ENVIRONMENTAL EDUCATION: IMPROVING STUDENT ACHIEVEMENT

by

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ABSTRACT

Environmental education:
improving student achievement

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The present research, being one strand of the Environmental Education Consortium's longer research effort, aims to study the impact of environmental education (EE) programs on student achievement in traditional subjects such as math, reading and writing. By comparing "environmental schools" and schools with traditional curricula and analyzing their teaching and learning environments, the present research aims to obtain statistical evidence of the positive impact of EE on student learning and to make an educational case for environmental education.

The research compares two groups of schools selected by the author after consulting with various EE providers, and other EE and educational experts: a group of EE schools that have been fully implementing EE for at least three years, and a group of comparison (or non-EE) schools which do not have an environmental education program or are only starting to develop it. Schools were paired using US census and OSPI information.

To evaluate the impact of the EE programs on student achievement, data about WASL and ITBS tests from the OSPI web site were used. WASL and ITBS data were analyzed through several statistical tests (t-tests, discriminant analysis, longitudinal analysis, etc.) Also in order to evaluate the schools' teaching and learning environments an electronic survey was administered.

According to the results, schools that undertake systemic environmental education programs consistently have higher test scores on the state standardized tests over comparable "non-EE" schools. The mean percentages of the students who meet standards on WASL and ITBS tests are higher in WASL and ITBS in the schools with environmental programs. There were no EE schools that had lower percentage of students who meet or above standards in all six areas. Overall, 73 pairs out of 77 EE schools had higher scores in ***at least*** one subject. Also the research shows a pattern indicating that in schools with environmental educational programs, teachers tend to use natural areas more; have more EE professional development/training; have more support from parents, community and administration; and see more value in environmental education.

To conclude, the author believes that the present research shows the correlation between level of implementation of environmental education and student achievement and emphasizes the necessity of more in-depth studies of this issue.

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Introduction

Environmental education (EE) has been developing for about a century. Some researchers and practitioners believe that it continues traditions of outdoor and nature education. However, although many states require EE to be taught in all grades and subjects, EE has not become an integral part of school curricula. Teachers and EE professionals name various reasons for the lack of environmental education in their classrooms. Lack of time, money and training, lack of support and other curriculum pressures are only some of them. In Washington State one more reason was added to the list several years ago. Teachers are required to prepare students to the Washington Assessment of Student Learning test (WASL), a new standardized test administered in elementary, middle and high school.

The supporters of environmental education believe that although the benefits of EE have been known for a long time, there has not been enough evidence that environmental education can be helpful in improving student learning. The concern has been expressed in several state and national reports, which state that most of research on this topic is anecdotal in nature.

Four years ago, a group of several state, non-profit, business and educational organizations in Washington State, known as the Environmental Education Consortium (EEC), started a project that aimed to prove the benefits of environmental education and integrate it into Washington school curricula. This research, one strand of the EEC's longer effort, aims to study the impact of environmental education programs on student achievement in traditional subjects such as math, reading and writing. By comparing

"environmental schools" and schools with traditional curricula and analyzing their teaching and learning environments, the present research aims to obtain statistical evidence of the positive impact of EE on student learning and to make an educational case for environmental education.

1. Environmental education: background

1.1. Development of the terms, definitions and objectives of EE

Many authors name the 1960s as the decade when environmental education (EE) started to develop in response to the world's growing awareness about environmental problems. Others believe that EE grew from movements that existed from the beginning of the last century such as nature study, conservation and outdoor education (NACD 1998). In general, the history of the development of the main terms and definitions of environmental education has been studied by different authors. According to Disinger (1983) the term "Environmental Education" appeared for the first time in 1948 at the meeting of the International Union for the Conservation of Nature and Natural Resources. Gough (1997), Palmer (1997, 1998), and Sterling and Cooper (1992) date the appearance of the definition of EE to the end of the 1960s when this term began to be used and discussed on the international level.

According to Stapp *et al.* (1969, p. 30), environmental education is a process aimed to produce "a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution." This definition as well as main objectives of environmental education were developed by Stapp and his graduate students at the Department of Resource Planning and Conservation, University of Michigan (MacGregor 2003). Among the goals of EE Stapp *et al.* (1969) named the development of *knowledge and understanding* of biophysical environment and interrelations of all its components,

and *awareness* and *concerns* for environmental quality as well as the development of *responsible behavior* patterns. Development of specific skills and values necessary for solving environmental problems was not mentioned directly in this definition.

One of the most widely accepted definitions of EE was given in the Tbilisi Declaration which was developed at the international conference of environmental educators, sponsored by UNESCO in 1977 (MacGregor 2003). There, environmental education was defined as "a learning process that increases people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action" (UNESCO 1978). According to the Declaration, environmental education is seen as a life-long process that is interdisciplinary and holistic in nature and application. It concerns the interrelationship between human and natural systems and encourages the development of an environmental ethic, awareness, understanding of environmental problems, and development of critical thinking and problem-solving skills. MacGregor (2003) believes that the Tbilisi definition was based on the definition developed by Stapp *et al.* (1969) given above, because of William Stapp's influence in creating and shaping the Tbilisi EE conference.

Palmer (1997, 1998) gives another definition of environmental education that slightly differs from the definition given above. She defines EE as "the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness among man, his culture and his biophysical surroundings" (Palmer 1998, p. 27). Like Stapp *et al.* (1969), Palmer

stresses the importance of interconnections between man, his culture and nature. In addition, EE should also include practice in decision-making processes, the development of self-cognition, the formation of environmental ethics and environmental behavior, and the development of skills for environmental assessment. Palmer concludes that the special feature of EE is that the knowledge of environmental laws and principles of functioning of the natural systems are studied *within* the environment which helps to develop practical skills and the ability to make an assessment of the state of the environment.

An analysis of the works of Bergeson *et al.* 2000, Klimov and Ukolov (1994), Palmer (1997, 1998), Stapp *et al.* (1969), Sterling and Cooper (1992), Volk and McBeth (1998), and others reveals that the goals, objectives, principles and content of environmental education have been clearly defined in many regional and international studies and official documents. The main approaches identified in the works mentioned above are in consensus that the objective of EE is to develop the system of scientific knowledge and a positive attitude towards the environment, to form an understanding of the necessity of nature protection, to increase awareness of the problems in this field as well as possible solutions, and to form a positive attitude towards the environmental laws of society. Although this set of principles is discussed by many researchers, it should be stated that all of them use Recommendation 2 of the Tbilisi Intergovernmental Conference, 1977 as a basis (UNESCO 1978).

According to the European Resolution on Environmental Education[1] which has been taken as a basis for many EE programs and actions in Europe, the goals of

[1] Resolution of the Council and the Ministers of Education meeting within the Council on Environmental Education (May 24, 1988)

environmental education are "to increase the public awareness of the problems which exist in this field, as well as possible solutions, and to lay the foundations for a fully informed and active participation of the individual in the protection of the environment and the prudent and rational use of natural resources" (Giolitto *et al.* 1997, p. 37). Giolitto *et al.* (1997) drew a conclusion that although in different countries of European Union the emphasis can vary from one point to another, there are four major aims of environmental education which are 1) the transmission of knowledge, 2) the creation of new behavior patterns, 3) the development of values, attitudes and skills necessary to protect and improve the environment, and 4) the development of awareness of the necessity to protect the nature and the environment and of the complexity both of the environment and the interactions between man and nature.

In American EE literature, a lot of attention is given to the development of responsible citizenry. Educators and researchers see educating of citizens who actively protect the environments, and feel their responsibility to do so, as one of the main goals of environmental education (Hines *et al.* 1986; Hoody 1995; Hungerford *et al.* 1980; Moody 1994, Stapp *et al.* 1969, etc.). According to MacGregor (2003), leading environmental educators such as Stapp and Hungerford emphasized that the field of environmental education differs from outdoor, nature and conservation education because it focuses on environmental *problems* and aims to find solutions to them. If so, then environmental education should help to develop patterns of responsible behavior as well as awareness, skills, knowledge and attitudes necessary to act on behalf of the environment. Stapp *et al.* (1969) believe that "citizens should realize that the responsibility for the solutions to [environmental problems] belongs to them and to the

governments which represent them" (p. 31). Thus, environmental education should reach citizens of all ages and help them to understand how to play an effective role in solving environmental problems. As mentioned in NAAEE's *Excellence in Environmental Education-Guidelines for Learning (K-12),* EE should help learners to develop questioning and analysis skills, knowledge of environmental processes and systems, skills necessary for understanding and addressing environmental issues (such as decision-making, investigation, and citizenship skills) and personal and civic responsibility (NAAEE 1999). Hungerford *et al* (1980) see the main aim of environmental education "... to aid citizens in becoming environmentally knowledgeable and above all, skilled and dedicated citizens who are willing to work, individually and collectively, towards achieving and/or maintaining a dynamic equilibrium between quality of life and quality of the environment" (p. 43). The authors believe that it should provide learners with ecological knowledge, develop conceptual awareness and environmental action skills, as well as skills for investigation and evaluation.

