EVALUATION OF ENVIRONMENTAL EDUCATION SOFTWARE

“PROTECTING YOUR ENVIRONMENT”

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This thesis entitled

EVALUATION OF ENVIRONMENTAL EDUCATION SOFTWARE

“PROTECTING YOUR ENVIRONMENT”

BY

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has been approved for

the Program of Environmental Studies

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The research project attempts to evaluate the environmental education software “Protecting Your Environment”, published by Ohio Environmental Protection Agency. The overall purpose of this research is to determine if the knowledge about the environmental issues possessed by the 5th grade students can increase as a result of working with the environmental software “Protecting Your Environment”. The study also attempts to assess whether educational setting plays a role in enhancing environmental knowledge relating to the use of the software.

A secondary purpose of this research is to evaluate “Protecting Your Environment” as an educational tool.

The following questions provide the foundation of the study.

1. Is there is a significant difference in the scores on the environmental quiz before and after using the software “Protecting Your Environment?”

2. Is there a significant difference in the scores on the environmental quiz before and after using the software “Protecting Your Environment” between the children who used the software at home and the children who used the software at schools?

The study was supposed to focus on science educators teaching grades 5-6 in public schools of Ohio. One school participated in the research. As such, results cannot be generated to all schools in Ohio.
In order to find the answers to the research questions, two kinds of analysis were used: descriptive statistics analysis and paired samples t-test analysis.

Three instruments were used to gather data: environmental quiz before using the software, environmental quiz after using the software by the students, and an oral interview questionnaire. Both quizzes and interviews were performed in a class.

The results implied that while there is no significant difference in the scores on the environmental quiz among the children who used the software at home, there is a significant difference in the amount of knowledge gained within the group, which used the software at class. In the whole, knowledge of children improved after they used the software.

Additional findings implied that for the software to be more effective in terms of gaining environmental knowledge, it is better to use it at class with the instructional materials.

Approved:

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CHAPTER 1. Introduction

Environmental Education (EE) is at critical point in Ohio and nationwide. Knowledge about the environment and environmental issues among the public is surprisingly low. The 1999 National Report Card on Environmental Knowledge, Attitudes and Behaviors (Starch, 1999) gives Americans an “F” on their understanding of causes of basic environmental problems in the 21st Century. With the increasing need to be aware of the environmental situation all around the world and the necessity to use environmental resources wisely, it is desirable for school age students to develop a knowledge and understanding of the concepts related to the environmental issues. Particularly, it has been proposed that EE takes place in elementary and/or middle schools since many attitudes are established and fixed by the time students reach high school (Pomerants, 1986). Environmental educators have the task of communicating environmental information to the public. They hope that by educating the public, people will make rational decisions about the environment. Hunderford and Volk (1990) are convinced that when people get more knowledge about the environmental issues, they will, in turn, become more aware of the environment and act toward it in more responsible ways.

Indeed, environmental educators are interested in ways to educate children about environmental issues. Knowledge is transmitted through different sources: teachers, parents, peers, mass media, and self-exploration to mention a few. It has been found that the manner in which scientific or ecological materials are presented may make a difference in learning (Ramsey & Rickson, 1976). Research on attitudes, values, and cognitive development shows that the middle years, between ages ten to thirteen, offer the greatest opportunities for acquiring knowledge and understanding about the environment (Ramsey & Rickson, 1976). Environmental educators need to
be cognizant of this and emphasize educational programs and activities in this age group that will encourage individuals to assess situations objectively and develop problem-solving skills to deal with environmental problems.

A growing body of education research has shown that technology can support learning in many non-traditional ways (Shelly, 2002). Using computers or computer-related technologies can capture and hold students’ attention as well as motivate and educate them. Computer assistance can provide practice in skill-building, real world solving, interactive learning, discovery learning, linking learners to online, and other instructional resources. Environmental software can be a unique approach to environmental education, which provides an additional tool for enjoyable, imaginative, safe and relevant learning experience. In order for any software to be offered to teachers and students as an additional educational tool, it is important to know if the software is worth working with or not.

1.1. Purpose of the Study

The overall purpose of this research is to determine if the knowledge about environmental issues possessed by the 5th grade students can increase as a result of working with the environmental software “Protecting Your Environment”. The study also attempts to assess whether educational setting (using the software at school or at home) plays a role in enhancing environmental knowledge relating to the use of the software.

A secondary purpose of this research is to evaluate “Protecting Your Environment” as an educational tool.

The study results will be presented to the developers of the software to provide a basis for change.
1.2. Research Questions

The following questions provide the foundation of the study.

1) Is there a significant difference in the score on the quiz before and after using the environmental software “Protecting Your Environment”?

2) Is there a significant difference in the score on the quiz before and after using the environmental software between the children who used the software at home and the children who used the software at schools?

1.3. Significance of the Study

On March 9, 2001, Ohio EE 2000, the Environmental Education Council of Ohio and Ohio State University Extension sponsored the symposium, named “Environment in Ohio Education: Support through Research: Exploring Research Needs for Environmental Education in Ohio”. During the interactive session of the environmental education research symposium, the participants discussed new topics or research questions to be investigated. Some of the topics were:

1) What is the best way to teach EE?

2) Non-formal teaching and learning and its relationship to formal education

3) Studies to assess the quality of EE materials

4) Is there follow-up support for youth in EE experiences? Do we have tools to do such follow-up?

5) Which locations/learning settings for EE experiences have the greatest impact?

6) Do learners attempt positive environmental behavior after short, one-shot experiences?

7) What is the role/value of textbooks in EE?

Environmental educators are interested in the impact of environmental education strategies upon students’ knowledge, skills, attitudes, and values regarding
the environment. Environmental educators are also interested in knowing how effective their programs are. Environmental learning occurs in many different forms including formal classroom programs, outdoor classrooms on school grounds, day field trips to nature centers and natural areas, and non-formal residential programs of 2 days or more etc. Because there are so many options, evaluation is important to determine if the forms or methods to educate children about environment are effective or not. In addition, evaluating EE materials may help teachers and administrators determine how their time and money can be best spent.

A growing body of education research has shown that technology can support learning in many non-traditional ways. (Shelly 2002)

“Protecting Your Environment” software is a unique approach to environmental education by providing a tool for enjoyable, imaginative, safe and relevant learning experience. It was developed in 1998 and distributed to teachers of science. However, it has never been evaluated for effectiveness.

Evaluation is one of the most important activities, which helps tell us if products are suitable for intended audience, if programs are meeting their objectives, if learners are learning, and what we can improve if we want to make our activities more successful (Stokking et al. 1999).

Several reasons are apparent for undertaking an evaluation:

1) Assessment of effectiveness
2) Determination of what has gone wrong, or right
3) Promotion of the tool
4) Accepted education practice
1.4. Limitations

The study focuses on science educators teaching grades 5-6 in public schools of Ohio. One representative school participated in this research. As such, results cannot be generalized to all schools in Ohio.

1.5. Organization of the Study

Chapter 1 contains an introduction, the purpose of the study, research questions, and the significance of the study, limitations, and the organization of the study.

Chapter 2 is a review and critique of the literature, connected to technology in education. Topics in the literature review include the information about current trends in technology, discussion about technology in education and its benefits, discussion about the difference between computer-based education, computer-based technology, computer-based learning and computer-based instruction as well as discussion about what makes educational software appealing. Chapter 2 also addresses the problem of how we distinguish between software which is “educational”, and that, which is not. Topics in Chapter 2 also provide a discussion about educational evaluation and its importance and discussion about the role software evaluation plays. This chapter also provides different points of view on educational objectives and computers.

Chapter 3 is a review and critique of the literature, connected to environmental education. Topics in the literature review include discussion about goals and objectives of environmental education, discussion about importance for educators to teach students environmental issues. This chapter presents discussion,
supplemented by guidelines about environmental education in US schools, information about methods on integrating environmental education into school curriculum as well as about choosing and using environmental education materials and importance of environmental education materials evaluation.

Chapter 4 examines the method of the study. It includes the design of the study, the population and sample, instrumentation, data collection and data analysis. The chapter also gives an overview of the school where the study was conducted as well as a brief overview of the environmental education software “Protecting Your Environment”.

Chapter 5 contains the presentation of the findings as well as the presentation of additional findings.

Chapter 6 contains a discussion, conclusion, and recommendations for additional research.
CHAPTER 2. Technology and Education

2.1. Trends in Technology

Technology is evolving rapidly, changing into more powerful, faster and less expensive components that are easier to use. The integration of telephone, television and computer technologies is changing the way we live. “Through computers and the Internet, we can see and hear someone in another country, telephone “operators” are often voice–recognition systems; in some places, it is possible to touch the television screen to order a movie or interact with a computer program that is transmitted to our house via cable or satellite” (Barron et.al. 2002). With more and more advanced cellar technology, we can check our e-mails using our cell phone, which are turning into personal digital assistants with access to calendars, and other features. Laura Lindhe was right when in 1999 she predicted, “In the near future, your phone will be a multifunctional device–you will be able to videoconference, play games, browse the web, and listen to the music” (as sited from Barron et.al. 2002).

Though computers and other technologies have become basic tools in our society, it has been difficult for our educational system to keep pace with advances in multimedia and information access. Many U.S. schools have changed for the better in terms of computer technology use, but unfortunately, some of them still use the way of teaching as educators in 1920s (Barron et.al. 2002).

Talking about trends of technology use in schools, Barron et.al (2002) pointed out some good signs for the future of computer and computer based technology at schools. According to the authors’ research, access to computers, the Internet, and other technologies is improving for schools. In the fall of 2000, approximately 98 percent of public schools had Internet access. Seventy-seven percent of classrooms had internet access in 2000, compared to only 64 percent in 1999. About one in every
seven students now has access to a multimedia computer or a computer with Internet access, compared to one in every thirteen students in 1999.

State and federal governments continue showing the interest in technology standards, and in improving access and use of technology in schools. They encourage schools to use computer technology through different grant programs, which designed to help schools support and install technology, as well as provide staff training.

