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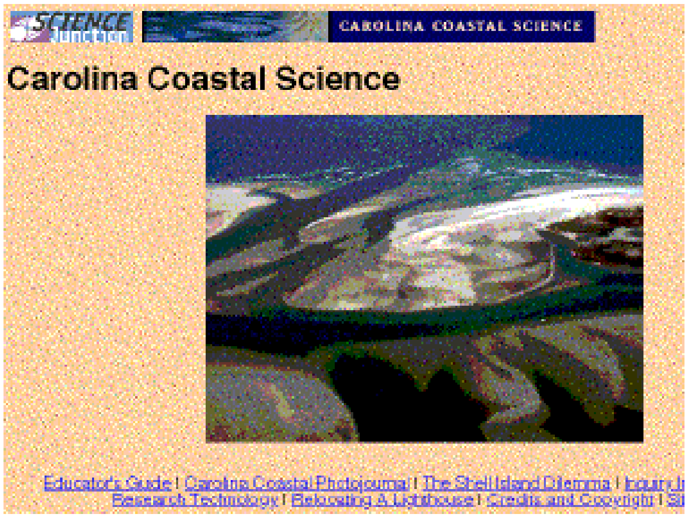
An Online Inquiry Instructional System for Environmental Issues



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"In a constructivist Web-based instructional system, students learn by doing. Knowledge is constructed through experience and learning is an active process."

Introduction

An instructional system may be defined as an arrangement of resources and procedures used to promote learning (Gagne, Briggs, and Wager, 1992). The Dick and Carey (1990) systems approach model for designing instruction is the best-known systematic instructional design model (Table 1). Traditional systems approach to instructional design by itself is not compatible with the concept of inquiry-based learning required in an online learning environment. The traditional systems approach is most directly applicable to the development of print instruction used in linear environments. The systems approach is being challenged by constructivist theories and models which recognize that social context, roles, and relationships are central to learning (Jones, Kirkup, and Kirkwood, 1993). Nonlinear development models also recognize that learning is dynamic and unpredictable and that learners can and do make their own decisions about learning tasks (Thorpe, 1995).

The systems model approach can be modified with the application of constructivist tenets to fit the conditions of nonlinear, Web-based instruction. Constructivism is based on the premise that knowledge is not something that can be transferred from one person to another, but instead must be built by each individual. In a constructivist Web-based instructional system, students learn by

The Shell Island Dilemma
Applying the Dick and Carey Model
Constructivist Elements
Conclusion
References

doing. Knowledge is constructed through experience and learning is an active process.

In a constructivist Web-based instructional system, learning is based on students' active participation in problem-solving and critical thinking regarding a learning activity that they find relevant and engaging. The student's role is active, not passive, in this setting. The Web-based medium becomes a learning environment that offers more than just text to read followed by a multiple-choice question to answer. This article describes how we used the systems approach model to provide a base for the design and development of an instructional system for an online learning environment for science education.

Reform Movements in Science Education

"The act of learning is not simply the acquisition of bits of information that then are recycled through summative assessment. Instead it is the process of learning, the act of solving the problem, that becomes predominant in the experience."

New reform efforts taking place in science education today are framed by the tenets of constructivism. Constructivist theorists regard learning as an active process in which a learner constructs knowledge and understanding in an active manner through personal experience or experiential activities. Learners "construct" their own knowledge by testing ideas and approaches based on their prior knowledge and experience, applying these to a new situation, and integrating the new knowledge gained with preexisting intellectual constructs. In essence, students learn by doing.

Constructivism has its roots in twentieth century psychology and philosophy and the developmental perspectives of Piaget (1954), Kant (1959), Bruner (1966), and Vygotsky (1978). The act of learning is not simply the acquisition of bits of information that then are recycled through summative assessment. Instead it is the process of learning, the act of solving the problem, that becomes predominant in the experience.

Another focus of the current reform movement in science education is to develop students' ability regarding inquiry as well as understanding of inquiry. The National Research Council, in its *National Science Education Standards* (1996), defines scientific inquiry as "diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work." Inquiry also refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world.