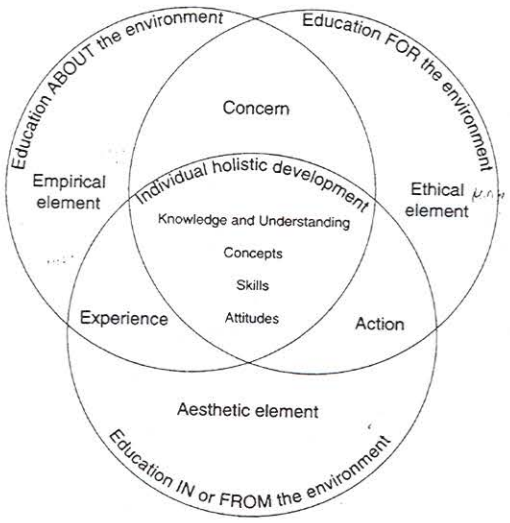
1.2. Models of environmental education

An effective model of EE implementation was needed to achieve all the above-mentioned goals. One of the first attempts was made in Europe in the middle of the1970s. The 3-dimensional model was suggested in 1974 by the Schools' Council in UK and later published by Lucas (1979). It has been mentioned frequently by different researchers (e.g. Palmer (1997, 1998), Uzzel (1999), etc.) and adapted according to the development of society. As mentioned by Palmer (1997, 1998), Sterling and Cooper (1992), Uzzel

(1999) and others, there are three components in the model, which are used for EE organization and planning. They are education ***About, For*** and ***Through /In /From*** environment (Fig 1).

According to Palmer (1997, 1998), the model consists of two subsystems - formal and informal education - both of which include the three above-mentioned components. The description of the components given below is done on the basis of the definitions and descriptions found in the works by Palmer (1997, 1998), Schools' Council (1974), Sterling and Cooper (1992), and Uzzel (1999).

Figure 1. A 3-dimensional model of environmental education by Palmer (1998)

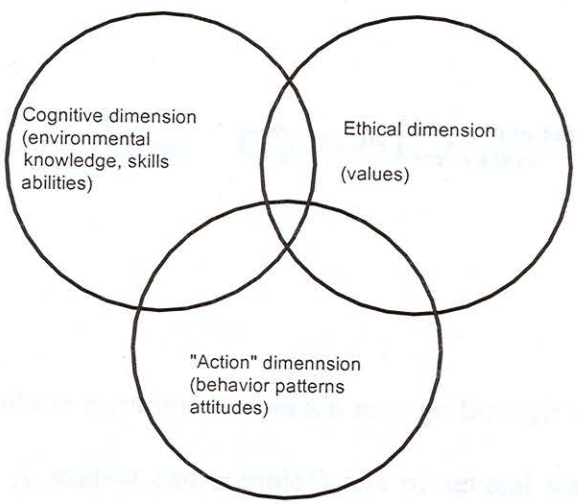


Education ***About*** the environment is usually a part of formal education and has an empirical character. The main aim is to develop knowledge about nature and natural systems using research activities and to form an understanding of the environment, its values and the complex interactions of the elements of the natural and human systems.

Education ***Through/In/From*** the environment sees nature as a tool and resource of the learning process in order to develop research activities of a child, to form the individual experience, to develop a wide range of skills of investigation and communication. The aesthetic element predominates here. This component is a part both of formal and informal education.

Education ***For*** the environment reflects the ethical element of EE. It puts the emphasis on the development of a personal ethic, a sense of responsibility and informal concern for environment. Its aim is to form positive caring attitude towards the environment.

Figure 2. A model of EE by Giolitto *et al.* (1997)



Since the 1970s different authors have worked out different models of environmental education. Thus, Giolitto *et al.* (1997) suggested a static model according to which there are three dimensions in environmental education: cognitive, ethical and

"action" dimensions (Fig. 2). The first - cognitive - dimension includes the level of environmental knowledge and skills, which can help to learn, understand and protect the environment. The second one – ethical - assumes the development of values. The last dimension – "action" – includes the development of special behavior patterns and positive attitudes towards the environment.

Sterling and Cooper (1992) presented two models for the process through which individuals progress as they become environmentally educated. Both models include all five categories mentioned in the Tbilisi Declaration. The first model is linear (Fig. 3). It assumes that the person passes the stages of environmental education in a strict order one by one.

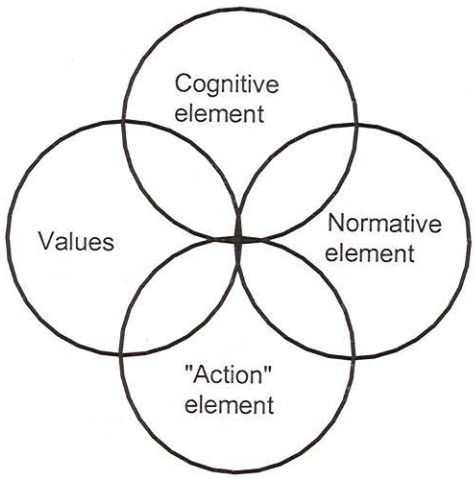
Figure 3. A linear model of EE by Sterling and Cooper (1992)

But, as the authors mentioned, a person may go through the stages of the process in a different order. A student can complete one or several stages simultaneously. It proves that EE is more complex and interrelated than the suggested linear model. Thus, Sterling and Cooper (1992) present another version of the model (Fig. 4) in which all elements are interrelated and mutually reinforcing.

Figure 4. A non-linear model of environmental education by Sterling and Cooper (1992)

Ukrainian researchers Klimov and Ukolov (1994) suggested another model of ecological education[2] according to which the system of ecological education consists of four components: cognitive, normative, "values" and "action" (Fig. 5).

Figure 5. Elements of environmental education by Klimov and Ukolov (1994)



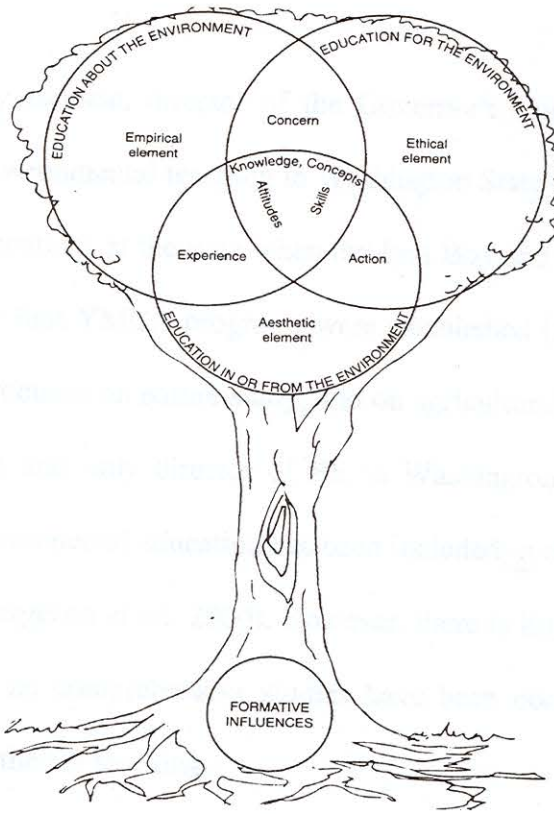
[2] The term "ecological education" is used as a synonym to "environmental education" in Ukraine as well as in many countries of the former Soviet Union and Central and Eastern Europe (Sterling and Cooper 1992; Subbotina 2000).

The cognitive element assumes fundamental knowledge about the interaction of man and the environment, basic understanding of the aims and goals of nature conservation process, and global environmental problems and the ways of solving them. **Values** include the understanding of value of the environment itself (cognitive, ethical, practical values, etc.), the ability to manage human activities within the environment and to foresee the possible changes in the environment as the result of these activities at different levels. **The normative element** presupposes the ethical, aesthetical and ecological norms of the usage of the environment and the behavior patterns for individuals, groups and society in the environment. **The "action" element** assumes the activities and methods directed toward the development of cognitive, practical and behavioral ecological skills (an ability to evaluate the situation, the choosing of the solution, the development of personal features of the student, etc.).

It is necessary to mention that it was Palmer (1998) who first stated that for the development of EE it is necessary to use not a static but dynamic variant of the model that takes into account individual peculiarities and personal experiences of students (Fig. 6). In this case three areas of the model are spheres which rotate constantly. The other difference is that the key element of the model is "formative influences." This element can become more important than the influence of the formal educational programs because it represents the combination of personal experience and formal education. Without taking this factor into account it is impossible to develop a sufficient level of knowledge, skills and values which will form environmental ethics and awareness. Although formative influences use the experience of formal educational programs, they

exist independently from programs. That is why it should be considered as a basis for the whole process of EE development.

Figure 6. A dynamic model of environmental education adopted from Palmer (1998)



Another framework has been developed by the North American Association for Environmental Education, according to which EE should include seven categories: affect (or factors that allow individuals to reflect (and act) on environmental issues), ecological (or conceptual) and socio-political knowledge (which include understanding of political, cultural and social aspects of environmental issues), knowledge of environmental issues, cognitive skills (or ability to analyze, synthesize and evaluate facts and data),

environmental responsible behaviors and its additional determinants (Volk and McBeth 1998).

1. 3. Environmental education in Washington State

According to Beverly Isenson, director of the Governor's Council for Environmental Education, the first environmental teaching in Washington State probably appeared in the early part of the 20th century, at the time when the first Boy and Girl Scout troupes were created, and when the first YMCA programs were established (Isenson 2003). Many of these early programs focused on nature study, and on agricultural and outdoor education. Tony Angell, the first and only director of EE in Washington State, believes that in Washington State environmental education has been included in classroom instruction for more than 50 years (Bergeson *et al.* 2000). However, there is little documentation of the formal programs, and no comprehensive studies have been done to describe their EE focus, or the extend of the EE teaching.