2.2. Technology in Education and Its Benefits

Many have speculated on whether technology can improve students’ performance. Archer (1998) said that technology may have positive benefits, but this depends on how it is used. Archer highlighted the need for effective teacher preparation when integrating computers into the classroom. According to Archer, it is difficult to replicate studies showing that technology can improve student achievement since researchers are wary of presuming that the same results will exist in other classrooms where teachers might be less motivated or knowledgeable about computers.

Raymond Fox, (1989) President, Society for Applied Learning Technology wrote that there is an ever-advancing body of knowledge pertaining to more effective technologies for development of interactive instruction systems. Coincident with this are technologies advances in available hardware and software to support development of these instruction systems. The challenge for designing a course for communicating specific ideas or information is to understand how these new technologies can assist in that task and what changes to existing strategies and design must take place to capitalize on the benefits these technologies offer.

Teachers, parents and reporters may be disappointed when they find that it is more difficult to measure the effectiveness of new technologies in education, rather
than to give standardized tests. Many of the multimedia programs are designed in an open-ended, constructivist format and the number of variables in the integration of multimedia and educational networks complicates the research process. (Barron et al. 2002).

Talking about significant capabilities that computer technology brings, Reynolds and Anderson (1991) distinguish several advances of computer technology. Among them are:

1) Rapid interaction with individuals,
2) Storing and processing of vast amounts of information in a variety of forms,
3) Combining with other media to display a broad range of audiovisual stimuli.

The Report of the Effectiveness of Technology in Schools: 2000 (Sivin-Kachala & Bialo, 2000), pointed out the results of several empirical research studies that found significant positive effects on student achievement. The research focused on such areas as reading, science, mathematics, and programming languages. In more than 7000 empirical research studies, it was found that students with access to at least one of the following showed positive gains in achievement of researcher-constructed, standardized, and national tests:

1) Integrated learning systems technology
2) Computer assisted instruction
3) Design and programming technologies
4) Simulations and software that teaches higher order thinking
5) Collaborative networked technologies.

make it easier for people to learn because of the parallels between multimedia and the ‘natural’ way people learn” (p.3-18). Blease (1986) listed a number of computer talents, which would suit a wide audience of teachers. They are:

1) Perform tirelessly and patiently for long periods of time in non-threatening manner. Children’s mistakes can be removed at the press of a key. Text can be manipulated and edited to produce perfect copy. Responses can remain constant and neutral no matter for how long the exercise is attempted.

2) Perform rapid and accurate calculations. Non essential and repetitive calculations can be dealt with quickly, leaving more time for the teacher to concentrate on developing the children’s skills of analysis and encouraging the discussion of results and ideas.

3) Store and manipulate text. Word processors, data-bases and text editors enable children to rapidly explore ideas and relationships, and to formulate and test hypotheses.

4) Present information in a variety of graphical forms, including animation. Histograms, pie charts, and graphs can be drawn and modified quickly and efficiently. Where movement or animation would enhance, the effect can be quickly achieved.

5) Produce seemingly endless random exercises and examples of both a textual and numerical nature. This possibility for randomization avoids the problems of children quickly learning the answers to the exercises in a book.

6) Communicate with the outside world via many external devices and robots.

All mentioned above promise to become dominant in instruction.

More and more often computers are being used in a variety of instructional activities. Some of these include the production of audiovisual media and graphics as well as development, delivery, and management of instructional materials.
Blease (1986) noticed that “computers can not replace teachers as caring human beings whose professional knowledge and experience enables them to match children’s learning experiences to their needs, abilities and interests” (p.56). Reynolds and Anderson (1991) believe that computer-based learning resources do not teach, nor do they manage the instruction. They do make learning easier, more appropriate, or more fun.

2.3. Computer-Based Education, Computer-Based Technology, Computer-based learning or Computer-Based Instruction?

University research pioneered the use of computers for learning. This origin led to use of the term computer-based education, or “CBE”. When industrial organizations began to use the so-called computer-based education, they substituted the more comfortable term “training” for the academically oriented “education.” The result was computer based technology (CBT). Some organizations chose to use “instruction,” resulting in CBI.

Still, others who prefer thinking in learner-oriented terms prefer Computer-Based Learning (CBL). Variations in meaning can make terms confusing. A closer look at what the major CBL-related terms mean will help. This is an “umbrella” term. It includes the activities described by the other terms. A personal favorite is the definition given by a man called the father of CBE, Donald Bitzer, of the University of Illinois. Bitzer said that CBE is “anytime a person and a computer get together… and one of them learns something” (as sited from Blease 1986).

CBE, CBT, CBI, and CBL are really synonyms. The term Computer-based Learning is becoming increasingly popular, reflecting today’s emphasis on learner centered thinking. It is also appropriate to all settings: academic, business, industrial and even the home.
2.4. Hardware, Software, and Courseware: What is The Difference?

According to Reynolds and Anderson (1991), “Hardware” is a straightforward term. It describes the actual, visible, physical items involved. While hardware includes the learning station, drives of all kinds, printers, keyboards, cables, mice, and any other physical item, software is the programs written in computer languages that makes the computer parts of a system work as they should. Confusion can arise between the terms “software” and “courseware.” In technical terms, some courseware is software. Reynolds and Anderson (1991) believe that the technology and non-technology elements that support learning are courseware. Courseware includes the computer delivered Computer Assisted Instruction (CAI) lessons and Computer Managed Instruction (CMI) tests, and the associated video, audio, texts, and other learning resources. The result of these distinctions is that learning specialists rarely refer to software. In this research paper, the term “software” will be used.

2.5. Educational Evaluation

Richard Venezky (1983) supposed that evaluation may have begun in China in 2200 B.C. with proficiency testing, or perhaps in 1864 with Reverend George Fisher’s Scale-Book, or may be in the 1890s with Rice’s studies of spelling and math. In the opinion of Venezky, twentieth-century educational evaluation might be dated from the publication of Thorndike’s handwriting scale, or the Cleveland School Survey of 1915-1916, or Tyler’s work on educational objectives in the 1930s.

Nowadays, evaluation is a major industry, having its own terminology, publications and training programs. In 1983, educational evaluation was in the classification stage of scientific development. Today, educators are more and more attentive to the effectiveness and quality of their programs. Schools and school
districts are more and more specifying their own criteria for effective instruction, and requesting that programs be adapted accordingly.

Since computer-assisted instruction (CAI) is generally highly specific and has potential for saving students responses, it offers possibility for adaptation of instruction and, thus, for evaluation that is not practical with non-computer approaches. Popham (1975) defined systematic educational evaluation as a formal assessment of the worth of educational phenomena. Evaluation supplies information that supplements what has been learned from other sources with a high degree of confidence in the validity and reliability of its results.

2.6. Software Evaluation: Why do we need it?

Since technology has been becoming an integral part of a school life and the curriculum, all teachers and students must become confident and competent users. Blease (1986) argued that the only way to achieve this objective is to insure that computers are used in schools in such a way that the unconvinced can see the positive benefits to them, not just in a few subjects, but also across the curriculum, and in their own subjects in particular. This depends upon the appropriate use of the hardware and software in schools. The use of appropriate software and hardware, in turn, depends on the ability of those teachers using it to make appropriate judgments about its use, which are founded upon a firm base of knowledge and understanding of educational principles and issues. Discussions and decisions about the appropriate and inappropriate use of computers in schools, center around the educational issues of the day, not those to do with computing itself. Teachers’ current curriculum model or a proposed model for the needs of society can raise educational issues in the future.

The pioneers of educational computing generally failed to see current use of the computer in the classroom as anything other than computer studies, or as
something, which might take over some of the teaching functions that were then, and
still are today, better performed by the teachers themselves. It is only in times that are
more recent that the quality of software and the debate about its use in the classroom
have begun to catch up with the phenomenal rate at which the technology itself is
developing. (Blease, 1986). It is of vital importance for teachers to develop their
ability to select appropriate programs. The teachers must choose programs, which
might, in certain circumstances, be of use to them in the classrooms. Rarely is there is
a chance to try a program out in school before deciding whether to buy it, although a
few software publishers are helpful in this respect. Since the financial constraints
place upon schools are ever greater, it is more important for teachers to be properly
equipped to make such informed decisions.

Talking about software evaluation and its importance, Blease (1986) said
that the act of evaluation implies the testing of material in real classrooms with
real children. What is more, such evaluations require that the programs are
judged against a set of well defined criteria. These criteria must be based upon
the teacher’s own curriculum model, which in turn determines the specific aims
and objectives for a series of lessons or particular topic to be taught. Software
evaluation is a process, performed in schools and classrooms, and can be
extended over a considerable amount of time.

Blease (1986) described the process of evaluation in two stages: software
selection and software evaluation. During the software selection, decisions are made
outside the classroom by the teachers about the potential of the programs under
scrutiny by critical reference to a whole series of commonly agreed criteria, which
should constitute aspects of good practice in the design and publication of educational
software. Decisions made by the teachers must be made according to the particular
use they have in mind for the program to achieve their own specific lesson aims and objectives. It is not necessarily true that software chosen by one teacher for one class, might work for another with a different class, having different interests, needs and abilities.

Parents are genuinely motivated by a belief that their children will receive a better education if they have access to computers (Armstrong, 2000). Missing from the discussion are questions about the quality or suitability of the material accessed through computers, as well as concern about how it will affect students physically, socially and intellectually (Armstrong, 2000). Along with the rapid development of educational computing, a great deal of poor software is produced. Alison Armstrong (2000) examined some of the software on which her school spent education dollars. She discovered that much of it was little more than electronic games, which look like math or language instruction. Some schools spend so much money buying hardware and software, yet take so little time to select and evaluate them. Armstrong (2000) said, “While we were spending a bundle on computers, our library needed books, magazines, and atlases, and many classes were short on math textbooks” (p 10).

Teachers rarely have time to screen, select and evaluate software, which are said by reviewers to be educational tools. It is much more difficult, time consuming to preview software, rather than look through a book, because of the amount of material software contains, and because of the way, information is presented (Armstrong, 2000). As a result, educators buy material based on packaging and advertising. However, selection and critical review is even more necessary for software than for books because the haste with which new software is placed on the market has led to uneven quality (Armstrong, 2000). When dinosaur specialist Merk (1995) reviewed four student targeted software programs for the magazine *The Sciences*, he found the
quality ranged from “terrible to pretty good.” Merk wrote: “The material of one of the software even failed to give an adequate definition of the term *dinosaur*, presented misleading and inaccurate information and made fundamental errors” (pp. 40-43).