The process of scientific inquiry can be embedded in a Web-based instructional system. In such a system, the learning process is facilitated by an environment that emphasizes active student involvement. The Web-based medium becomes a learning space where students can make observations, classify objects, communicate observations and data, make measurements, formulate inferences, and make predictions. Furthermore, online scientific inquiry can be facilitated by resources students explore from distant geographical locations, including remote environments, laboratories, museums, and reference libraries.

Initial Ideas for Developing this Online Inquiry Instructional System

In response to the demand of reform efforts and the lack of an appropriate design model approach, the Carolina Coastal Science project commenced with an idea to develop a Web site that was an organized, nonlinear information resource in the context of an inquiry-based constructivist learning environment. Most of the content would be original, created specifically for the site, while other material would be available via links to other sites.

"One of the main goals of this project was to create an online environment for primary, middle school, and upper secondary students of varying abilities to engage in authentic scientific inquiry …"

One of the main goals of this project was to create an online environment for primary, middle school, and upper secondary students of varying abilities to engage in authentic scientific inquiry, including identifying questions that guide scientific investigation, using technology to improve investigations and communications, formulating scientific explanations using logic and evidence, recognizing and analyzing alternative explanations and models, and communicating and defending a scientific argument. This instructional system was created on the World Wide Web because the nature of hypertext markup language (HTML) supports a user-centered learning environment through a nonlinear information landscape. Also, a Web site is not a static entity. It can be a dynamic, changing entity in ways that are simply not possible with traditional printed material. Designing effective materials for science educators that provide instructional strategies based on constructivist approaches and various uses of technology was a challenge of this project.

Another important goal of the design and development process was to create a user-friendly interface that would make it easy for novice teachers and students to navigate within the Web site. Table 2 lists design considerations that were taken into account in developing the Carolina Coastal Science Web site. Several modes of learning and teaching strategies were chosen to be available to the users, including a role-playing simulation/debate, open-ended inquiries, guided inquiries, independent research, and cooperative group learning.

To page 2 of 3

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| Table of Contents | Review Board | Resources | Archive |

MERIDIAN

Environmental Issues

The Carolina Coastal Science Web Site

The resulting Web site, Carolina Coastal Science (available online at http://www.ncsu.edu/coast), contains five separate areas to engage students in different types of inquiry:

1. An educator's guide with a variety of teaching suggestions to assist teachers with incorporating the Web site into primary and secondary school classrooms;
2. An inquiry simulation in which students investigate the issues concerning the fate of the Shell Island Resort and then debate the future of this and other oceanfront structures threatened by coastal erosion;
3. An interactive photojournal that students can use to construct their own set of inquiry questions to explore;
4. A section of "Inquiry Images" which can be used as whole class-guided inquiry activities;
5. A "Coastal Research Technology" section that students can use to identify the scientific instruments used by oceanographers and coastal geologists to collect data.

Educator's Guide

Shell Island Dilemma

Inquiry Images

Carolina Coastal Photojournal

Coastal Research Technology

The Educator's Guide

The Carolina Coastal Science educator's guide offers science educators a selection of teaching suggestions for implementing the instructional system into a classroom setting. These include:

- Using the "Shell Island Dilemma" as a JIGSAW II small group learning activity. Students work together in expert groups on an information seeking task. The groups are reorganized so that an exchange of ideas and information occurs by peer tutoring.
- Using the "Inquiry Images" as a whole class-guided inquiry activity. This Web site area can be used to generate discussion and debate on environmental issues.
- Using the "Carolina Coastal Photojournal" and "Coastal Research Technology" sections with students who wish to follow their own learning pathways.

The educator's guide also provides additional suggestions for implementing the instructional system into primary school and secondary school settings. Hypertext links occur throughout the educator's guide to facilitate navigation within the Web site.