Since the 1980s, EE has been mandated in every grade and in nearly every subject. This is a requirement of the state law adopted by the Washington State Legislature and the Washington State Board of Education (Washington Administrative Code – WAC 180-50-155), according to which "instruction about conservation, natural resources, and the environment shall be provided at all grade levels in an interdisciplinary manner through science, the social studies, the humanities, and other appropriate areas with the emphasis on solving the problems of human adaptation to the environment" (Arrasmith 1995, p. 1).

According to *Environmental education guidelines for Washington schools*, there are four goals for environmental education in the state. EE should help students

1. to develop knowledge about the environment and its components as well as understanding of interactions between them.
2. to develop understanding of the importance of social and natural systems "in supporting our physical lives, economy, and emotional well-being" (Bergeson *et al.* 2000, p. 22)
3. to understand the impact of personal decisions and actions on the environment; and
4. to develop knowledge and skills necessary to maintain and improve the environment.

Bergeson *et al.* (2000) believe that there are many opportunities for educational reform which would "engage students constructively in their environments." such as service learning projects, integrated curriculum, school site-management, and the usage of technology" (p. iii). Also, they argue that environmental education can become a tool for improving student achievement in other disciplines as well as strengthening their critical thinking and problem-solving skills.

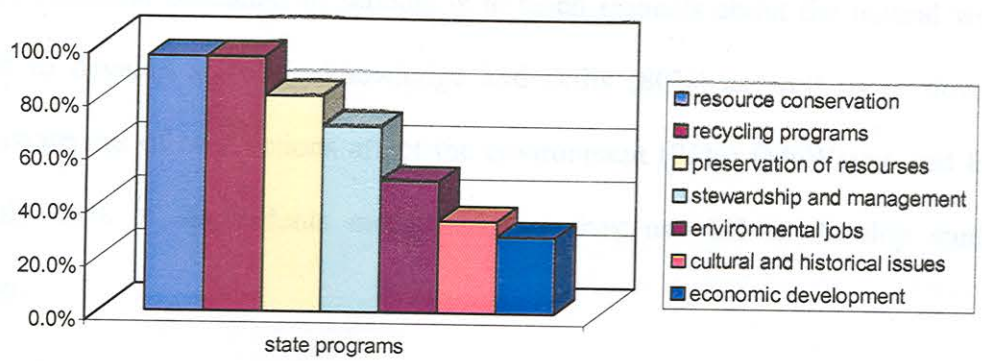
According to the research conducted by the Northwest Regional Educational Laboratory in 1995, "less than 30 percent of the school districts in the state adopted specific policies for implementing environmental education, yet the majority of schools have environmental education included in their curriculum" (Arrasmith 1995, p.3). About 75 percent of Washington schools offer environmental education to 3rd-8th-grade students. Overall, in 1995 about 30% of students in the state were found to have been exposed to

some kind of environmental education. Today according to the preliminary assessment conducted by the Washington Department of Fish and Wildlife, this number has increased. Today 53.4% of Washington schools are doing environmental education in at least one classroom (Tudor 2003).

The list of published environmental education curriculum guides that can be used in classrooms is extensive. Project WET (Water Education for Teachers), Project WILD, and Project Learning Tree are three nationally produced curricula that are very popular among WA teachers. Although these curricula have been developed nationally, they are readily adaptable to classroom applications of local natural habitat and issues.

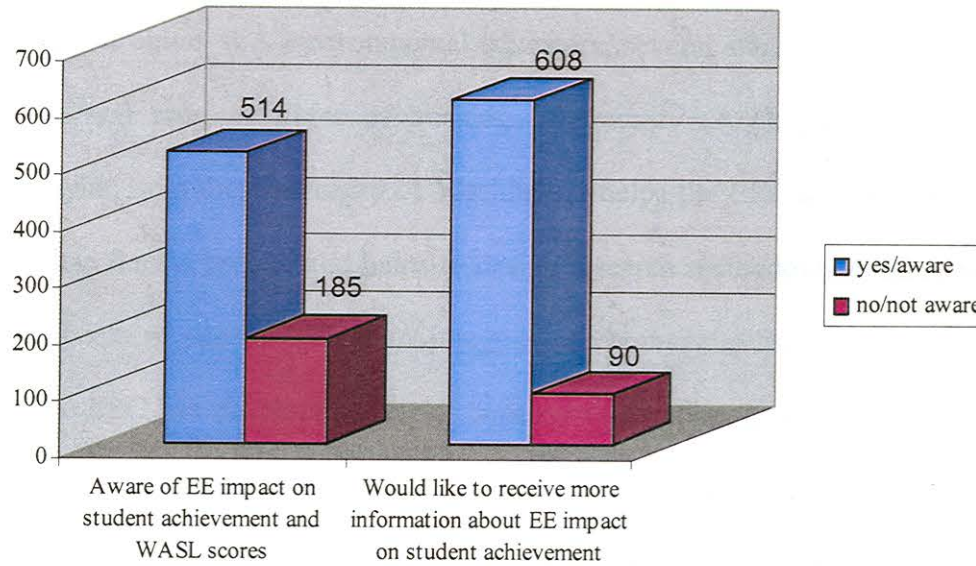
In general, 90.7% of K-12 local environmental programs in WA have science units and about 40% have social science and interdisciplinary units. As reported by Arrasmith (1995), the most popular topics are resource conservation and recycling (Figure 7). The least attention is given to economic development (28.7%) and environmental jobs (49.1%).

Figure 7. Distribution of environmental educational programs by context in Washington State (source: (Arrasmith 1995)



In 2001-2002 the Washington State Environmental Education Needs Assessment (WSEENA) was conducted by the Washington State Office of Environmental Education (WA OEE) at the Washington State Office of the Superintendent of Public Instruction (WA OSPI) to assess the status of EE in public schools in the state and to identify schools which need assistance in EE program development and implementation, as well as to determine the needs schools are facing (McWayne and Ellis 2003). The survey was sent to all 2,651 K-12 public schools in Washington State. Responses were received from 709 schools (27%). According to the survey, 23 percent of respondents are not aware of Washington State's EE Mandate (WAC 180-50-115), which requires environmental education to be taught in all subjects and grades. As shown on Figure 8 below, adopted from McWayne and Ellis (2003), 514 respondents (or 74%) said that they are aware that EE can be used as a tool for improving student achievement and either are currently using EE (40%) or would like to use it (34%) for this purpose. Also 87% mentioned that they would like to have more information about EE's impact on student learning. About half of surveyed teachers (or 47%) use environmental education to align their curriculum activities with state standards (Essential Academic Learning Requirements). According to the study, the most common use of environmental education in schools is to teach students about the natural world (91%) and to develop scientific knowledge and skills (80%) as well as to develop students' awareness of how actions affect the environment (85%) (McWayne and Ellis 2003). Only 45% of respondents mentioned that they use EE to develop student stewardship.

Figure 8. Awareness of EE impact on student achievements and need for more information around the state (adopted from McWayne and Ellis (2003))



However, although many schools in the state have some kind of environmental course, program or unit, over 60% of respondents stated that they do not have adequate resources to implement integrated education in their classroom (McWayne and Ellis 2003). In general, according to several studies, the main barriers to teaching environmental education in schools are lack of funding, lack of training and materials, and lack of time (Arrasmith 1995; McWayne and Ellis 2003). For example, about 55.6% of the respondents who participated in NREL's study[3], named lack of funding as one of the barriers for EE implementation (Arrasmith 1995). Also lack of in-service teacher training was seen as a barrier by 51.9 percent of survey participants.

[3] Northwest Regional Educational Laboratory

Four years ago, the Washington Department of Fish and Wildlife and the Washington Forest Protection Association decided to combine their efforts in shaping EE in the state. As a result, in 1998 the Environmental Education Consortium (EEC) was created. Today it unites WA environmental educators, several state agencies, non-profit organizations and representatives of business community (Angell *et al.* 2001). Dr. Catherine Taylor from the University of Washington helps the EEC to develop a strong theoretical base for the project and helps to design research methodology and standards. One of the goals of the project is to integrate environmental education into school curricula. The EEC has developed a set of benchmarks that integrate existing academic standards into one coherent system using environmental education as a basis for integration. The benchmarks describe environment-based knowledge and skills that should be acquired by students at the 5th grade, 8th grade and 10-12th grade level and align them with the Essential Academic Learning Requirements (state academic standards) in all subjects. The EEC also developed a package of WASL-like performance tasks based on integration of core knowledge and skills in language arts, history, civics, math, natural and social sciences, health and the arts providing scoring criteria for evaluating quality of student work. The members of this EE Consortium believe that their performance tasks based on EALR and EE benchmarks can be used to prepare students for the WASL tests, to improve their critical thinking, analytical, and inquiry skills as well as to assess knowledge and understanding of environmental concepts. Overall, the present thesis research was done as a part of the Environmental Education Assessment Project conducted by the EEC.

To conclude, although there are many terms and definitions of environmental education, they have a lot in common. All of them agree that it is necessary to develop knowledge, skills, positive attitudes toward the environment, and responsible behavior. We can use EE to develop knowledgeable and responsible citizens who understand the complexity of natural systems and interrelationships between the components of the environment, cultures and social entities, and are able to participate in solving environmental issues. Overall, the number of EE programs is growing. However, teachers who are motivated enough to respond to the surveys indicate clearly that they need more support and training to use environmental education on a more regular basis.