With new information on the market, it is very important for schools to filter materials in order to insure what gets into the electronic library or classroom, to be sure it is appropriate and has educational value (Armstrong, 2000).

Describing the second stage of software evaluation, Blease (1986) said that this time the effectiveness of the program should be measured in terms of such things as learning outcomes, or its ability to maintain high levels of pupil motivation over time. What might appear to be a totally uninspiring program can end up as part of a most stimulating and creative lesson in the right hands (Blease, 1986)

Blease (1986) admitted that too few programs were adequately tried in the classrooms before they were produced or chosen for the use in the classroom. Blease compared the fate that educational software is experiencing with that identified by Annan (1977), with regard to educational broadcasting that is there is a “…profound suspicion of research in educational broadcasting. Even among those who are willing to support the idea in principle, there is a distinct sense of unease about applying research in such a way that it may affect the way programs are produced”, (As cited in Blease, 1986). Blease (1986) said that in fact, little appraisal is reported, let alone effective trials in schools. Many seem to feel that subjective impressions or mechanical checklists are adequate. However, Blease (1986) showed some good examples where publishers tried out software before offering it to British schools as an educational tool. According to Blease (1986), The Loughborough Primary Micro project program (LPMP) “The Kingdom of Helior”, produced in 1985, includes a
description of follow-up work done by children in a variety of schools. Teachers and children of the trial schools gave their suggestions and opinions about the program.

Another example, which Blease (1986) provides is The 4Mation package “Dragon World”, published in 1985, which is documented by ideas and impressions of trial schools’ teachers and children. Blease (1986) supposed that some software publishers might see researchers as “outsiders”, without much understanding of educational issues. According to Blease (1986), the best software evaluation is done using teachers in their own classrooms or by teachers themselves.

Indeed, there is much to be learned from the teachers’ professional judgment. There are some things, which can be done very well by computers, but in the context of the classroom, there are some things that cannot be done as well as with other conventional resources. Judgments have to be made knowing the strengths and weaknesses of the class and the rate at which individuals are able to absorb new ideas.

Most teachers would argue that time is too short for them to judge every program before they use it in the classroom. Therefore, it is important that teachers come to understand how software assessments are conducted, and to be able to distinguish between the software, which might be appropriate and those that might not. It is an important aspect of evaluation and selection of the software to be able to find out these strengths and weaknesses of the software. The criteria by which the programs are judged need to have become second nature in order that teachers can make these important professional judgments in a short period of time (Blease 1986). If teachers do not need to think about computing issues, they can spend more of their time on drawing their attention and concentrating on those issues, which are essentially educational.
Evaluation is one of the most important activities that helps tell us if products are suitable for intended audience, if programs are meeting their objectives, if learners are learning, and what we can improve if we want to make our activities more successful.

2.7. When Does Software Become “Educational”? 

Parents and teachers are always receiving advertising claims for the educational value of many things, among which are home computers and different software. But what is really educational software?

Blease (1986) argued that all experience is educational. He said that people learn from their experiences, and this includes all experiences with computer software. However, Blease (1986) pointed out that educational experiences must bring about the development of desirable qualities in people. These qualities differ from culture to culture, from society to society. Therefore, definitions of what is educational and what is not can vary in any society, particularly between teachers, and even between groups of teachers. Blease asserted that the concept of education is linked with the development of a person’s state, which includes deep knowledge and understanding as well as being desirable. The author connected this concept of education to computer use in schools today since the call of education in depth is commonly heard in educational circles, in particular with reference to discussion about the using computer technology in schools. (Blease 1986)

Many researchers believe that teachers can judge if software educational or not based on their specialist knowledge and experience. If the software meets educational objectives, that is, statements of what the pupils are intended to do or learn, if the software promotes effective learning, then the software is educational.
2.8. Appealing Educational Software

Not only graphic and animation make the software appealing. Thomas Malone (1982), designed guidelines for creating highly motivating educational software. Malone divided the characteristics that in his opinion make instructional environments interesting. They are challenge, fantasy, and curiosity; he developed the following questions to use in assessing software:

**Challenge**

In providing challenge, does the activity set a clear goal? If it does not, can students determine appropriate goals for themselves?

Does the activity set goals, which can be personally meaningful?

Is the level of difficulty of the exercise variable, and are there multiple goal levels?

Does the exercise include random elements and selectively reveal hidden information?

**Fantasy**

Is the fantasy emotionally appealing?

Does the fantasy relate intrinsically to the skill to be learned in the activity?

Does the fantasy provide a useful metaphor or analogy to help the learner apply old knowledge in understanding new things?

**Curiosity**

Does the program use visual effects and sound as decoration, to enhance fantasy, as a reward or as a representation system?

Are there surprises included in the program?

Does the user receive constructive feedback?

Malone’s checklist can be applied to many educational programs.
2.9. Educational Objectives and Computers.

The process of software selection and evaluation should go hand in hand with the specific objectives set up for lessons. “Objectives” are statements of what the educators intend to teach students. This is not only about specifying the content of the lesson; “objectives” also implies determine the nature of the actual activities of the lesson.

Tyler (1949), one of the earliest advocates of the “Objectives” approach, proposed that educators must specify both curriculum content and the processes and skills to be used and developed in dealing with that content. Bloom (1956) classified educational objectives in three domains: the cognitive domain, which is concerned with intellectual knowledge and skills; the affective domain, concerned with feelings, attitudes and values, and the psychomotor domain, concerning physical skills.

In a cognitive domain, cognitive development follows a sequence from knowledge through comprehension of the knowledge, its applications in particular situations, to the higher order mental skills of analysis, synthesis, and evaluation, all of which are involved in the problem-solving process.

Affective domain also suggests a sequential development of knowledge. It starts with attention to specific phenomena, then responding to them, and then learning to value them, and organizing ones values relative to one another to finally create ones own personalized “value system”.

In the psychomotor domain, we can observe how computer applications can be used in the development of the visual-motor skills. Starting with the reflexive skills, simple repetitive stimulus-response types of activity involving little or no planning, the progression leads on to the planning-intensive skills, which involve complex decision-making at the conscious or subconscious level.
An educational objective is a statement of what children ought to be able to know after a lesson. Blease (1986) supposed that when deciding upon objectives, it would be more practical to concentrate on process only omitting content altogether. By formulating objectives in terms of processes, without specific reference to content, we are constantly reminded of our basic aims, which, in turn, provide a framework within which the best methods and content can be chosen to suit the situation. However, there are other points of view on objective approach.

Stenhouse (1975) focused upon the models of learning appropriate to different kinds of knowledge. He believed that the field of any knowledge to be taught implies implicit principles of procedure, which govern learning, and thus teaching this subject.

Eisner (1969) considered the objective approach to be unsatisfactory since it claims to predict student responses to stimuli provided by the lesson. He believed that this is more acceptable when all that is required is the reproduction of what is presented, but when the learner’s active participation is sought, something different is required. Eisner (1969) suggested expressive objectives, which identify a situation in which children are to work, a problem with which they are to cope, a task in which they are to engage, but it does not specify what from that encounter, situation, task or problem they are to learn. Instead of specifying a new competence or knowledge that will be learnt, they specify the activity that the learners will be engaged in, which in turn specifies the situation that the teacher must set up. It is at this point that decisions can be made about the possible role that a computer program might play.
CHAPTER 3. Environmental Education

3.1. What is Environmental Education and why do We Need It?

Because of its multifaceted nature, EE means different things to different people. The phrase “EE” might embrace concepts of ecology, environmental science, outdoor education, or issue instruction- each of which might fit under the EE umbrella and each of which offers only a partial contribution to the total package.

Ramsey and Hungerford (1992) described the objectives of EE established by Tbilisi Declaration in 1997. They are as follows:

1) Awareness: Helping students acquire an awareness and sensitivity to the total environment and its problems; develop the ability to perceive and discriminate among stimuli; process, refine, and extend these perceptions; and use this new ability in a variety of contexts.

2) Knowledge: Helping students acquire the skills needed to identify, investigate, and contribute to the resolution of environmental problems and issues.

3) Participation: Helping students acquire experience in using their knowledge and skills in taking thoughtful, positive action toward the resolution of environmental problems and issues (p.35-45).

Environmental education aims to produce a person who is motivated toward the rational use of the environment in order to develop the highest quality of life for all. Goals of environmental education include the basic understanding that man is not a separate form of life and completely independent, but that he is interrelated to resources both natural and cultural and to other forms of life around him. An individual should have an adequate understanding of the biophysical world including both natural environment and man made environment and the role of these resources in contemporary society. Each individual should have an understanding on how to
identify environmental problems, how to solve these problems and the acceptance of responsibility for the solution of the problems as a basic civic duty. (Roth, 1992)

Environmental education is important, because it increases people’s awareness about environmental issues and associated challenges and thus, motivates people to behave in environmentally friendly ways. In order for people to demonstrate environmentally friendly behavior, they should be environmentally literate citizens. Following the objectives, established by Tbilisi conference, Marcinkowski (1991) distinguished the following components of environmental literacy:

1) An awareness and sensitivity toward the environment.

2) An attitude of respect for the natural environment, and of concern for the nature and magnitude of human impacts on it.

3) A knowledge and understanding of how natural system work, as well as how social systems interface with natural systems.

4) An understanding of the various environmentally-related problems and issues (local, regional, national, international, and global).

5) The skills required to analyze, synthesize, and evaluate information about environmental problems/issues based on evidence and personal values.

6) A sense of personal investment in, responsibility for, motivation to work individually and collectively toward the resolution of environmental problems/issues. Knowledge of strategies available for use in remediation environmental problems/issues.

7) The skills required to develop, implement and evaluate single strategies and composite plans for remediation of environmental problems/issues.

