planning in environmental education*. Madison, WI: Department of Public Instruction.
- Ham, S. H., & Sewing, D. R. (1988). Barriers to environmental education. *Journal of Environmental Education*, 19(2), 17-24.
- Hidi, S., & Baird, W. (1988). Strategies for increasing test-based interest and students' recall of expository texts. *Reading Research Quarterly*, 23(4), 465-483.
- Hidi, S., Baird, W., & Hildyard, A. (1982). That's important but is it interesting? Two factors in text processing. In A. Flammer & W. Küntsch (Eds.), *Discourse processing*. Amsterdam: North-Holland Publishers.
- Hunt, S., & Staton, A. (1996). The communication of educational reform: A nation at risk. *Communication Education*, 5(4), 271-292.
- Kaspar, M. (1999). Achieving standards through environmental education. *EEducator*. Spring 1999, Special Issue, 48-51.
- Lieberman, G. A. (1995). *Pieces of a puzzle: An overview of the status of environmental education in the United States*. San Diego, CA: Report prepared for the Pew Charitable Trusts.
- Lieberman, G. A., & Hoody, L. L. (1998). *Closing the achievement gap: Using the environment as an integrating context for learning*. State Environmental Education Roundtable. Poway, CA: Science Wizards.
- Model Links: Environmental Education and School Improvement. (1999). *What's Changing In Model Links Schools? 1995-1998 Progress Report*. Olympia, WA: U.S. Department of Fish and Wildlife.
- Monroe, M. C., & Cappaert, D. (1994). *Integrating Environmental Education Into the School Curriculum*. Workshop Resource Manual, EE Toolbox. Ann Arbor, MI: National Consortium for Environmental Education and Training (NCEET): University of Michigan.
- Ramsey, J. M., Hungerford, H. R., & Volk, T. L. (1992). Environmental education in the K-12 curriculum: Finding a niche. *Journal of Environmental Education*, 23(2), 35-45.
- Ruskey, A., & Wilke, R. (1994). *Promoting environmental education: An action handbook for strengthening EE in your state and community*. National Wildlife Federation. Amherst, WI: New Hope Graphics.
- State Education and Environment Roundtable (SEER). (2000). *California Student Assessment Project: The effects of environment-based education on student achievement*. San Diego, CA: SEER.
- Sussman, A. (1999). A primer on education reform. *EEducator*. Spring 1999, Special Issue, 14-16.