2. Review of research and approaches in Environmental Education

As a part of educational research in general, environmental education is affected by social and natural sciences and uses both "social" and "natural" methods. In the last 40 years the amount of EE research has varied from year to year, reflecting the changes in the interests of society in environmental problems. This chapter will review and analyze the approaches and research existing in the field of environmental education.

Wilson and Smith (1996) found that the number of environmental education articles in educational journals has *decreased*, compared to those of 20 years ago. The authors surveyed the Education Index, a cumulative index of educational publications to compare the number of EE publications over the 1970-1991 time period. According to the authors (Table 1), the number of publications in 1990-1991 was less than it was 20 years ago. Besides, only 7 educational journals out of 30 surveyed had articles addressed to any EE topic. On the basis of these findings the authors make a conclusion that EE is "far from being a priority in the schools" (p. 41).

Table 1 Education index search results comparing number of environmental education references over a 20-year span (adopted from Wilson and Smith (1996))

Date	No. of references
July 1970-June 1971	74
July 1980-June 1981	59
July 1990-June 1991	65

An opposite view is presented by the National Environmental Education & Training Program's (NEETF) report (2000), according to which the amount of EE research has *increased* since the 1970s. The report presents supporting statistics from various research studies which show that the number of studies is growing constantly from year to year. For example, Roth (1976) identified 100 EE research studies from 1973-1976 whereas Iozzi (1981) reported 263 EE journal reports and 88 dissertations from 1970-1981. By 1990, about 500 articles and 700 dissertations had been published (NEETF 2000). One of the possible explanations is that these researchers focused on different periods of time. Wilson and Smith looked at three specific periods, each a year in length, whereas others analyzed research over longer periods of time. Also unlike Wilson and Smith who analyzed articles devoted to EE, Roth, Iozzi and others included dissertations and reports in their analyses.

2.1. Three research and teaching approaches in EE

Being a part of educational research in general, environmental educational research uses methods and models popular in this field. Robottom and Hart (1993) define three paradigms in environmental education, which influence the choice of research and teaching methods in environmental education. The first "positivist approach" to EE aims to develop knowledge "about the environment." In such learning processes teachers are the keepers of knowledge whereas students are passive recipients. The knowledge in this model is derived from experts and is for the most part objective, systematic and discipline-based. Educational research based on this approach is usually conducted by

external experts. It is based on applied science methods and is instrumental, quantitative, individual and acontextual in nature. According to Robottom and Hart (1993, p. 29), this positivistic model uses an applied science approach to educational inquiry, "seeking to apply standards and methods of natural sciences to the problems of education."

The second "image" of environmental education is based on "an interpretivist model" (Robottom and Hart 1993). In it the purpose of education is to conduct activities "in the environment", in which a teacher is an organizer of experiences and students are active learners. The source of knowledge is personal experience. The research based on this approach is constructivist and subjective in nature and is usually conducted by external experts. Unlike the positivist approach, interpretivist research takes into account the context of learning events and uses interpretivist qualitative research methods.

And finally, the third approach to environmental education, which is actively developing now, is the "critical approach". Environmental education based on this model aims to provide students with opportunities for action "for the environment", in which teachers are collaborative participants with students who are actively generating their own knowledge. Educational research based on this approach applies methods used in critical social sciences and is dialectical, qualitative and collaborative in nature. As in the previous model, it takes into account the context of the events. However, unlike the two other approaches, in this case research is conducted by internal participants.

Another researcher Tom Marcinkowski (1993) states, the great majority of research in environmental education uses natural and physical science methods of inquiry and is based on "logical" positivist views, which assume that social facts exist separately from individuals' beliefs. According to the research conducted by Roth (1976) (cited in

Marcinkowski), most of environmental researchers use experimental-type studies in their works. In addition, about 90-92% of them were quantitative. As concluded by Marcinkowski (1993), the supporters of positivist approach see its power as "the extent to which it will allow one to predict, control, and/or explain the phenomena of interest." The "ultimate achievement of research is perceived as a situation in which it is possible fully to predict environmental behavior" agree Robottom and Hart (1993, p. 36).

Table 2. Summary of three paradigms in environmental education defined by Robottom and Hart (1993)

Model	Teaching	Learning	Research
Positivism	Authority-in-knowledge	Passive	Applied science Instrumental Quantitative Acontextual Objectivist Individualist
Interpretivism	Teacher - organizer of experiences in the environment	Active learners through environmental experiences	Interpretivist Constructivist Qualitative Contextual Subjectivist Individualist
Critical	Collaborative participants	Active generators of knowledge	Critical social science Reconstructivist Qualitative Contextual Dialectical Collaborative

Table 2 summarizes the description of three models in environmental education described by Robottom and Hart (1993). These models form the foundation for research and teaching approaches in this field. However, EE teaching/learning and research do not develop simultaneously. At the moment many EE practitioners see their role as organizing engaging activities in the environment for their students (interpretivist model

in the table). These teachers try to provide students with hand-on experiences. Other teachers go further. They become collaborative participants of the learning process, allowing students to generate their knowledge and to self-reflect on their learning. On the other hand, most of the studies conducted in this filed are still for the most part quantitative, objective and acontextual. Thus, while teaching approaches in environmental education are evolving and maturing moving from the intepretivist model toward the critical model, approaches to research in EE have appeared to remain quite traditional.

2.2. Quantitative and qualitative methods

There appears to be a growing interest in qualitative methods of research in EE and in the field of education in general. The difference between quantitative and qualitative methods is discussed by many writers. According to Creswell (1994, (p.1-2)) (cited in Sogunro), quantitative research is "an inquiry into a social or human problems, based on testing a theory composed of variables, measured with numbers, and analyzed with statistical procedures, in order to determine whether the predictive generalizations of the theory hold true"; and qualitative research is "an inquiry process of understanding a social or human problem, based on building a complex, holistic picture, formed with words, reporting detailed views of informants, and conducted in a natural setting."

McMillan and Schumacher (1999), Marcinkowski (1993) and others state that the purposes of quantitative research can be divided into four categories: 1) to describe (using surveys, longitudinal and cross-sectional developmental studies, correlational

studies); 2) to predict (using correlation and multiple correlation statistical analysis); 3) to control and 4) to explain (using experimental type designs). Table 3 below presents the synthesis of tables and discussions in Marsinkowski (1993) and Sogunro (2001) who compare quantitative and qualitative approaches.

Table 3. Comparative analysis of quantitative and qualitative approaches (sources: Marcinkowski (1993); Sogunro (2001))

Feature	Quantitative	Qualitative
Form of results	Numerical, statistical "hard" data	Narrative, description "soft" data
Origins	Derived from the natural and physical sciences and reflects the tradition of scientific inquiry	Derived from social sciences
Assumptions about the World	Social facts exists apart from individual's beliefs	Multiple realities constructed through social processes
Assumptions about Truth	Truth consists of observable and verifiable facts	There is no objective reality apart from the knower, truth consists of a complex value-laden observations and interpretations
Research purpose	Seeks to establish patterns, relationships between, and causes of social phenomena (description, prediction, explanation)	Seeks to establish understanding of social phenomena from participant perspective (exploration, description, grounded explanation)
Research methods and processes	A priory design of methods and research questions	Questions and design emerge or develop during study
Prototypical designs	Surveys, correlational and experimental design	Ethnographic, historic, and policy designs
Researcher's role	Detached Passive interaction	Active participation
Validity and reliability estimates	Are seen as characteristics of measurement devices. Estimates are obtained by known analysis procedures	Are seen as characteristics of the data themselves. Estimates obtained through triangulation and audit trails
Methods of data analysis	Parametric and non-parametric statistical tests	Content analysis
Impotence of research	Generalization of the results beyond the particular setting	Generalization which are specific to the particular setting of the study

Importance of theory	Theory building ad testing serve as it basic aims	If any attention is given to theorizing, it tends to emphasize the generation of grounded theory
Research variables	Small number	Larger number
Sample populations	Large population	Small population
Relationship	Distant and short term	Intense and long term
Research context	Controlled	Uncontrolled
Interpretation of information	Objective	Subjective
Nature of inquiry	Positivism	Interpretivism

The debate about the "right" methods for educational research has been going on for decades. There are supporters and defenders of both methods. However, as stated by Sogunro (2001), a researcher should know and be able to apply both methods. Sogunro used a mixed method of quantitative and qualitative tools in his study of the impact of the leadership training program on the participants. He emphasizes that "the usage of numbers and descriptions, which anchor both quantitative and qualitative research paradigms, are mutually complementary, and the strengths of both can produce a research synergy in which whole collective benefits are greater than obtained from either approach taken alone" (Sogunro 2001, p. 8-9). A similar view is presented by Firestone (1987), who states that qualitative and quantitative approaches have different descriptive strengths. "Used separately, qualitative and quantitative studies provide differing kinds of information. When focused upon the same issue, qualitative and quantitative studies can triangulate – that is use differing methods to assess the robustness or stability of findings," believes Firestone (1987, p. 19-20). As Firestone (1987) continues, if the studies receive similar results using different methods, that means that the results are not affected by methodology. "In this case the two studies corroborate each other" (Firestone 1987, p. 20).