8) Active involvement at all levels in working toward the resolution of environmental problems/issues.
Several writers, including Childress and Wert (1976), Harvey (1977), Hungerford Peyton, and Wilke (1980), argued that producing environmentally literate citizens who demonstrate responsible environmental behavior is the ultimate goal of environmental education. This goal is widely accepted among environmental educators, but assembling the links to achieve this goal is the challenge. From the research literature, it is clear that several of the above-mentioned links can be found in methods of instruction related to environmental problems, issue investigation, and action training.

3.2. Current Trends in Environmental Education

In the past decade, the area of Environmental Education (EE) has been of great concern to teachers from preschool to college level. Because education is the vehicle through which society prepares its citizens to carry out their responsibilities, education must be environmental. A broad body of research shows that knowledge, attitudes, awareness, and appreciation of natural environment are established and fixed by the time students reach high school, it has been proposed that instruction in EE takes place in elementary and/or middle school. Ramsey and Hungerford (Ramsey & Hungerford, 1992) said that research on attitude, value, and cognitive development shows that the middle years, between ages ten to thirteen, offer the greatest opportunities for acquiring knowledge and understanding about the environment. Environmental educators need to be cognizant of this and emphasize educational programs and activities in this age group that will encourage individuals to assess situations objectively and develop problem-solving skills to deal with environmental problems.

The task of recasting U.S. K-12 curricula in an environmental dimension poses not only significant challenges, but also untapped potential, particularly with respect
to opportunities for interdisciplinary configurations. In a society, children do not automatically develop an awareness and appreciation of the natural environment. The curricular and instrumental tools are necessary for effective, systematic K-12 education about the environment is necessary. There is a strong evidence that even two hours of instructional time devoted to the affective outcomes of environmental education augment children’s attitudes toward the environment in a very positive way (Pomerants, 1986).

Environmental Education strategies spring from widely accepted parameters of educational, cognitive, and social learning theories. Pomerants (1986) found that most instructional strategies and techniques are based on environmental awareness models, with emphasis on ecological foundations and appreciation of environmental resources.

3.3. Early Childhood Environmental Education

Well-known Ohio educator Dr. Ruth Wilson (1993) tried to define the field of early childhood EE in her book, *Fostering a Sense of Wonder During the Early Childhood Years*. Wilson examined the philosophy, theory, and best practices of both early childhood education and environmental education. Wilson stresses that EE can help young children understand themselves better as well as discover the world around them. Wilson established six goals with a set of related understandings, which may be used as content guidelines for early childhood EE. Since early childhood is generally defined as birth through third grade, these goals are presented particularly for the prekindergarten/preschool audience. The childhood goals and related understandings, adapted from Wilson are:

Goal 1: To develop an awareness and enjoyment of the beauty and wonder of the natural world.
Related understandings:

1) The natural world is full of beauty and wonder,
2) Many works in art, music, and literature are based on different aspects of nature,
3) The natural world can be a source of personal joy and inspiration.

Goal 2: To become aware of the concepts of cycles, diversity, and interconnectedness in nature

Related understandings:

1) The natural world is in a state of constant change,
2) Everything in nature is connected,
3) All living things, including people, need food, air, and water to survive,
4) All the resources we use come from the natural world,
5) Wildlife is found everywhere,
6) Diversity is a part of natural environment.

Goal 3: To develop a sense of appreciation and respect for the integrity of the natural world

Related understandings:

1) The natural world is ordered, balanced, and harmonious,
2) Change is a natural part of the workings of the earth,
3) All living and non-living things should be treated with respect.

Goal 4: To develop a sense of caring for Planet Earth and an understanding of how different types of pollution might harm the Earth.

Related understandings:

1) Earth is our home,
2) We need to relate to the natural environment in a respectful, caring way,
3) There are many different types of pollution—noise pollution, visual pollution, air pollution, water pollution, etc.

4) Pollution tends to destroy the natural environment and our enjoyment of it.

Goal 5: To develop awareness that people are part of the natural world, not separate from it

Related understandings:

1) The health and well-being of people are affected by the quality of the natural environment,

2) The actions of individuals and groups affect other individuals, society, and the natural environment.

Goal 6: To develop an understanding of how to contribute to the well-being of the Earth

Related understandings:

1) We can reduce pollution by picking up trash,

2) We can save the Earth by recycling,

3) We should respect and take care of all aspects of the natural world,

4) We should live lightly on the Earth.

Environmental Education content for early childhood audiences focuses on providing sensory experiences to foster a sense of wonder with the natural world. Wilson (1993) believed that the most important thing that young children can learn about the Earth is that it is full of beauty and wonder.
3.4. Content Guidelines for K-12 and Higher Education

The North American Association for Environmental Education (NAAEE) developed content guidelines for K-12 formal education (NAAEE, 1999). The guidelines are consistent with major national standards and curriculum reform documents and with the Ohio model curricular and proficiency outcomes. Organized into four strands, they represent a broad aspect of EE and the goal of environmental literacy (Appendix 1). All four strands show that environmental education content is not only factual learning of scientific, technical, and ecological information. Content of environmental education for K-12 education includes questioning and analysis skills, knowledge of environmental processes and systems, skills for understanding and addressing environmental issues, and skills for personal and civic responsibility. Specific content for these strands depends on the developmental stage of the learner.

3.5. Methods for Incorporating Environmental Education into the Curriculum

There are two main methods of incorporating EE into the Curriculum: infusion and insertion. Monroe and Cappaert (1994) point out that infusion is the historically preferred method of incorporating EE into formal school curricular. While infusion is the incorporation of environmental concepts, activities and examples into existing curricular goals, insertion is the method where an environmental unit is added to the class or curriculum.

Engleson (1989) developed a process for infusing EE into the school curriculum:

1) Select the environmental topic to be infused into an existing subject area instructional unit.

2) Identify the subject area units, which relate to, or support, the investigation of the selected environmental topic.
3) Develop one or more environmental objectives for the subject matter unit.

4) Specify the environmental content to be added to the unit.

5) Develop new instructional procedures as needed.

6) Identify new process skills that might be used or developed in achieving the new environmental objectives.

7) Identify new resources to be used in achieving the environmental objectives: equipment, consumable materials, references, field trip sites, resource people, etc. Identify related activities and new topics for investigation that may be suggested by teaching the newly infused unit.

Along with the methods of infusion and insertion, many educators recommend the method of integrated approach into EE. In an integrated approach, the boundaries between discrete disciplines of study are crossed or even eliminated. According to Cantrell and Barron (1996), an integrated approach to teaching and learning may include:

1) Multidisciplinary: Making connections across the boundaries of disciplines.

2) Interdisciplinary: Blurring the boundaries among disciplines.

3) Transdisciplinary: Eliminating the boundaries among disciplines.

In a multidisciplinary approach a single thematic idea is emphasized and topics from various disciplines explore the theme.

In an interdisciplinary approach, thematic ideas are used to investigate an interdisciplinary issue or topic. This approach gives the learners opportunity to make connections to real-life issues that are relevant to them.

In a transdisciplinary approach learners investigate broad areas of interest that exemplify a theme.
A research study of 40 United States schools, including two Ohio schools, gives evidence that Environment as an Integrating Context approach clearly has a strong potential to increase academic performance of students, enthusiasm for learning and enhance teaching and learning in formal education by focusing on environmental issues (Best Practices for Environmental Education: Guidelines for Success, 2000).

3.6. Choosing and Using Environmental Education Materials

Preexisting curriculum, different types of educational materials and media often determine the content of EE programs. There are many sources, which create a huge number of EE materials available for educators to use in their programs. Project Learning Tree, Project WET and Project WILD are known examples of the EE material. Unfortunately, not all EE materials are of the same level of quality. In order for educators to decide which materials to use in their program, the North American Association for Environmental Education developed *Environmental Education Materials: Guidelines for Excellence* (NAAEE, 1986). These guidelines can help educators who are involved with providing EE to evaluate the quality of existing EE materials (Appendix 2). Guidelines can also be useful to help learners build skills in critically evaluating materials.

3.7. Summary

The content of environmental education is the skills, knowledge, and behaviors that make up the subject matter of EE products, services, and programs. The content of environmental education relates to an environmental topic or issue. Environmental education helps individuals build environmental knowledge, life skills and develop responsible citizens. Environmental education is interdisciplinary, relevant to learners, and based on accurate information presented in an unbiased
manner. If environmental educators are to achieve the goal of responsible environmental behavior, then it is critical to design materials suited to the task. Curricula that provide the necessary knowledge about environmental issues, tools to adequately review these issues, and citizenship skills to help resolve these issues are available, which appears to be a link to success in promoting responsible environmental behavior.
CHAPTER 4. Methodology of the Study

4.1. Research Design

The following questions provide the foundation of the study.

1) Is knowledge of the children who used the software “Protecting Your Environment” increased significantly as a result of working with the tool?

2) Is there a significant difference in the score on the quiz before and after using the environmental software between the children who used the software at home and the children who used the software in the classroom?

In order to find the answers to the research questions, two kinds of analysis were used: descriptive statistics analysis and paired samples t-test. Descriptive statistics analysis gave a general idea about the contestants’ knowledge before using the software that is to find out if the level of knowledge of participants in two groups is equal before the using of the environmental software. To find out if there is a statistical significant difference in the scores on the pre-test quiz of the group “at home” and “in class” group, the paired samples t-test was performed.

To find out if there is any significant difference in the scores on the quiz before and after using the software paired samples t-test for each group (at home and at school) was performed. Paired samples t-test was employed to find out if there is a significant difference in the scores on the quiz before and after using the software for the group “at home” and the group “in class” altogether.

The principal, the fifth grade science teacher, and parents of students from a middle school in rural southeastern Ohio, were contacted in January, 2004 for permission to conduct the research. Permission letters to the principal, the science teacher and to the parents of the fifth graders of Middle School, Ohio were signed by
the principal, the science teacher, and by the parents in January 2004. Copies of the letters are included in appendix 6.

4.2. Population and Sample

The population of the study consists of Ohio students of the 5th grade. The above-mentioned population consists of two groups: students who use the environmental education software at home and students who use the environmental software “Protecting Your Environment” at class.