The Shell Island Dilemma Inquiry Simulation

The Shell Island Dilemma

Video Clip

Stakeholder Roles

- The Shell Island Resort homeowners
- The Wrightsville Beach town manager
- North Carolina Coastal Resources Commission members
- Coastal engineers
- Coastal scientists
- Members of the environmental advocacy organization, North Carolina

The Shell Island Dilemma is an inquiry simulation, in which students investigate the issues concerning the fate of the Shell Island Resort and then debate the future of this and other oceanfront structures threatened by coastal erosion. As students engage in the investigation, they identify the social, political and scientific issues with which different stakeholders must deal. Students place themselves into the role of one of the stakeholders. Questions are used throughout the instructional system to focus student's thoughts during their exploration:

"As you explore the resources, remember that you are in the role of a stakeholder. Think about the current North Carolina policies regarding the placement of hard structures in public trust areas such as the beach. How does the current coastal policy affect your vested interests as a stakeholder?"

Students are first presented with a video clip that introduces the dilemma. After being introduced to the problem, students are to select their stakeholder role. The roles for this simulation include:

- The Shell Island Resort homeowners,

Coastal Federation

aerial photographs

photographs of Shell Island Resort

newspaper articles

statements from coastal engineers

permit applications

meeting proceedings, NCCRC

Position Statement Handout

Student Record Sheet Assessment

- The Wrightsville Beach town manager,
- North Carolina Coastal Resources Commission members,
- Coastal engineers,
- Coastal scientists, and
- Members of the environmental advocacy organization, North Carolina Coastal Federation.

Each stakeholder role Web page includes a brief description of the role and a recommended list of important resources to review. The resources include authentic documents and photographs, including aerial photographs illustrating the recent history of the migration of Mason's Inlet, photographs of the Shell Island Resort, newspaper articles, statements from coastal engineers, permit applications to construct a hard structure, and meeting proceedings from the North Carolina Coastal Resources Commission.

After students review the resources, they are to prepare a statement to decide what should be the next course of action regarding the Shell Island Resort. Students present their statement in a debate to decide the future of the Shell Island Resort. Each student also completes a "Position Statement Handout." After students have had enough time to review the resources and prepare their position statements, a class debate is held to decide the next course of action. When the debate is complete, students take a vote on the proposed solutions and conclude the debate when a consensus of 2/3 of the class agrees on a proposed solution.

A "Student Record Sheet Assessment" is completed by each individual student at the conclusion of the debate. Both the "Position Statement Handout" and the "Student Record Sheet Assessment" can be easily adapted to be used with other controversial environmental topics such as solid waste disposal, water pollution, and air pollution issues.

To page 3 of 3

MERIDIAN

Environmental Issues

Applying the Dick and Carey Model to the Shell Island Simulation

"Students understand and act on personal and social interests which facilitate development of decision-making skills while experiencing science in a form that

Although this instructional system was designed to be delivered in a nonlinear environment, each stage of the Dick and Carey model was applied to the design. The Dick and Carey model was then augmented with constructivist components. The following explains how each component of the Dick and Carey model was implemented with regard to the instructional design and development of the Shell Island Dilemma simulation:

1. **Determine Instructional Goal**
   The instructional goal arose out of a need for good environmental science teaching curricular resources that align with North Carolina Department of Public Instruction instructional objectives within the framework of the National Science Education Standards (National Research Council, 1996). There is currently a lack of inquiry-based simulations that North Carolina secondary school teachers can use in their classrooms which pertain to real-life problems in the state of

engages them in active construction of ideas and explanations."

North Carolina. The instructional goal of the system is for learners to identify the social, political and moral issues that different stakeholders must deal with in a current environmental science issue—the fate of the Shell Island Resort.

2. **Analyze Instructional Goal**
When students are performing the goal, they investigate the issues concerning the fate of the Shell Island Resort. Students take a position for or against building a hard structure to protect the Shell Island Resort. Students develop a personal view of the issue. Students also identify environmental and economic concerns of various stakeholders regarding the issue.

3. **Analyze Learners and Contexts**
Learners use technology skills to explore an online Internet resource of information and use data to construct a reasonable explanation for an unresolved issue. Students must use critical thinking skills to explore an issue which is currently unresolved. Learners take a position in their role-playing which they may not necessarily agree with. Students understand and act on personal and social interests which facilitate development of decision-making skills while experiencing science in a form that engages them in active construction of ideas and explanations. They also communicate investigations and explanations.