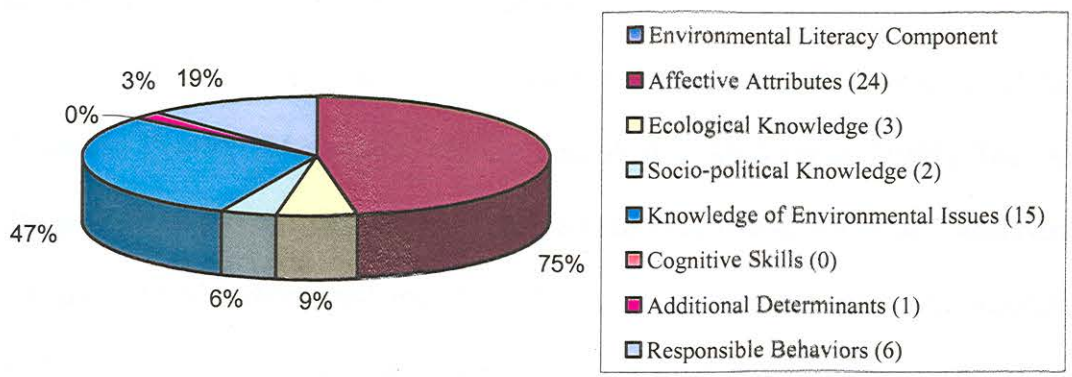
In general, as mentioned by many authors, there are many factors that affect the choice of a research method, such as the match between research purposes and methods, the researcher's training, availability of resources and information, accessibility to situations, data and sample populations, etc. All these factors should be analyzed in advance before designing and conducting a study.

2.3. What is being measured?

Volk and McBeth (1998) analyze what components of environmental education (or environmental literacy as they call it) have been researched recently. The authors use the framework developed by NAAEE's National Project for Excellence in Environmental Education, which consisted of seven components: affect, ecological knowledge, socio-political knowledge, knowledge of environmental issues, cognitive skills, additional determinants of environmental responsible behavior, and environmentally responsible behaviors. Figure 9, which was created using information in Volk and McBeth (1998), presents the number and percentage of studies that have measured each of the components named above. According to the figure, the amount of research attention is not evenly distributed. Most researchers study variables related to attitudes and environmental knowledge (75% and 47% respectively). Less then half of the studies selected by the authors, investigated environmentally responsible behavior (19%), socio-political (6%) and ecological knowledge (9%). Only 1 study looked at the additional determinants of environmentally responsible behavior and none of the studies focused on cognitive skills developments.

For my literature review besides books and monographs, I selected about 50 articles from peer-reviewed educational journals. The results of the analysis are similar to those presented by Volk and McBeth (1998). Most of the research examines knowledge, attitudes or responsible behavior or relationships between these components. Few articles discuss needs for EE, various definitions of environmental education used in this field, biographies of famous environmental educators, or opinions of EE practitioners and researchers. And only a few articles look at the impact of environmental education on student achievement.

Figure 9. Number and percentage of studies that assessed environmental literacy components (source: Volk and McBeth (1998))



2.3.1. Research to measure knowledge component

In the last decade many researchers have focused on measuring environmental knowledge of various populations. According to the articles surveyed, most of these studies show predominantly low levels of knowledge among populations studied

(Gigliotti 1990; Hausbeck *et al.* 1992; Kuhlemeier *et al.* 1999; Lawrenz 1983; Wright and Floyd 1992, etc.). Blum (1987) analyzed the results of the survey of environmental knowledge and attitudes in the United States, England, Israel and Australia and came to the conclusion that the 9th and 10th grade students in all four countries have low environmental knowledge.

Brody (1996) assessed the 4th-, 8th-, and 11th-grade students' science knowledge related to Oregon's marine resources. According to the study, the students tested showed understanding of concepts such as geological structure and process, energy, nutrients and food webs. However, students' "understanding of physical and chemical characteristics, process and effects did not progress beyond the early grade level" (p. 25). Also students showed little understanding or misunderstanding of concepts related to weather and climate. The author believes that it is necessary to conduct more research on misconceptions related to environmental science.

Gambro and Switzky (1996) examined data from the Longitudinal Study of American Youth (LSAY) conducted and described by Miller *et al.* (1991). The study was designed to assess the development of math and science attitudes and achievement of middle and high school students. According to the research, most of the students tested understood basic concepts underlying environmental issues. However, a majority of participants were not able to apply their knowledge or to suggest possible solutions or explain the consequences of the issues. Also, the authors found a very little increase in environmental knowledge in the period from 10th to 12th grade. Gambro and Switzky (1996) believe that it is necessary to develop critical thinking of students and to use students' concerns as a source of motivation. "The interdisciplinary nature of

environmental problems provides an ideal opportunity for meaningful, integrated, and problem-oriented instruction," conclude the authors. Obviously, it is the complex nature of environmental problems that allows the integration of different subjects, skills and knowledge and, as a result, stimulates critical thinking and inquiry skills. Its complexity does not allow the usage of the same "standardized" or conventional pedagogical approaches. In this kind of complex teaching, questions do not have a "standard" answer. They demand that learners apply their imagination, curiosity, creativeness, thinking and knowledge.

On the other hand, many researchers found changes in environmental knowledge of students who have attended environmental and/or outdoor programs or courses. Thus, Lindemann-Matthies (2002) report an increase in students' knowledge after participation in EE programs. Gillett *et al.* (1991) also found changes in self-concept and environmental knowledge of teenagers who participated in a hiking program. Alvarez *et al.* (2002) state that students who were taught using an "experimental approach" which allowed them to investigate and research an issue, showed significantly higher environmental knowledge and attitudes compared to students exposed to traditional curriculum and teaching methods. The authors believe that this methodology should become a part of teacher training programs in EE.

At the same time, some researchers believe that there is a strong correlation between environmental knowledge and positive environmental attitudes. As reported by Bradley *et al.* (1999), Jordan *et al.* (1986), and other researchers, students who had attended environmental programs showed increased environmental behavior and awareness about environmental issues as well as their environmental knowledge.

According to Bradley *et al.* (1999), student knowledge and attitudes increased by 22% and 2% respectively after participation in an environmental science course. Also the authors found a statistically significant correlation between these two components. According to the article, students with higher scores on the knowledge test had higher environmental attitudes. As concluded by the authors, "increased knowledge may help improve environmental attitudes", and this fact should be taken into account by educators. Similar results are reported by Mangas and Martinez (1997) who found significant changes in students' attitudes and their knowledge and understanding of environmental concepts after participating in a year-long environmental education course. Hsu and Roth (1996) who studied the development of environmental knowledge and attitudes of community leaders, believe that because there was a correlation between environmental knowledge and attitudes, "the development of the cognitive domain of environmental education might be an effective means of promoting positive environmental attitudes" (p. 30).

Unlike the authors presented above, Border and Schettino (1979) state that an increase of positive attitudes toward the environment does not cause an increase of knowledge, and conversely, an increase of environmental knowledge does not always lead to greater environmental concern. According to the authors, it is the combination of these two factors that produces an environmentally responsible action of an individual.

Zimmermann (1996a) also studied the relationships between environmental knowledge and attitudes. According to this researcher, most previous studies in this area investigated how EE changes knowledge or attitudes toward the environment, analyzing these two components as separate factors. However, Zimmermann argues, "given that

both knowledge and affect are necessary for active participation in environmental concerns, more research is needed to determine how existing attitudes influence knowledge acquisition and now knowledge influences attitudes" and to investigate the relationships between these two components (p. 42).

Ballantyne and Packer (1996) state that recently EE teaching and research have been focused on the attitude/value component, whereas knowledge and behavior areas seemed less important. A similar idea was expressed by Iozzi (1984) who mentions that environmental education emphasizes the affective rather that the cognitive domain. Ballantyne and Packer (1996) believe that "an approach that addresses attitude/values in isolation is no more effective..." and does not correct misconceptions in environmental knowledge. The authors propose a constructivist approach to improve EE as more successful for "achieving the goal of developing environmentally literate citizens as it supports the teaching of environmental knowledge, attitudes/values, and behavior in an integrated manner" (p. 33). Similarly, Corcoran and Sievers (1994) believe that "to realize its potential, environmental education needs to be reconceived – expanded by deep ecology, informed by the perspectives of conservation biology, put in context through bioregionalism, enriched through ecofeminism, and critiqued through socially critical analysis" (p. 9).

2.3.2. Studies to measure behavior

Most environmental psychologists and educators believe that environmental education is linked to environmental behavior (Palmer 1996, 1997, 1998, 1999; Tilbury 1994; Wilson

1996, etc.). A major assumption here is that education leads to greater awareness and attitude change that ultimately improves environmental behavior. Thus, these researchers believe that the primary goal of EE should be to encourage people to engage in more pro-environmental behaviors.

The process of the development of a positive attitude towards the environment and environmental behavior is a major focus of both American and European researchers (e.g. Disinger 1982; Eagles and Demare 1999; Kamaneva *et al.* 1991; Lysenko 1993; Marcinkowski 1987; Nikolaeva 1992, 1993; Sia 1984; Tilbury1994; Uzzel 1999; Wilson 1996; Zelezny 1999, etc.). These authors emphasize that the development of EE is a continuing process that takes place during the whole life of an individual. But the starting point for it is the earliest stage of the formation of personality when environmental values and a positive attitude towards environment are built. Wilson (1996) identifies two main reasons for beginning EE during the early years of a child's life. Her premises focus on the conservation of nature and the healthy development of a child. The first reason is that if a child does not develop a sense of responsibility, respect and positive attitude towards nature during his/her childhood, he is liable not to form such attitudes later in life. The idea of existence of critical periods for the development of environmental attitudes and values is supported by Stapp (1978), and Tilbury (1994). They emphasized that if a child develops a negative attitude towards the environment, it is hard to change such an attitude later. A second reason for beginning environmental education in the early years is that a child needs healthy positive interactions with the natural environment (Carson 1956; Wilson 1996). A child uses the environment as a source of wonder, joy, and knowledge (Nikolaeva 1992, 1993; Sobel 1993, 1998). Sobel (1993, p. 52) believes

that childhood is a "critical period in the development of the self and in the individual's relationship to the natural world." Small children tend to construct "special places" and investigate their world starting from their neighborhoods and expanding the area of their interest later. By doing this they explore the world around them and their place in it. Thus, environmental education in the early years should focus primarily on young children exploring and enjoying the world of nature under the guidance of adults (Lysenko 1993; Sobel 1991, 1998; Vygotskiy 1991).