The sample in the research is the students of the 5th grade of a middle school in South Eastern Ohio. The sample consists of two groups: students who use the environmental software at home and students who use the environmental software “Protecting Your Environment” at class. Seventy-five students participated in the study, but not all of them did the post-test activity. Since only sixty-three students did pre and post test activity, the results on the scores of the quiz of 63 students were compared and analyzed. The following number of students fully participated in the study: 25 students from the group who used the software at home and 25 students who used the software at class. There were also 13 students who used the software at class with the manual.

4.3. Instrumentation

To pre-test general knowledge on environmental issues, an environmental quiz was distributed to the 5th graders of the Middle school. The environmental quiz consisted of seven multiple choice and three short essay questions (Appendix 3). The questions for the quiz were developed by the Environmental Protection Agency of Ohio.
The same quiz was distributed to each sample population to assess the knowledge of the 5th graders after using the environmental software “Protecting Your Environment”.

The short oral interview guide was developed to find out students’ opinion about their experience with the environmental software. The oral interview guide consisted of six questions (Appendix 4). The questions for the oral interview were developed by the researcher. The interview guide contained the questions, directly connected to childrens’ experience with learning from the software “Protecting Your Environment”.

4.4. Data Collection

Three instruments were used to gather data: environmental quiz before using the environmental software “Protecting Your Environment” by the students, the same environmental quiz after using the software by the students and an oral interview questionnaire. Both quizzes and the interviews were performed in class.

The quiz, given in January 2004, was conducted before the software was used. The second quiz was conducted in February, 2004 after the software was used. The results of the both, pre and post quizzes were returned to the researcher immediately after the students have completed answering the quiz questions.

A guided oral interview was conducted in May, 2004, and lasted between 10-15 minutes. Ten randomly chosen participants were interviewed in person. The science teacher also participated in an oral interview. Notes were taken during the oral interviews. Students’ answers were kept confidentially.
4.5. Overview of the Software “Protecting Your Environment”

“Protecting Your Environment” software was published by the Office of Environmental Education under the Ohio Environmental Protection Agency. “Protecting Your Environment” software was developed as a result of the Ohio Comparative Risk Project, a citizen-based environmental planning project that evaluated environmental problems in Ohio based on scientific evidence and public values. The targeted audience for the use of the software is adults and teenagers.

The environmental software provides users with the overview of environmental risk issues facing Ohio and gives suggestions on what can be done by citizens to reduce environmental risks in the state.

The program deals with such topics as air pollution, land use, water quality, and habitat destruction. The environmental software purpose is to give better understanding of the environmental issues by providing the users with the facts, stories, surveys, videos, charts and games. Links to a variety of environmental databases and Web sites offer additional places to the users of the software to search for information.

Ohio Environmental Education Fund provided the publishers with the funding to produce and distribute the CD-ROM “Protecting Your Environment” to all six hundred school districts in Ohio. In addition, local libraries and other locations have the CD-ROM. To-date, more than 10,000 CDs have been disseminated in Ohio.

4.6. Local Middle School Overview

The study was conducted in a 5th grade of a middle school in South Eastern Ohio. Students who were tested were in Mrs. D’s science class.

The school is located in southeastern Ohio in a rural community with influences from Ohio University. There are not many high paying jobs in this area of Ohio.
students come from middle to low income homes. Many students still do not have computers at home.

Students, participating in the research, are very computer literate and seem to enjoy using computers. Computer technology is taught and used throughout all classes and integrated into core curriculum areas. Mrs. D integrates computers and technology in the classroom through lessons, projects, and research. She is the technology supervisor for the middle school along with curriculum and the continuous improvement process.

4.7. Data Analysis

Scores collected from the quizzes were entered into a database. To analyze and ensure the results of the data gathered, calculations performed with the help of SPSS software were used.

4.8. Step by Step Methods of Conducting the Study

1) School officials were asked for permission to administer the preliminary environmental quiz in order to pre-assess the children’s environmental knowledge. The meeting with the principal of the school took place on January, 11, 2004. The meeting with the science teacher of the 5th grades was held on January, 23, 2004.

2) The letters of permission were signed by the principal of the school, by the science teacher of the school and by the parents of the 5th graders to allow the researcher to conduct the study by January, 27, 2004 ( Appendix 6).

3) To pre-assess general knowledge on environmental issues, an environmental quiz was distributed to 5th graders on January 27, 2004.

4) The software was distributed and tested among selected children of a middle school. The students were divided into two groups by their teacher: students
who would use the software at school with their teacher and students who
would use the software at home.

5) After 4 weeks of testing the software, the environmental quiz was
administered again on February, 27, to the children who used the tool to
assess their environmental knowledge.

6) To assess the effectiveness of the software, pre-test and post-test results
among children who used the software were compared and analyzed.

7) The pre-test and post-test results in terms of the settings were also compared
and analyzed.

8) The children were asked about what they learned from the software, including
if it was difficult for them to use it, which topics they liked the best, and what
they did not like about the software.

9) As a result of the study, suggestions were made on improving the “Protecting
Your Environment” software performance.

4.9. Data Interpretation

To get the general idea about the participants’ knowledge before using the
software, descriptive statistics analysis was used.

The quiz contained eleven questions. The highest score that could be obtained
by the children equaled the number eleven. Each right answer corresponded to the
score, which was equal the number one. Each wrong answer corresponded to the
score, equaled zero.

According to the results of descriptive statistics analysis, quiz scores in the
populations are normally distributed, which is seen from the histogram and
distribution curve (Figure 1, A and B). The same figures show that the means of two
samples, which are at home and school groups, are equal 5.96 and 5.16 with standard
deviations 1.45 and 1.81 respectively. The mean score in descriptive statistics analysis is the average score on the quiz, gained by the children. The figure 1, A and B, imply that the level of knowledge of participants in two groups was statistically equivalent. However, according to the mean scores of both groups, children who were going to use the software at home did better than children who were going to use the software at class.

Figure 1. The level of knowledge of participants before using the software
A. “At home” group

<table>
<thead>
<tr>
<th>Score on the test</th>
<th>Frequency</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>3.5</td>
<td>1.26</td>
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<tr>
<td>3</td>
<td>2</td>
<td>4.5</td>
<td>1.67</td>
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<tr>
<td>4</td>
<td>3</td>
<td>5.5</td>
<td>1.82</td>
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<tr>
<td>5</td>
<td>4</td>
<td>6.5</td>
<td>2.03</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>7.5</td>
<td>2.24</td>
</tr>
<tr>
<td>7</td>
<td>6</td>
<td>8.5</td>
<td>2.45</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>9.5</td>
<td>2.66</td>
</tr>
</tbody>
</table>

B. “At class” group

<table>
<thead>
<tr>
<th>Score on the test</th>
<th>Frequency</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td>3.5</td>
<td>1.26</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>4.5</td>
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<td>8</td>
<td>7</td>
<td>9.5</td>
<td>2.66</td>
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</tbody>
</table>

Std. Dev. - standard deviation

To find out if there is any significant difference between two groups in the scores on the quiz before using the software, paired samples t-test was performed. Two-tailed t-test was used because two-tailed t-test gives more accuracy when comparing two groups rather than one-tailed t-test. Two-tailed t-test gives 95%
accuracy in the relationship between p-value and confidence interval. For the results to be significant in the paired samples t-test, p-value has to be less than 0.05.

The results of the paired samples t-test suggest that while there is no significant difference in the pre-test scores between the group “at home” and the group “in class”, children who used the software “Protecting Your Environment”, performed better on the pre-test activity (table 1).

Table 1. The results of two groups before using the software

<table>
<thead>
<tr>
<th>Pair</th>
<th>Home and class Before</th>
<th>Paired Differences</th>
<th>t-value</th>
<th>Degree Of Freedom</th>
<th>Significance 2-tailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Mean: .6800</td>
<td>.228619</td>
<td>.45724</td>
<td>-.2637</td>
</tr>
</tbody>
</table>

The table 1 shows that there is no significant difference in the pre-test activity between “at home” and “in class” groups, because the p-value is not less than 0.05.

To find out if there is any significant difference within the each group (at home and at school) in the scores on the quiz before and after using of the software paired sample t-test for each group was performed. The results imply that while there is no significant difference in the score on the quiz before and after using the tool by children at home (tables 2-3, p.40), there is a significant difference in the score on the quiz before and after using the software by the children at class (tables 3 and 4)
Table 2. Mean scores before and after using of the software among the pupils who used the software at home.

<table>
<thead>
<tr>
<th>Pair 1</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>5.9600</td>
<td>25</td>
<td>1.45717</td>
<td>.29143</td>
</tr>
<tr>
<td>After</td>
<td>6.5200</td>
<td>25</td>
<td>1.04563</td>
<td>.20913</td>
</tr>
</tbody>
</table>

N- number of students; Std. - standard

Table 3. The difference within the group “at home”

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>95% Confidence Interval of the Difference</th>
<th>t-value</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before – After Home</td>
<td>-.5600</td>
<td>1.68523</td>
<td>.33705</td>
<td>-1.2556</td>
<td>-.661</td>
<td>24</td>
<td>.110</td>
</tr>
</tbody>
</table>

Std. - standard; df –degree of freedom; Sig. - significance

The p-value in the results below equals .110, which implies that there is no a significant difference in the score on the quiz before and after using the software among the children who used the software at home.

Table 4. Mean scores before and after using of the software among the pupils who used the software in class.

<table>
<thead>
<tr>
<th>Pair 1</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>5.1600</td>
<td>25</td>
<td>1.81842</td>
<td>.36368</td>
</tr>
<tr>
<td>After</td>
<td>6.8000</td>
<td>25</td>
<td>1.38444</td>
<td>.27689</td>
</tr>
</tbody>
</table>

N- number of students; Std.- standard
Table 5. The level of significance within “At Class” group

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>95% Confidence Interval of the Difference Lower</th>
<th>Upper</th>
<th>t</th>
<th>Df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before - After Class</td>
<td>-1.64000</td>
<td>2.11896</td>
<td>.42379</td>
<td>-2.51466</td>
<td>.76534</td>
<td>-3.870</td>
<td>24</td>
<td>.001</td>
</tr>
</tbody>
</table>

N- number of students; t- t-value; Sig.- significance; Std.- standard

Table 5 shows the p-value, which is less than 0.05 shows the level of significance. The p-value in the results below equals .001, which means that there is a significant difference in the score on the quiz before and after using the environmental software among the children who used the tool at school.