4. **Write Performance Objectives**
   - Students will identify environmental and economic concerns which may result from building a hard structure to protect the Shell Island Resort.
   - Students will list the three strongest arguments in favor of building a hard structure to protect the Shell Island Resort.
   - Students will list the three strongest arguments against building a hard structure to protect the Shell Island Resort.
   - Students will identify all individuals, interest groups, or organizations that are in favor of building a hard structure to protect the Shell Island Resort.
   - Students will identify all individuals, interest groups, or organizations that are opposed to building a hard structure to protect the Shell Island Resort.
   - Students will prepare a statement to decide what should be the next course of action regarding the Shell Island Resort.

5. **Develop Assessment Instruments**
Two different assessment instruments were designed to

parallel and measure the learner's ability to perform the listed objectives:

- After students review the resources, they prepare a statement to decide what should be the next course of action regarding the Shell Island Resort. Students present their statement in a class debate to decide the future of the Shell Island Resort. Each student completes a "Position Statement Handout" which is designed to assess the stated objectives before the class debate occurs.
- A "Student Record Sheet Assessment" is to be completed by each individual student at the conclusion of the debate.

6. **Develop Instructional Strategy**
   The strategy used in the instruction to achieve the terminal objectives was to design a role-playing activity. A current unresolved issue is selected — the fate of the Shell Island Resort, which is in danger of being destroyed by the migrating Mason's Inlet. Background information is collected. A real-life scenario is then developed. Stakeholder roles of real people are identified. Student roles are developed. An online research resource is created. A debate format is selected with set time limits. A time limit of two days (assuming 90 minute block periods) is given for student research and a period of 1-2 days is required for the actual debate.

7. **Develop and Select Instruction**
   The instructional materials are developed in the context of a Web site called "The Shell Island Dilemma" which is a section of the Carolina Coastal Science Web site. An Educator's Guide is provided which recommends teaching strategies and assessments for implementing the instructional unit. A Web site was chosen as the delivery mechanism of instruction because of the many readily accessible resources students can explore in an online environment.

8. **Design and Conduct Formative Evaluation of Instruction/Revise Instruction**
   The Shell Island Dilemma's formative evaluation was conducted in a small group setting with a group (n=13) of primary, middle, and upper secondary school educators enrolled in a graduate course on instructional design and evaluation of educational materials at North Carolina State University. According to Reiser and Kegelmann's (1994) review of current methods of evaluating instructional software, teachers are recommended as the individuals who should be responsible for rating software designed for delivery in classroom settings.

   Our evaluation group was presented with an overview of the activity and was then instructed to review the activity as a teacher and then as a student. Each reviewer completed an evaluation sheet of the Shell Island Dilemma activity (Table 3). The evaluators were asked to rate the individual program features of the activity using a Likert-type scale, indicating the degree to which the feature is present. The features evaluated included instructional design, content, learning considerations, documentation, and the goals and objectives of the activity.

The evaluators were also asked to look at the activity holistically and reach an overall conclusion based on their impressions. After the evaluators completed the evaluation form, a focus group discussion was conducted to discuss the strengths and weaknesses of the activity. The focus group made recommendations to modify the instructional program, including creating a specific description of each stakeholder within the instructional system and developing a "Student Record Sheet Assessment."

The Shell Island Dilemma debate simulation was field tested with a 10th grade environmental science class. The teacher of this class served as the evaluator. The students (n=30) spent two days in the computer lab gathering information on their stakeholder role and one day debating in the classroom. The evaluator stated that "the Student Record Sheet Assessment made sure that they (the students) were well-prepared for the debate." The evaluator also stated that the students' attitudes toward the activity were positive. Additional recommendations after the field test resulted in the creation of a "Position Statement Handout" to be utilized by students during their investigation.