As stated above, many researchers believe that environmental education leads not only to increased awareness but also to improved environmental behavior (Disinger 1982; Marcinkowski 1987; Sia 1984; Zelezny 1999). According to Disinger (1982), environmental education in non-traditional non-formal settings is expected to be more effective than traditional classroom programs in changing environmental behavior. Zelezny (1999), who presents the analysis of 22 studies on educational interventions, also agrees that EE could improve environmental behavior. However, unlike Disinger (1982), the author states that interventions in non-traditional settings (such as outdoor camps, etc.) are less effective because of the short-term nature of most visits, and the fact that many visitors are adults, whose behavior is less easy to influence or change. According to the researcher, programs that target young learners and are longer in duration tend to be more effective in changing environmental behavior of the participants.

Many researchers believe that responsible behavior is connected to personal experiences in the environment and participation in environmental activities outside the classroom (Dresner and Gill, 1994; Jordan *et al.*, 1986). Howe and Disinger (1988) state that in order to develop responsible behavior of students, the EE programs should provide

investigation and analysis experiences as well as an opportunity to work on real environmental issues. Also, as mentioned by the authors, programs and projects that include long-term activities usually are more successful in developing positive environmental behavior than short-term activities. Culen and Volk (2000) come to a similar conclusion and suggest using investigation-evaluation and an "action training" model. Ballantyne *et al.* (2001) who studied two EE programs and their impact on students, teachers and parents, concludes that the programs that provided an enjoyable experience for students affected student learning and changed their behavior.

2.3.3. Research to measure attitudes

As stated by many researchers, environmental education programs help to develop positive attitudes toward the environment (Dettman-Easler and Pease 1999; Knapp and Poff 2001, Zimmermann 1996b). Dettman-Easler and Pease (1999) evaluated six residential programs and came to the conclusion that students' positive attitudes toward wildlife increased after their participation in the programs. The authors assume that there are other important factors besides program content that affect students' attitudes. In addition, the article recommends that classroom work be more closely integrated with residential programs and that the number of pre-, during-, and post-visit activities be increased.

On the other hand, Gillett *et al.* (1991) reported that although there were changes in self-concept and environmental knowledge of teenagers who participated in a hiking program, no changes in environmental attitudes of the students took place. Similarly,

Eagles and Demare (1999), who observed students who participated in a week-long program in a residential camp, did not find any significant changes in environmental attitudes of the participants. As authors conclude, environmental attitudes are created over a long period of time, so the week–long period is not enough to increase existing environmental attitudes significantly.

Musser and Diamond (1999) developed and described an "age-appropriate scale" for measuring environmental attitudes of pre-school children. According to the authors, although many kindergartens and pre-school programs provide different types of environmental activities, no instrument for measuring young children's environmental attitudes had been developed. So theirs was the first. They found a correlation between children's attitudes and their participation in different environmental activities. Also children's attitudes seemed to be influenced when children observe their parents' participation in such activities. The authors believe that the family and school are very important environments in which young children learn about behavior patterns and develop attitudes appropriate for the culture and environment they live in.

2.3.4. Research instruments: surveys and questionnaires

Many researchers have used tests and questionnaires in their work in order to measure different components of environmental education (Alekseev 1998; Bunting and Cousins 1983; Eagles and Demare 1999; McKechnie 1971, 1977; Musser and Diamond (1999); Palmer 1 996, 1 999; P almer *e t a l.* 1 999; P ustovit a nd P lechova 1 995; S ubbotina 2 000; Zimmermann 1996). Most of the tests (Bunting and Cousins 1983; McKechnie 1971,

1977; Zimmermann 1996b, etc) have been used for measuring people's attitudes towards the environment and environmental values. For example, McKechnie (1971, 1977) has developed a test named the Environmental Response Inventory (ERI) to study people's interaction with their environment. Bunting and Cousins (1983), using the ERI as a basis, have developed the Children's Environmental Response Inventory to study children's attitudes toward the environment. Both tests were multiple-choice test with the 5-point answer scale ("Likert scale"), ranging from "agree very strongly" to "disagree very strongly". The neutral answer is "don't know, can't say". Later Zimmermann (1996b) developed a short form of the CERI to assess environmental values and attitudes in adults and children. The test measures values related to conservation, pollution, and urban/natural environments. It consists of 31 questions and has the same answer scale (five options). Schindler (1999) created the Survey of Environmental Issue Attitudes to measure environmental attitudes among college students. In addition, the survey measures ecological knowledge, behavior changes, and demographics.

Besides tests for measuring environmental attitudes and skills, many tests have been developed for assessing knowledge (e.g. Alekseev 1998; Palmer 1996, 1999; Pustovit and Plechova 1995, etc.). The number of questions and the levels of difficulty are highly variable. At the same time, most of them are multiple-choice tests (MCT), i.e. they ask the respondent to choose one answer out of several given. However, such types of tests are unable to capture the complexity and richness of students' thinking, the depth of his/or her knowledge. So it is very unlikely that they present *real,* complex assessment of student understanding and performance. On the other hand, these tests are easier to administer and score and require less time and financial resources.

Overall, it can be stated that although there are many research efforts in which tests or questionnaires have been introduced, environmental researchers and educators traditionally focus on measuring such components as attitudes towards the environment, level of environmental knowledge and environmental behavior that results from environmental programs. Fewer instruments have been developed to measure environmental skills. The reason for this is, probably, the difficulty of measuring practical or physical skills through a survey or a paper test.

In general, most of the research presents statistical analysis of the findings. However, many authors agree that all components of environmental education are very complex in nature and involve the "human" dimension. The development of knowledge, skills, values, responsible behavior and other EE components are affected by many external factors, such social status of the families, parents attitudes, education and knowledge, living environment, reinforcement from friends, family and community, culture and traditions, etc. Thus, there are many interactions and correlations between these various components and not all of them have been studied. In many cases, it is difficult to capture the whole range of complex interactions through statistical functions. I believe that qualitative studies would be more appropriate and effective in EE because they would provide more in-depth descriptive analysis of the living and learning environments in which EE components are developed. These qualitative descriptions could be combined with statistical results for a more complex and nuanced interpretation of the research findings. Overall, like Firestone (1987), Sogunro (2001) and others, I believe that EE researchers should use a combination of both research methods in order

to obtain more diverse information and to allow more in-depth interpretation of the results.

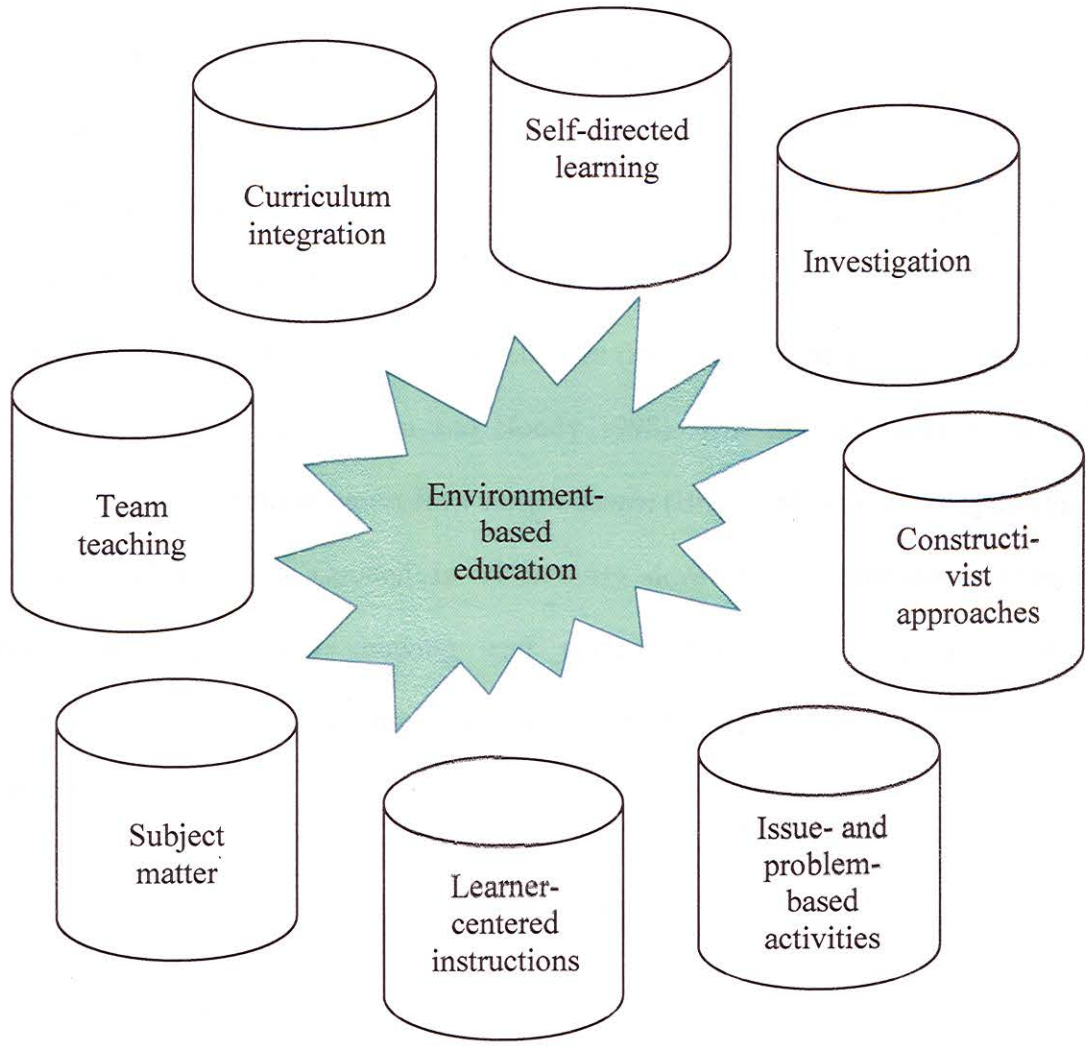
2.4. Rational for environment-based education