Paired Samples T-test was performed to find out if there is a significant difference in the knowledge gained as a result of using the software between two groups (at home and in class). Table 6 shows a mean score in two groups. Table 7(p.42) shows that there is no significant difference in the test scores after using the software between two groups.

Table 6. Mean scores of two groups

<table>
<thead>
<tr>
<th>Pair 1</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>After Class</td>
<td>6.8000</td>
<td>25</td>
<td>1.38444</td>
<td>.27689</td>
</tr>
<tr>
<td>After Home</td>
<td>6.5200</td>
<td>25</td>
<td>1.04563</td>
<td>.20913</td>
</tr>
</tbody>
</table>

N- number of students; Std. - standard
Table 7. The mean score within two groups

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>Paired Differences</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>Std. Deviation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After Class home</td>
<td>.28000</td>
<td>.176824</td>
<td>.35365</td>
<td>-.44989</td>
</tr>
</tbody>
</table>

N- number of students; t- t-value; Sig. - significance; Std. - standard; df-degree of freedom

To find out if there is a significant difference in knowledge the children in two groups gained as a result of using of the software, the paired sampled t-test was employed. The table 8 shows that the p-value equals .000, which is less than 0.05. This means that the knowledge of children in two groups improved significantly after they used the software.

Table 8. The difference within two groups

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>mean</th>
<th>Standard. Deviation</th>
<th>Standard Error mean</th>
<th>95% Confidence Interval of Difference</th>
<th>t value</th>
<th>Sig. 2-tailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Home and Class After Home and Class</td>
<td>.1000</td>
<td>1.97174</td>
<td>.27885</td>
<td>Lower -1.6604</td>
<td>Up. .5396</td>
<td>3.945</td>
</tr>
</tbody>
</table>

Sig. - significance
Chapter 5. Findings, discussion, and recommendations.

5.1. Findings

There is a difference, but not significant one in the score on the quiz before and after using “Protecting Your Environment” software among the children who used the software at home.

There is a significant difference in the score on the quiz before and after using the environmental software within the group, which used the software in class.

There is no significant difference in the score on the quiz before and after using the environmental software between two groups of students.

In the whole, the environmental knowledge of children increased after they used the “Protecting Your Environment” software.

5.2. Interview Results

The results of the interview showed that students enjoyed using the “Protecting Your Environment” software. Most of the students liked the environmental games, especially, the game, concerning recycling issue. Students considered the games, presented in a tool to be “very educational and fun”. In their opinions, there should be more games presented in the software. Children liked the colorful pictures and video, which supplemented the text of the topics given in the tool. Some participants liked graphs, which help the children visually understand environmental issues. What students also liked was that software covered environmental issues, facing Ohio. The participants noted that they learned more about the state in which they live.

Participants said that though there was a lot of directions offered by the tool, “Protecting Your Environment” software was easy to run.
Answering the question about the difficulties that they experienced when using the environmental software, 5th grade participants responded that sometimes they could not understand a topic, because of the adult language of the tool. They also recommended that it would be better if the text to be always accompanied by a reader. Complaining that they have a lot of reading at school, children suggested less text in the software, but more video, pictures and games. Some of the students would see “the type in” program in the software, which would allow them to type and draw for themselves while using the tool.

Mrs. D, in whose class the software was used, found the software to be well worthwhile. The software was integrated into the science curriculum and lesson plans. Mrs. D found that the software aligned to the state standards and proficiency outcomes very well. She found that she would use “Protecting Your Environment” software to reinforce teaching of ecology. Students have spent every Tuesday for eight weeks since the research study has finished, working on the software, learning the program, and completing the activities. Mrs. D found the software “very user friendly” and easy to download.

She suggested the areas of improvements for the software- software to download on the server. In her opinion, this would save time and loading software once. In addition, a teacher information packet with reinforcement sheets would be helpful for the software to be more productive in terms of helping students to gain more environmental knowledge.

5.3. Additional Study and Findings

Environmental Protection Agency of Ohio developed the manual, named “The Scavenger Hunt” (Appendix 6). To investigate whether software usage at school with
the manual improves test scores or not, the group using the software at school with the manual was formed and scores of this group were studied.

The students were given the instruction on how to work with the software. The quiz scores of the “group at school with the manual” after using the software were compared with the scores of the “at school” group. Since there was no significant difference in gaining environmental knowledge as a result of using the software within the “At home” group, the last was not taken for this step of the research analysis. Environmental quiz was distributed to the group “at school with the manual” before and after using of the software.

For the purpose of this analysis, descriptive statistical analysis and paired samples t-test were used.

5.4. The Results on Additional Findings.

Descriptive analysis showed that the level of knowledge of the children of “at class” and “at class with the manual” was statistically equal before using the software (see figure 2, A and B).
Figure 2. The level of knowledge of the students before using the software

A. “At class” group

B. “At class with the manual” group

<table>
<thead>
<tr>
<th>Pair 1</th>
<th>Class Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class after Manual After</td>
<td>6.3600</td>
<td>25</td>
<td>1.65529</td>
<td>.33106</td>
</tr>
<tr>
<td>Manual After</td>
<td>9.4000</td>
<td>25</td>
<td>1.50000</td>
<td>.30000</td>
</tr>
</tbody>
</table>

N-number of students; Std.-standard
Table 10. Difference between two groups after using the software

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Std. Deviation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Std. Error Mean</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>95% Confidence Interval of the Difference</td>
<td>Lower</td>
<td>Upper</td>
<td></td>
</tr>
</tbody>
</table>

Std.-standard; t- t value; df- degree of freedom; Sig.-significance

The p-value in the results in table 10 equals .000, which means that there is a significant difference in the score on the quiz after using the software between “at class” and “at class with the manual” groups. The children who used the software with the manual performed better than the children who used the software at class without the manual.

The results of the paired samples t-test showed that there is a significant difference in the score on the quiz before and after using the environmental software among the children who used the tool at school with the manual (see tables 11 and 12, p.47-48).

Table 11. Means of the group “with the manual” before and after using the software

<table>
<thead>
<tr>
<th>Pair 1</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual After</td>
<td>9.0000</td>
<td>13</td>
<td>1.73205</td>
<td>.48038</td>
</tr>
<tr>
<td>Manual Before</td>
<td>5.7692</td>
<td>13</td>
<td>1.48064</td>
<td>.41066</td>
</tr>
</tbody>
</table>

N-number of students; Std.-Standard
Table 12. Difference within the group “with the manual”

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>Std. Error Mean</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.806</td>
</tr>
</tbody>
</table>

Std.-standard; t- t value; df –degree of freedom; Sig.-significance

The p-value, which is less than 0.05 shows the level of significance. The p-value in the results below equals .000, which means that there is a significant difference in the score on the quiz before and after using the environmental software among the children who used the tool at school with the manual.

To find out if the knowledge of all the groups of children (“at home” group, the group “in class” and the group “in class with the manual”) altogether improved significantly as a result of using the software, paired samples t-test was used. Table 13(p.49) shows that the knowledge of all children who used “Protecting Your Environment” software improved significantly after they used the software.

Table 13(p.49) that the level of significance within all the groups of children who used the software equals .000. According to the rules of statistics, for the difference to be significant, the p-value should be less than 0.05. According to this study, the knowledge of all the groups of children overall improved significantly after they used the software.
Table 13. The level of significance in groups. Paired differences

<table>
<thead>
<tr>
<th>Pair</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>Std. Error Mean</th>
<th>Lower</th>
<th>Upper</th>
<th>t</th>
<th>df</th>
<th>Sig.(2 tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pair 1</td>
<td>-6.400</td>
<td>2.11896</td>
<td>.4237</td>
<td>-25147</td>
<td>-.7663</td>
<td>-3.870</td>
<td>24</td>
<td>.001</td>
</tr>
<tr>
<td>Pair 2</td>
<td>-.5600</td>
<td>1.68523</td>
<td>.3370</td>
<td>-12556</td>
<td>.1356</td>
<td>-1.661</td>
<td>24</td>
<td>.110</td>
</tr>
<tr>
<td>Pair 3</td>
<td>-3.2308</td>
<td>2.00640</td>
<td>.5564</td>
<td>-4.4432</td>
<td>-2.0183</td>
<td>-5.806</td>
<td>12</td>
<td>.000</td>
</tr>
<tr>
<td>Pair 4</td>
<td>-.8800</td>
<td>2.12507</td>
<td>.3005</td>
<td>-1.4839</td>
<td>-2.761</td>
<td>-2.928</td>
<td>49</td>
<td>.005</td>
</tr>
<tr>
<td>Pair 5</td>
<td>-1.5397</td>
<td>2.14646</td>
<td>-.2704</td>
<td>-2.0803</td>
<td>-.9991</td>
<td>-5.694</td>
<td>62</td>
<td>.000</td>
</tr>
</tbody>
</table>

Std.-standard; Dev.-deviation; t- t value; df-degree of freedom; Sig.-significance

Pair 1-before class-after class

Pair 2-before home-after home

Pair 3-before manual-after manual

Pair 4-before home and class-after home and class

Pair 5-home, class, and manual before-home, class, and manual after

5.5. Summary on Additional Findings

1) There is a significant difference in the score on the quiz after using the environmental software among the children who used the tool at school and the students who used the software at school with the manual.

2) There is a significant difference in the score on the quiz before and after using the environmental software among the children who used the tool at school with the manual.