9. **Conduct Summative Evaluation**
   Summative evaluation was conducted by a marine education specialist, a coastal geologist, a university professor with expertise in curriculum and instruction, and two secondary school environmental science teachers. The evaluators were asked to examine the instructional effectiveness of the Web-based activity and provide their overall impressions. Each reviewer was requested to pay attention to science content issues, Web site navigation, Web site design, performance, and multimedia issues. The marine education specialist and the coastal geologist were asked to pay particular attention to the accuracy of the scientific facts and issues presented in the activity.

   The evaluators were requested to use the NC State University's SERVIT Group's (Science Education Research in Visual Instructional Technologies) "Evaluating Science WWW

Resources" paper as a guideline during their review of the Shell Island Dilemma. This guideline is contained in the Appendix. Reviews were returned to the instructional designer via email. Each review was positive and no further recommended changes to the activity were stated. One reviewer even commented that this activity would be an effective tool for a social studies teacher to discuss the handling of social issues.

Constructivist Elements

The following elements were incorporated into the Dick and Carey model to create a constructivist environment within the instructional system:

- Learning occurs with the context of an authentic learning environment in which students use real information and make decisions in a learning environment.
- Learning occurs within the context of a social experience.
- Learners are provided an experience from multiple perspectives.
- Learners are provided with experience in a knowledge construction process.
- Learners are aware of their knowledge construction process.

"...the Shell Island Dilemma ...illustrates that the traditional systems model continues to provide a base for the design and development of instructional systems in an online constructivist environment for science education."

Conclusion

The Carolina Coastal Science Web site is an instructional system defined as an arrangement of resources and procedures used to promote learning. Although the Dick and Carey systems approach model for designing instruction was designed for linear instruction, this approach can still be used as part of the instructional design and developmental process in an inquiry-based online learning environment. Creating an instructional system in an online environment promotes the use of constructivist theories in student learning due to the nature of their engagement within a hypermedia environment.

The systems approach is currently being challenged by constructivist theories and models which recognize that social context, roles and relationships are central to learning. However, the Shell Island Dilemma on the Carolina Coastal Science Web site illustrates that the traditional systems model continues to provide a base for the design and development of instructional systems in an online constructivist environment for science education.

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To page 1 of 3

MERIDIAN

Environmental Issues

Table 1 The Dick and Carey Systems Approach Model for Designing Instruction

- Determine Instructional Goal
- Analyze the Instructional Goal
- Analyze Learners and Contexts
- Write Performance Objectives
- Develop Assessment Instruments
- Develop Instructional Strategy
- Develop and Select Instruction
- Design and Conduct Formative Evaluation of Instruction
- Revise Instruction
- Conduct Summative Evaluation

Note. From Dick and Carey, 1990.

return to An Online Inquiry Instructional System for Environmental Issues

MERIDIAN

Environmental Issues

Table 2 Design Considerations Used in the Development of the Carolina Coastal Science Web Site

- Keep it simple.
- Identify your audience.
- Identify the size screen on which your audience will view your Web site.
- Identify the type of Internet connectivity your audience will have.
- Accommodate special populations of students that will use your Web site.
- Create an organizational site map of your Web site before you start writing Web pages.
- Use relative links to navigate within your Web site (../../index.html). Avoid using absolute links within your Web site (http://www.ncsu.edu/servit/index.html).
- Use design attributes to let the user know that they are in your Web site. Use consistent background, layout and navigation links throughout the entire Web site.
- Use thumbnail images for large graphics.
- Use ALT IMG tags when using graphics. This will decrease the loading time of your images and facilitate your Web page use with "text-only" browser users.
- Avoid using frames.

Source. Judy Rice, Brigham Young University, 1998, personal communication.

return to An Online Inquiry Instructional System for Environmental Issues

MERIDIAN

Environmental Issues

Table 2 Evaluation Sheet of the Shell Island Dilemma

Directions: Rate the following features of the Shell Island Dilemma using a scale from 1 to 5.
1=poorly developed, 3=adequately developed, 5=well developed

Item	Ranking
Goals and objectives	______
Instructional strategy	______
Information presented in activity	______
Visual segments of the instruction	______
Instructions for naive user	______

Please respond to each of the following statements by marking an "X" on one of the blanks, to indicate how much you agree or disagree with the statements.