In recent decades more and more educators and researchers have started to speak about integrating environmental education into all subjects and grades rather than teaching it as a separate discipline. Moreover, many of them see EE as a *curriculum integrator*, an environment in which deeper learning could take place. Several terms such as "integrated environmental education", "environment-based education", "environment as the integrating context for learning" are widely used in the literature (Angell *et al.* 2001; Lieberman *et al.* 2000; Lieberman and Hoody 1998, NAAEE & NEETF 2001, etc.)

NAAEE & NEETF (2001) explicitly state that there is a difference between *environmental education* and *environment-based education*. While *EE* aims to develop environmental knowledge and skills that an individual could use for solving environmental issues, *environment-based education* "uses a popular subject matter [the environment] to improve students' learning skills and create a wider learning context for students, teachers, and the community." This idea can be found in the philosophy of outdoor education which suggested to "teach in the outdoors what can best be taught in the outdoors" (MacGregor 2003). As seen from Figure 10, environment-based education integrates subject matter, issue-, and problem-based projects and activities, self-directed learning, learner-centered instruction, constructivist approaches and team-teaching, and problem investigation. Similarly, according to Liberman and Hoody (1998), *environment*

as the integrating context for learning is an approach that combines natural, social and cultural environments and aims to develop critical thinking, investigation, analytical and decision-making skills in students and to help them to construct a coherent system of knowledge rather than to develop environmental knowledge and attitudes alone. Its aim is to create a framework within which students can construct their knowledge and integrate and apply information received in the classroom.

Figure 10 Components of environment-based education



Federal legislation to strengthen K-12 public education, entitled *The Goals 2000*, set goals to create a student population that is ready to learn, to develop measurable benchmarks for student achievement and active citizenship, to educate literate adults and lifelong learners, to increase parents' participation in the school activities, and to create a safe and disciplined school environment (NEETF 2000). As argued by NEETF (2000), Monroe *et al.* (2002), WDFW (1999), environment-based education can provide opportunities to fulfill these goals.

Educators today generally agree that an increase in student achievement and cognitive development takes place when students are motivated and interested in what they are doing, see the connections between subjects, and issues and have an opportunity to work collaboratively on solving real-life problems (NEETF 2000). The proponents of environment-based education believe that it does exactly this. It gives opportunities for integrated learning. It develops decision-making, critical-thinking and problem-solving skills. It uses issue-based projects and activities (Howe and Warren 1989; NEETF 2000, Monroe *et al.* 2002, Lieberman and Hoody 1998). This line of reasoning is largely corroborated by the major report *How People Learn* (Bransford *et al.* 1999), published by the National Research Council in 1999. By developing investigation, teamwork, problem-solving, critical thinking and communication skills, environment-based education also helps to prepare students for professional work (NAAEE & NEETF, 2001).

2.5. Efficacy of environmental education

While analyzing recent articles from the *Journal of Environmental Education* and several online databases, I have found only a few articles and reports that discuss the impact of environmental education on student achievement in traditional school subjects and on standardized school tests. Hoody (1995) reached a similar conclusion, stating, that she could not locate any "compelling research ...that measured the effectiveness of interdisciplinary EE methods" (p. 14). According to the literature, there are several explanations for the lack of research on EE efficacy, such as lack of funding for EE programs and research and planning time for evaluation; lack of examples because of a poor research base; the difficulty of assessing and evaluating students' problem-solving, decision-making, critical thinking and analytical abilities through traditional assessment methods (such as multiple-choice tests) (Hoody 1995). Hoody believes that "until the educational systems are restructured to incorporate learning modeled by EE methods (e.g., critical thinking, problem-solving, hands-on activities and use of relevant subject matter), evaluation of its effectiveness can't take place" (p. 18-19).

One study that has attempted to investigate the efficacy of environmental education in increasing school learning was conducted by the State Education and Environmental Roundtable (Lieberman and Hoody 1998). The report *Closing the achievement gap: using the environment as an integrating context for learning* presents the analysis of student achievement at 40 schools across the United States that adopted environment-based programs, also called EIC ("Environment as Integrating Context") schools. The research conducted by the SEER group claims that the students learn more

effectively within an environment-based context than within a traditional educational framework. These students demonstrate better performance on the standardized tests in reading, math, writing, science, and social studies. For example, in Tahoma High School (Maple Valley, WA) 11th grade students who had been in the EIC program averaged 4.8 percent higher scores on Curriculum Frameworks Assessment System (CFAS) in language, 1.7 percent higher scores in writing, and 4.4 percent higher in social studies compared to the students who did not participate in the program. In Bagley Elementary (Seattle, WA) the average reading and language scores on Iowa Test of Basic Skills (ITBS) rose from 46 to 52 and from 43 to 53 respectively. According to 98 percent of teachers who use EIC methodology, the students showed increased engagement, enthusiasm, and interest in math, science and other subjects if they were a part of an integrated EE program (Lieberman and Hoody 1998). The authors argue that removing the boundaries between subjects enabled these students to tie together disciplinary knowledge they received in the classroom. Also students who participated in the EIC programs showed an increased ability to think critically, stronger communication and collaborative skills, and greater pride and ownership in accomplishments.

According to the report, SEER's researchers used 8 criteria for EIC schools selection. First, the whole school should have implemented the EIC concept or at least have one EIC program in its curriculum with at least 2 classes involved and lasting for a majority of the school year. The length of such a program was to be at least 2 years. Also, teachers should have worked in teams to integrate at least three subjects around the environmental topic or theme. And finally, students should have been involved in problem-solving activities and projects, constructing their own knowledge.

Overall, it should be stated that SEER's methodology used in both studies is superficial at best. Although the report provides comparisons of EIC schools (or classes in some cases) and schools with traditional curricula, there is no information about the comparison schools or groups of students. EIC schools are situated in different states with huge variations in curricula. Furthermore, there is no description of the initial learning and teaching environments of the schools (teachers' background, amount of funding and training the schools received from state organizations or districts *and* from SEER's staff, the overall level of the participating schools compared to other schools in the same location, etc.) In addition, although the SEER's team gathered data through teacher, administrator and student surveys, the report does not provide the items on the surveys. Also it is not clear what methods of analysis the group used to analyze the data.

In some cases the report presents the comparison of EIC and non-EIC schools' test scores. However, there is no information about the statistical analysis of this data or whether the difference between schools was statistically significant (probably, because no statistical analysis of this kind was done. Finally, for some schools/or subjects the report presents a kind of longitudinal analysis, showing that the test scores for EIC schools have improved over the years (usually 2-3 years). However, there is no information about other schools in the same location and changes in their test scores. In my opinion, the changes in the test scores could have been caused not only by EIC programs but by changes in the state or district policies and regulations or increased or decreased amount of teacher training. So such facts presented alone without supporting information cannot be considered strong evidence of EIC impact on student learning. Overall, I think that this

widely circulated report presents anecdotal "success stories" rather than research data based on sound theoretical and statistical foundations and/or qualitative analysis.

Another study conducted by SEER presents the analysis of student achievement in 11 "environmental schools" or "EIC schools" in California. The study compares student achievement between "EE schools" and "control schools" with a traditional curriculum. According to Lieberman *et al.* (2000), EIC students showed higher results in 101 (72%) out of 140 academic assessments in language arts, math, science and social science.

Like the first SEER's report, the methodology of this study has some deficiencies. As stated in the report, the pairs of schools were selected using demographic criteria such as attendance rates, ethnicity percentage, percentage of students who receive free or reduced lunch, etc.). On the other hand, it not clear how the EIC schools were selected in the first place. Also according to the report, students who participated in the EIC program were matched with students in non-EIC courses or program. However, there is no information about how this was done. Finally, although the study seems to compare test scores of EIC and non-EIC students, no information about any statistical analysis is presented. The report claims that the EIC schools scored a certain percentage higher than their comparison schools, however, there is no evidence that this difference is significant.