3) The knowledge of “in class”, “at home”, and “in class with the manual” groups altogether, significantly improved.
CHAPTER 6. Conclusion

Research questions were answered. The results of the study are as following:

- There is a difference, but not significant one for knowledge related to the using of the “Protecting Your Environment” software among the children who used the software at home.
- There is a significant difference in the score on the quiz before and after using the environmental software within the group, which used the software in class.
- There is no significant difference in the score on the quiz before and after using the environmental software between “in class” and “at home” groups.
- There is a significant difference in the score on the quiz after using the environmental software among the children who used the tool at school and the students who used the software at school with the manual.
- There is a significant difference in the score on the quiz before and after using the environmental software among the children who used the tool at school with the manual.
- In the whole, the environmental knowledge of all groups of children altogether significantly increased after they used the “Protecting Your Environment” software.
- The software “Protecting Your Environment” can be an additional educational tool for educators to teach students environmental issues.
6.1. Discussion

Research indicates that “Protecting Your Environment” software can positively affect student knowledge and attitudes toward the environment. The study provides evidence of the power of the software to improve students’ knowledge about the environmental issues.

School administration involvement and the leadership of a teacher were key factors in developing an environment conductive to the use of the software among children. Technology experience of the teacher in the computer practices was a critical factor. I was fortunate to work with the computer literate teacher who actively used computer technology in her class and who was willing to try the software “Protecting Your Environment” with her students. The teacher could create a friendly, caring environment in which students felt secure and were willing to accept new way to learn about the environmental problems in the state they lived.

Creativity of the teacher, acquaintance with new environmental materials, and the willing to use the technology in the classroom were the main factors of integration of the software into the science curriculum and lesson plans of the school where the study was conducted. The science teacher found that the software aligned to the state standards and proficiency outcomes very well. The teacher found that she would use “Protecting Your Environment” software to reinforce teaching of ecology.

According to the interview results and non-formal conversation with the teacher, environmental software excited students, held their interest, and provided engaging learning experiences that are unavailable in the traditional classroom.

The results in this study suggested the power of the software to provide concrete visual and sound support for learning environmental issues. The study suggested the value of the computer software that offered both text-based and
graphic-based information and that provided multiple pathways to the information. Video and animations added an affective dimension to the software, making the learning from the software more interesting, more meaningful, and hence more memorable.

It is said that when playing, children learn better. The environmental games in the software not only entertained students and held their attention, but also educated them.

Although all the groups performed better on the quiz after using the software than before using the tool, students who used the software with the manual, scored significantly higher on the quiz than a comparable group of students who did not use the manual. The study suggests that the instruction on how to use the software is a critical factor to study particular environmental topics. The software contains a lot of information and it is very difficult for a child to comprehend all the issues, covered in the software in a month. Carefully designed instruction can help students and teachers meet the objectives of the software use and make the learning more meaningful.

The study showed that while there is no significant difference in knowledge related to the using of the “Protecting Your Environment” software among the children who used the software at home, there is a significant difference for knowledge gained as a result of using the environmental software within the group, which used the software in class. One of the reasons of this finding could be a learner-designed environment, which may provide more concentration on the task. Another reason of a significant difference for knowledge gained as a result of using the environmental software within the group, which used the software in class could be teacher’s explanations of some “adult” words or phrases to the children. Perhaps, not all the parents of the children who used the software at home could help them
understand the meaning of the new world for the students. In addition, students who used the software in class were permitted to work collaboratively if they wished, which also could be a reason of a significant difference in the amount of knowledge gained related to the use of the software among the students who used the tool in class.

The software “Protecting Your Environment” contains many links to environmental websites. While all the students who used the software in class had access to the internet, not all the students who used the software at home had an internet connection, which speaks in favor of in-class software use in my case.

The results of the research showed positive impacts on students learning from the software “Protecting Your Environment” and can be used as an educational tool by schools. However, just having the software does not automatically translate to better instructional outcomes. Whether a given school experiences the potential benefits of technology depends on the design of the software, what students actually do with the software, how educators structure and support technology-based learning and whether there is sufficient access to the technology.

6.2. Recommendations for an additional research

The study suggests that “Protecting Your Environment” software can be an effective tool for students to learn about the environmental issues. Before using the software the students who participated in a research were not provided traditional classroom instruction about the issues covered in the software. I would like to know what is better: traditional classroom instruction without the learning from the software or learning from the software is better than the traditional classroom instruction. I would also like to know how the software is effective if it is used not only in class with the manual, but also with supplemented classroom instruction. I suppose that the students would demonstrate significantly greater gains in the knowledge about the
environmental issues if in addition to a computer-based instruction they received traditional classroom instruction. I would like to know how the software works if it is integrated in the curriculum by a teacher. My question is how “Protecting Your Environment” software can meet the educational objectives of a teacher.

The students, who participated in the study, used the software for only one month. I would like to know how the software is effective among the children if they are provided more amount of practice with the environmental software.

This study implies that the classroom settings are better for the software to be more effective in terms of gaining environmental knowledge. I would like to know if grouping of students makes a difference in learning from the software, that is what is better for students’ gaining knowledge from the tool-to work collaboratively, or to work individually with the software.
References


Strand 1: Questioning and Analysis Skills. Environmental literacy depends on learner’s ability to ask questions, speculate, and hypothesize about the world around them; seek information; and develop answers to their questions. Learners must be familiar with inquiry, master fundamental skills for gathering and organizing information, and interpret and synthesize information to develop and communicate explanations. Specific skills in this strand are:

Questioning
1) Designing investigations
2) Collecting information
3) Valuating accuracy and reliability
4) Organizing information
5) Working with models and simulations
6) Developing explanations

Strand 2: Knowledge of Environmental Process and Systems. An important component of environmental literacy understands the process and systems that comprise the environment, including human systems and influences. That understanding is based on knowledge synthesized from across traditional disciplines. The guidelines in this section are grounded in four sub-categories:

2.1 The Earth as a Physical System
1) Processes that shape the Earth
2) Changes in matter
3) Energy

2.2 The Living Environment
1) Organisms, populations, and communities
2) Heredity and evolution

3) Systems and connections

4) Flow of matter and energy

2.3 Humans and Their Societies

1) Individuals and groups

2) Culture

3) Political and economic systems

4) Global connections

5) Change and conflict

2.4 Environment and Society

1) Human/environment interactions

2) Places

3) Resources

4) Technology

5) Environmental Issues

   Strand 3: Skills for Understanding and Addressing Environmental Issues.

Skills and knowledge are refined and applied in the context of environmental issues. These environmental issues are real-life dramas where differing viewpoints about environmental problems and their potential solutions are played out. Environmental literacy includes the abilities to define, learn about, evaluate, and act on environmental issues. The guidelines in this section are grouped in two sub-categories:

3.1 Skills for Analyzing and Investigating Environmental Issues

1) Identifying and investigating issues

2) Sorting out the consequences of issues

3) Identifying and evaluating alternative solutions and courses of action
4) Working with flexibility, creativity, and openness

3.2 Decision-Making and Citizenship Skills

1) Forming and evaluating personal views
2) Evaluating the need for citizen action
3) Planning and taking action
4) Evaluating the results of actions

Strand 4: Personal and Civic Responsibility. Environmentally literate citizens are willing and able to act on their own conclusions about what should be done to ensure environmental quality. As learners develop and apply concept-based learning and skills for inquiry, analysis, and action, they also understand that what they do individually and in groups can make a difference. Specific skills in this strand are:

1) Understanding societal values and principles
2) Recognizing citizens’ rights and responsibilities
3) Recognizing efficacy
4) Accepting personal responsibility
Key characteristic #1 Fairness and accuracy: EE materials should be fair and accurate in describing environmental problems, issues, and conditions, and in reflecting the diversity of perspectives on them.

Guidelines:

1.1 Factual accuracy: EE materials should reflect sound theories and well-documented facts about subjects and issues.

1.2 Balanced presentation of different viewpoints and theories: Where there are differences of opinion or competing scientific explanations, the range of perspectives should be presented in a balanced way.

1.3 Openness to inquiry: Materials should encourage learners to explore different perspectives and form their own opinions.

1.4 Reflection of diversity: Different cultures, races, genders, social groups, ages, etc., are included with respect and equality.

Key characteristic # 2 Depths: EE materials should foster awareness of the natural and built environment, an understanding of environmental concepts, conditions, and issues, and an awareness of the feelings, values, attitudes, and perceptions at the heart of environmental issues, as appropriate for different developmental levels.

Guidelines:

2.1 Awareness. Materials should acknowledge that feelings, experiences, and attitudes shape environmental perceptions and issues.

2.2 Focus on concepts. Rather than presenting a series of facts, materials should use unifying themes and important concepts.
2.3 Concepts in context. Environmental concepts should be set in a context that includes social and economic as well as ecological aspects.

2.4 Attention to different scales. Environmental issues should be explored using a variety of scales as appropriate, such as short to long time spans, localized to global effects, and local to international community levels.

Key characteristic # 3 Emphasizes on Skills Building: EE materials should build lifelong skills that enable learners to prevent and address environmental issues.

Guidelines:

Critical and creative thinking. Learners should be challenged to use and improve their critical thinking and creative skills.

Applying skills to issues. Students should learn to arrive at their own conclusions about what needs to be done based on thorough research and study, rather than being taught that a certain course of action is best.

Action skills. Learners should gain basic skills needed to participate in resolving environmental issues.

Key characteristic # 4 Action Orientation: EE materials should promote civic responsibility, encouraging learners to use their knowledge, personal skills, and assessments of environmental issues as a basis for environmental problem solving and action.

Guidelines:

4.1 Sense of personal stake and responsibility. Materials should encourage learners to examine the possible consequences of their behaviors on the environment and evaluate choices they can make that may help resolve environmental issues.
4.2 Self-efficacy. Materials should aim to strengthen learners’ perception of their ability to influence the outcome of a situation.

Key characteristic # 5 Instructional Soundness: EE materials should rely on instructional techniques that create an effective learning environment.

Guidelines:

5.1 Learner-centered instruction. When appropriate, learning should be based on learner interest and on learner’s ability to construct knowledge to gain conceptual understanding.

5.2 Different ways of learning. Material should offer opportunities for different models of teaching and learning.

5.3 Connection to learners’ everyday lives. Materials should present information and ideas in a way that is relevant to learners.

5.4 Expanded learning environment. Learners should learn in environments that extend beyond the boundaries of the classroom.