1. Instructional materials are appropriately developed for the intended audience.
strongly disagree- __ __ __ __ __ __ -strongly agree

2. Instructional materials are closely related to the objectives stated.
strongly disagree- __ __ __ __ __ __ -strongly agree

3. Instructional materials are self-instructional and clear.
strongly disagree- __ __ __ __ __ __ -strongly agree

4. Instructional materials are free of grammatical errors.
strongly disagree- __ __ __ __ __ __ -strongly agree

5. Assessment items are appropriate and adequate.
strongly disagree- __ __ __ __ __ __ -strongly agree

6. Instructional design incorporates elements of constructivist instructional approaches.
strongly disagree- __ __ __ __ __ __ -strongly agree

Additional Comments:

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Environmental Issues

Appendix. Evaluating Science WWW Resources

I. Science Content Issues

1. Content accuracy.

Does the site contain accurate, reliable information or is the site full of science misconceptions? (For example, is the "Physics of Star Trek" the real deal?)

2. Responsible author.

Is there a way to validate the information at the Web site? Is it clear who is responsible for the content? Can you contact the person who has written the information? Is there a way to e-mail a webmaster to ask specific questions? Often, biographical information of the author(s) is contained as a link somewhere within the Web pages. If there doesn't appear to be any background information on the author, there is often a webmaster to e-mail for further information to clarify questions about the authori

3. Credentials of the author.

Is the content written by a scientist or another type of professional educator? Is the content biased to one point of view? Some Web sites are known to advocate or support different causes and their biases are part of what we must keep in mind when we evaluate them. Some grassroots environmental organizations' on-line publications are slanted in a particular direction, just as one would expect from an activist group. Look at the viewpoint of the Web site and analyze it.

4. Student engagement.

Does the content promote inquiry learning? Does the content encourage students to think and reflect? Are critical thinking skills needed to analyze and synthesize information? Is there a way students can be evaluated on their knowledge acquisition of the Web site content using an on-line quiz or some other type of evaluation? Can students communicate with scientists or other field researchers at the Web site? Does the site offer any other types of interactive opportunities for students such as datls for students to be involved in sustained inquiry activities both on-line and off-line?

5. Using the strengths of the Web environment.

Does the Web site present material just like a textbook? Then why not write a textbook! Are there special features included such as interactive animations, graphical organizers, concept maps, or graphs? Are the media elements, i.e. sound, video, graphics, well done and meaningful?

6. A level playing field.

Does the content promote multicultural science education? Is the content biased toward culture, gender or race?

7. Nature of the content.

Is the content comprehensive or cursory? Is the content appropriate for the grade level of the students? Is the math content appropriate for the grade level of the student? Is the content developmentally appropriate and relevant to your curriculum? Does the content support or enrich the curriculum? Is the content unique and not available elsewhere? For example, a Web site which displays daily sea temperature readings in a graphical form is unique.

8. Dynamics of the site.

Is the content at this Web site updated often? This is important for Web sites which contain science datasets. New data should be appended periodically. Is this Web site permanent? Many Web sites change locations and often do not leave forwarding addresses.

9. References.

Are appropriate references and copyright statements included?

10. Reviews.

Has the content been through a peer review process?

II. Navigation

11. Linking within and outside of the Web site.

Can you move around the Web site easily? Are there sufficient shortcut or hot buttons available? Are the navigation links visually obvious?

12. Site organization.

Does the home page contain a well-labeled table of contents?

13. Consistent appearance within the Web site.

Are the navigation buttons consistent throughout the Web site? Are navigation button labels confusing or obvious? Will your students be able to intuitively know what to click their mouse onto in order to navigate around the Web site? Are the links clearly and accurately described? Hypertext links to other Web sites frequently don't work at a Web site that is not properly maintained.

14. Ease of browsing.

Do the links take you directly to the information or do you have to go through a series of mouse clicks to get to the information that you want?

15. Searching.

Are search engines included to assist you in finding the location of specific material?

III. Web Site Design

16. Visual appeal.

Do the design and style of the site enhance information delivery? Is it innovative? Is the design layout visually pleasing?