5.5 Interdisciplinary. The materials should recognize the interdisciplinary nature of EE.

5.6 Goals and objectives. Goals and objectives for the materials should be clearly spelled out.

5.7 Appropriateness for specific learning settings. Claims about the material’s appropriateness for the targeted developmental levels and the implementation of the activity should be consistent with the experience of educators.

5.8 Assessment. A variety of means for assessing learner progress should be included in the materials.

Key characteristic # 6 Usability. EE materials should be well-designed and easy to use.
Guidelines:

6.1 Clarity and logic. The overall structure (purpose, direction, and logic of presentation) should be clear to educators and learners.

6.2 Easy to use. Materials should be inviting and easy to use.

6.3 Long lived. Materials should have a life span that extends beyond one use.

6.4 Adaptable. Materials should be adaptable to a range of learning situations.

6.5 Accompanied by instruction and support. Additional support and instruction should be provided to meet educators’ need.

6.6 Make substantiated claims. Materials should accomplish what they claim to accomplish.

6.7 Fit with national, state, or local requirements. EE materials should fit within national, state, or local standards or curricular.
APPENDIX 3 Environmental Quiz

Dear Children! Answering the questions, choose A, B or C, please.

1) Where does \( \frac{1}{2} \) of the pollution come from?
   A. Factories and plants
   B. Automobiles
   C. Play grounds

2) Why do we need plants?
   A. Release oxygen, air would be poisonous without it
   B. Absorb oxygen
   C. Release carbon dioxide

3) In what layer of the atmosphere is the air we breathe?
   A. Stratosphere
   B. Troposphere
   C. Stratosphere and Troposphere both

4) What is the value of ozone, which is found in stratosphere?
   A. Protects us from the ultraviolet rays
   B. Gives us more ultraviolet rays
   C. There is no value of ozone, which is found in stratosphere

5) How much water per day do we need?
   A. 5-6 quarts
   B. 2-3 quarts
   C. 7-8 quarts
6) How much water does the average American use per day?
   A. 87 gallons
   B. 10 gallons
   C. 111 gallons

7) How is the garbage created in people’s homes called?
   A. House waste disposal
   B. Municipal waste
   C. Municipal solid waste

Thank you for answering multiple choice questions! Please, answer the following questions:

What can you personally do to reduce pollution from motor vehicles? Give at least one thing, please.

1) Give one thing you could encourage adults to do to reduce pollution from vehicles.

2) List two reasons of why litter is bad.

3) What is non-point pollution?
APPENDIX 4 Oral Interview Guide

1) Did you enjoy using the environmental software?

2) What did you like in the software?

3) What you did not like in the software?

4) Did you learn something from the software? Explain, please.

5) Was it difficult for you to operate the software? Explain why “Yes” or “No”

6) What would you suggest the publishers of the software for the tool to be more interesting for you to use?
APPENDIX 5. The letters of permission.

5.1. The letter to the principle, asking for permission to conduct environmental quiz at school and the permission for the students to work with the software.

Dear Principal! My name is Irina Shvadlenko. I am a graduate student of Ohio University. My major is environmental studies. I am interested in environmental education and the ways children are presented it. My current research is focused on how environmental software “Protecting Your Environment” is useful for children to know more about environmental issues, facing the USA today.

Could you, please, give me a permission to conduct environmental quizzes among the children of the 5th grade of your school as well as permission for the 5th grade students to work with environmental software? All the children’s answers to environmental quizzes will be anonymous and will be kept confidentially.

The software “Protecting Your Environment” was published in 1997 by Environmental Protection Agency of Ohio. “Protecting Your Environment” provides an overview of environmental risks in Ohio and suggests what people can do to reduce them. The program offers a look at dozens of problems affecting our air, land, water and animal habitats. An interactive CD–ROM is developed to help children gain better understanding of environmental issues while browsing through facts, stories, surveys, videos, games, and more. The software can be a great tool for children to meet science curriculum at school.

If you give me a permission to conduct a research in your school, put your signature with a date below, please.

Thank you. Signature---------------------
5.2 The letter to the science teacher asking for permission to conduct environmental quiz and the permission for the students to work with the software.

Dear Teacher! My name is Irina Shvadlenko. I am a graduate student of Ohio University. My major is environmental studies. I am interested in environmental education and the ways children are presented it. My current research is focused on how environmental software “Protecting Your Environment” is useful for children to know more about environmental issues, facing the USA today.

Could you, please, give me a permission to conduct environmental quizzes among the children of the 5th grade of your class as well as permission for the 5th grade students to work with environmental software? All the children’s answers to environmental quizzes will be anonymous and will be kept confidentially.

The software “Protecting Your Environment” was published in 1997 by Environmental Protection Agency of Ohio. “Protecting Your Environment” provides an overview of environmental risks in Ohio and suggests what people can do to reduce them. The program offers a look at dozens of problems affecting our air, land, water and animal habitats. An interactive CD–ROM is developed to help children gain better understanding of environmental issues while browsing through facts, stories, surveys, videos, games, and more. The software can be a great tool for children to meet science curriculum at school.

If you give me a permission to conduct a research in your class, put your signature with a date below, please.

Thank you. Signature........................
APPENDIX 6 Instructions for students on how to work with the software

Answer the following questions on loose-leaf. The directions to help you navigate the CD-ROM are in bold.

1) Go to Understanding Environmental Risks, Go to Air We Breathe, Go to Introduction Watch the movie and answer the following questions.
   a. Where does 1/2 of the pollution come from?
   b. In-what layer of the atmosphere is the air we breathe?
   c. Why do we need plants?

2) Go to Air We Breathe, Go to Motor Vehicle Pollution
   a. Where is ozone found in nature and what is its value to humans?
   b. Give one thing you personally can do to reduce pollution from motor vehicles.
   c. Give one thing you could encourage adults to do to reduce pollution from motor vehicles.

3) Go to Water of Life under Understanding Environmental Risks. Watch the introduction.
   a. How much water per day do we need?
   b. How much water does the average American use per day?

4) Use one of the categories under Water of Life for the following question.
   a. If you Were a farmer building a vacation resort list 2 things you could do to prevent non-point source pollution.
   b. Under what heading did you find your answer?
5) Under Understanding Environmental Risks go to Waste Management.
   a. What is the garbage created in peoples’ homes called?

   b. Under what heading did you find your answer?

6) From the same screen the answer from above was found, use the direction bar along the bottom of the screen for the following questions.
   a. In a sentence give one reason we should worry about older landfills used to dispose of municipal solid waste.

   b. List two things you can do to reduce municipal Waste disposal.

   c. Play the compost game.

7) Go to Waste Management then to Litter.
   a. List 2 reasons litter is bad.

8) From the Main Menu go to Participating in Environmental Protection. Read the whole section called the Big Picture.
   a. Write a paragraph of how specific actions affect the environment locally, regionally (state or country), and globally. Do not use the same examples from the CD. You need to describe an activity that harms the environment. Describe the negative action, negative impact on the environment, and what you could do to help the situation. You can go back and review Understanding Environmental Risks to get ideas.
APPENDIX 7 Definitions of Terms

Access: process by which information contained either in memory or mass storage is made available to another sub-unit of a computer or, ultimately, to the user. Also, refers to the ability or authority to communicate with a remote computer.

Affective Domain: refers to the area of human learning associated with attitudes, opinions and values. Contrast with cognitive and psychomotor.

Animation: the apparent movement of objects on a video or computer display.

Educational Objectives - statements of what the pupils are intended to do or learn.

CBE: abbreviation for Computer-Based Education. Since computer-based learning was originally developed in a university setting, the term naturally applied to it was education. Therefore, CBE is the oldest of the several synonymous terms in use. See CBL.

CBL - abbreviation for Computer-Based Learning. CBE is the umbrella term that includes all forms of use of computers in support of learning.

CD-ROM - acronym for Compact Disk Read Only Memory. Optical disk storage providing about 550 megabytes of storage (approximately enough for five encyclopedias) on a 5 F (1, 4) inch disk. The disk is read by a laser.

Cognitive Domain - refers to the area of human learning associated with intellectual skills. Contrast with affective and psychomotor domains.

Computer Application - human endeavor (a manual task) that is susceptible to being automated by computer technology. Also, any technique for applying computer technology to the solution of a variety of information processing problems. The applications most commonly done using microcomputers are: word processing, spreadsheets, data bases, graphics, and communications.
Courseware- term used to describe those computer application programs, and other media such as texts and video, that support educational objectives.

Data Acquisition- a process. Information derived from analytical instruments is captured, converted to digital form, if necessary, and held in computer readable form.

Data Base- collection of information, organized for retrieval. Generally, it is implied that this information is available in computer readable form for either on-line or off-line access. However, some data bases that have been generated by a computer exist only in hard - copy form. An example may be the individual personnel records formed into a personnel data base.

Delivery- the process of delivering the learning activities to learners. Also, called implementation.

Environmental education- the process involving life-long learning as it comes to understand the complexity of the natural world and environmental issues, using various approaches for individual and societal decision-making based on knowledge integrated from various disciplines, and resulting in our own attitudes and action strategies to make a difference in the world.

Evaluation- the measure of the effectiveness of the materials.

Graphics- ability to plot points, draw lines, or otherwise create pictures either in hard copy or on the display screen of a computer or a terminal. Graphics aid student understanding of complex items or processes, and can make an important contribution to the learning process.

Hardware- category of computer components that involves physical equipment. It excludes the instructions to the equipment called software and the instructional software and supporting physical materials called courseware. Typically, hardware is
divided into two major types: the central processing unit and peripheral devices.

Contrast with software and courseware.

Learner- the preferred term for students.

Software- in computer-based learning it takes on a more specialized meaning. The special software used by the instructors and students is called “courseware.”

Software Evaluation- a process performed in schools and classrooms, and can be extended over a considerable amount of time.

Software Selection- a process undertaken outside the classroom by a teacher or group of teachers who are well informed about educational issues or computing.

Technology- electronic devices that perform some function, such as overhead projectors, audio cassette players, videocassette recorders, televisions, calculators and computers.