17. Thematic design.

Is the design related to the science content? Is the design consistent for each Web page within the Web site?

18. Clarity of presentation.

Are the pages uncluttered and cleanly designed? Appealing Web design features usually include tables and graphs. Some science Web sites use frames which appear unappealing and cluttered.

19. Flexibility.

Is the Web site designed to be viewed both by text browsers (Lynx) and graphics browsers (Netscape Navigator and Microsoft Internet Explorer).

20. Obtrusive frills.

Does the Web site contain advertisements? Flashy advertisements may distract your students from the science content and slow down the browser.

21. Stimulation.

Does this Web site get your attention? Will it get your students' attention and maintain their attention?

22. Appropriateness.

Is there appropriate use of graphics in the design layout?

IV. Performance

23. Page acquisition time.

Does the site take a long time to load with the type of connection you are using in your classroom? Students do not have much patience (as well as the teachers) in waiting for Web pages to load large graphics and will become distracted and lose interest easily. Caching items locally or using a Web harvesting application such as WebWhacker can solve time-loading problems. Does the Web site offer you a text-only option? Are there thumbnail versions of large graphics?

24. Connectivity.

Is the site usually accessible or is it difficult to connect into? For example, many NASA sites become very busy and difficult to access when new scientific discoveries are made. Some sites offer only a limited number of connections. Also, accessing sites overseas can sometimes cause long wait times for Web page connecting and loading. Load time is important when considering the use of a site for a classroom demonstration. The best way to be safe with a demonstration is to harvest the Web site locally and view it from your computer's hard drive or another external mass-storage device.

25. Hardware speed.

Consider your connection speed when you access a Web site. Accessing large movie files with a 14.4 modem may not be worth your time unless they are extremely unique.

V. Multimedia Issues

26. Problems of size.

Multimedia files such as videos, sounds, and animations are usually very large files and can take a very long time to download. It is recommended to download these types of files ahead of time and have students access them locally from a hard drive or mass-storage device.

27. Required applications.

Many multimedia objects on the World Wide Web require a helper application or plug-in. Some helper applications such as Shockwave requires an excessive amount of memory and time to load and run a multimedia animation. Make sure you have the appropriate helper application or plug-in loaded ahead of time before using these files with students. If you think a multimedia file is slow to load and run, so will your students.

28. Purpose of the multimedia.

Does the multimedia object promote learning or is it just a flashy novelty?

29. Real time communications.

Consider the pros and cons of using chat-rooms and video conferencing applications with students before engaging in these activities. Is the server you use available to the general public? Can anyone access your conversation? Is it worth the set up time to engage in such activities? Do you have enough bandwidth to maintain a reliable connection? Is this the only way you might be able to visit with a scientist or field researcher? Is this the only way your students can collaborate and share data?

SOURCE: The SERVIT Group, NC State University

return to An Online Inquiry Instructional System for Environmental Issues

MERIDIAN

Environmental Issues

About the authors

Alec M. Bodzin is an Assistant Professor of Science Education in the Department of Education & Human Services at Lehigh University. He received his PhD in Science Education at NC State University. His interest in instructional technology began in the early 1990s with his use of hypermedia applications that interfaced with laserdiscs for instruction in secondary science classrooms. His interests include incorporating telecommunications into science curriculum development and implementation with emphasis on the roles that visual instructional technologies can play in these areas. He is currently involved in the development of a variety of science education multimedia projects, including CD-ROM and World Wide Web technologies as a member of the SERVIT group.

John C. Park is an Associate Professor of Science Education at NC State University. He came to NC State in 1985 after completing a PhD in Science Education at The Ohio State University. His interest in instructional technology developed from his early 1980s use of the microcomputer for instruction in science. Although his main research effort is in the use of the microcomputer-based laboratory, his interests have expanded to the use of all visual technologies. Dr. Park organized a research group in 1997, Science Education Research in Visual Instructional Technologies (SERVIT). The group's goals include exploring, developing, and researching the use of new instructional technologies in the pre-college science classroom and laboratory.