Another study conducted by Randall (cited in Monroe *et al.* 2002), shows that if environmental education lessons are designed to meet state curriculum goals, they can improve student achievement (test scores in particular). According to Randall (2001), students who participated in a biodiversity program that focused on development of l biology knowledge and writing skills, showed a significant increase in writing test scores. "When teachers perceive environmental education as an "extra", environmental activities

will be easily discarded in favor of increasing student knowledge and performance for state tests. When environmental education lessons are developed for state curriculum standards, they will be acknowledged as supporting student achievement in dimensions that educators recognize, such as performance tests, attendance, and interest", Monroe *et al.* (2002) conclude. However, it is not clear how comprehensive this study was.

The National Environmental Education and Training Foundation's report *Environment-based education: creating high performance schools and students*, supports the idea that environment-based education can improve student learning. According to the case studies presented in the report, student achievement in reading, math, science and social science tend to improve due to the environment-based programs (NEETF 2000). Students in the schools with environment-based curriculum appear to develop the ability to transfer knowledge they receive in class to unfamiliar contexts. And, finally, the teachers reported a decrease in behavioral problems in EE classes. The report recommends conducting further research on the efficacy of environmental education, and the development of environment-based programs that show how EE can become a tool for improving students' skills and achievement.

The Washington Environmental Education Model Schools Program, started in 1993 by OSPI is one of the most cited and studied EE programs in Washington State. Its aim was to create effective K-12 environmental education programs at 18 different schools using an interdisciplinary, community-based approach. Billings *et al.* (1996) report that environmental behaviors of students participated in EE programs increased by 38 percent. Also students became more environmentally interested and engaged. Teachers who participated in the study commented that environmental education

programs made learning more interesting and relevant for students. The program decreased behavioral and attendance problems and improved students' environmental knowledge and attitudes.

Another OSPI project, called Model Links, continued the Washington Environmental Education Model Schools Program. It was designed to improve their teaching and learning environment and to continue integration of school curriculum through environmental education. EE was seen as a tool for the implementation of state standards (such as Essential Academic Learning Requirements in math, writing, reading, communications, etc.) Yap (1998) conducted a summative study to investigate impact of the project on student achievement in reading, writing and communication. The study included an analysis of the test results on several state tests such as Comprehensive Test of Basic Skills and the analysis of the surveys given to teachers and administrators of the schools. According to the report, although the number of years schools participated in the Model Links project varied from one year to three years, all participating schools reported a high level of EE implementation through thematic activities correlated with state standards. However, the study did not find any significant differences in student achievement between EE and comparison schools. As stated by Yap (1998), students from both EE and comparison schools had scores near or above the national norms on CTBS. On the other hand, there was a correlation between student achievement and the level of EE implementation. Schools with higher levels of implementation of their environment-based programs had higher results on the standardized tests.

According to another report on Model Links Schools conducted by the Washington Department of Fish and Wildlife (1999), implementing EE improved staff

relations in schools; and increased teachers' and students' engagement. Also it increased teachers' professionalism and strengthened schools' relationships with parents and communities. Several schools reported improved test scores due to participation in the Model Links program. As mentioned in the report, students' thinking skills improved as well. Teachers cited attributed these improvements to providing students with "more meaningful and experiential learning opportunities" which helped them "to construct their own meaning in new curriculum frameworks" (WDFW 1999, p. 16-17).

2.6. Limitations of existing research

After analyzing articles and reports from the various sources, it is possible to state that there are several limitations in the existing EE research. The most common are weak methodology, small groups in the studies and lack of theoretical foundations and valid research instruments. For example, most of the research uses schools' test information as an indicator of student achievement. Usually the researchers compare the results on state standardized tests such as ITBS, CTBS, etc. However, I could not find any research that studied the applicability of these multiple choice test results to demonstration of student learning progress in the classrooms. Although, as mentioned by NEETF (2000, p. 47), "test scores are the most universal and quantifiable tool we have to measure learning", different states use different tests aligned with different state standards, so it is difficult to compare the results of the studies from different states. And, finally, many variables such as the amount of teacher professional development, the degree of engagement of teachers in EE work, the extent of reinforcement and support by EE consultants and school and

district administrations, etc. are difficult to control. In most cases these variables have complex dynamic nature. They interact with one another as well as with many other external components of the living, teaching and learning environments. Thus, in many cases researchers can only infer that correlations seem to exist between the components of the research and cannot claim the cause-effect relationships between them.

As stated in the NEETF report (2000), "to date, most of the research on the connections between environmental education and academic achievement has been qualitative and/or anecdotal" (p. 45). Many of the existing research cannot be called "scientific" because of the research methodologies, selection of control groups, etc. The authors of the report believe that it is necessary to conduct more "quantitative studies to prove the efficacy of environmental education" (p. 45).

As argued by Hoody (1995) and others, most EE research articles do not conduct follow-up studies to evaluate long-term effects of EE programs. In most cases the studies measure the state of variables immediately after the program (or "intervention"). Many research studies were conducted on very small sample sizes (a single class or even 5-10 students). Some of them present poorly designed studies and use invalid and/or unreliable instruments and provide inconclusive results. A similar conclusion was reached by Lewis (1981-83, cited in Hoody 1995), who agued that "a majority of the reports had instruments of questionable validity and lacked sufficient methodological detail" (p. 13). Like Lewis, Leeming *et al.* (1993) comment on weak research designs and invalid research instruments. The authors mention that very often it is the designers of the EE programs and materials who create instruments to assess the efficacy of the course/or material. This raises questions about the validity and credibility of these studies,

Leeming *et al.* (1993) argue. Also, many of the practitioners who designed instruments for program assessment did not have experience or training in the development of assessment instruments (Hoody 1995; Leeming *et al.* 1993, etc.). This leads us to the conclusion that EE research in general needs to develop a much more sound theoretical and methodological base.

Overall, although there are many research studies in the field of environmental education, most of them focus on the development of environmental knowledge, attitudes and behavior, and the relationships between them. A few studies investigate the impact of environmental education on student achievement in the traditional school subjects and most of them are anecdotal in nature. They do not have a sound theoretical base and, in most cases, present a set of "success" stories rather than a thorough quantitative or qualitative analysis of the findings. All this leads me to the conclusion that there is a need for more in-depth quantitative and qualitative studies to prove the efficacy of environmental education and its positive impact on student achievement.

3. Factors influencing student achievement

Improvement of student achievement has always been one of the main goals of education. In past decades researchers and educators have conducted many studies and experiments to determine the factors that affect (positively or negatively) student achievement. Many factors have been identified and the relationship between them is very complex and dynamic. Some researchers believe that student characteristics, their living and learning environments and instruction activities contribute to student achievement (House 2002, etc.). NEETF (2000) divides factors that influence learning outcomes into five categories:

1. external (such as gender, race, parents' educational background, etc.),
2. internal,
3. social,
4. curricular and
5. administrative.

Table 4 summarizes the findings of Brown (1999), Garton *et al.* (1999), Harris and Mercier (2000), Hitz and Scanlon (2001), House (2002), Howley (1989), Howley *et al.* (2000), Klavas (1994), Klein and Merritt (1994), Kozioff *et al.* (2000/2001), Lieberman and Hoody (1998), Lord (1999), NEETF (2000), NAAEE & NEETF (2001), Papanastasiou (2002), Patrick (1991), Peterson (1989), Rainer and Guyton (1999), Schacter (1999), Thomas *et al.* (2000) and others. The table presents factors listed in NEETF's report as a basis (NEETF 2000), with additional factors mentioned in other research.

Table 4. Summary of factors that influence achievement

	Positively	Negatively
External	• Male gender; • Member of Caucasian race; Asian immigrant; • Average or above-average income; • High expectations of teachers and parents • Parent education • Good, safe neighborhood • Reinforcement • Small school size • Less TV viewing • "maintstreaming" students, i.e. putting students with different abilities together	• Female gender; • Member of minority race; • Under- or uneducated parents; • Poverty; • Tracking/ability group (divide students by their abilities • Unsafe neighborhood • Large school size • More TV viewing
Internal	• Motivation • Self-reflection	• Motivation (lack)
Social	• Ability to connect with teacher and fellow students (smaller learning communities)	• Poor or remote relationship with teacher (larger or "anonymous" learning communities)
Curricular	• Matching teaching style to learning style; • Engaging material; engaged teachers and learners; • Student choice in curriculum; • Collaborative/cooperative learning; • Participation in group discussions at school and home; • Peer interaction; • Demanding subject matter; • Problem-based learning; • Issue-based and/or project based real-world instructional activities; • Teaching for connections • Using environment as an integrated	• Using same teaching style for all students; • Unengaged teachers • Teacher-centered curriculum; • Irrelevant curriculum • Traditional teaching methods such as lectures • Subject matter that is too easy • Lack of resources • Less time spent on homework

	context • Parents and community involvement in educational process • Use of technology and other multiple resources, computer-based instructions • Active learning • Authentic assessment • Student-centered curriculum • Constructivist teaching approach • Integrated curriculum • Much time spent on homework assignment	
Administrative	• Common vision • Implementation of comprehensive reform programs • Teacher empowerment • Access to assistance, in-service training, and resources • Continuous quality improvement of teaching and learning • Good supportive school climate	• Lack of focus; • Lack of administrative support or attention to enhancing teacher quality/competence

Patrick (1991) found that "achievement has been associated with the following factors: high educational attainment of parents, a home environment where reading and discussions of ideas are valued, limited television, significant amounts of time spent on homework assignments, and stable family structure" (p.2). The author believes that student achievement is positively influenced by

- challenging subject matter;
- in-depth investigations of topics;

- discovery of alternative solutions to the problems;
- active learning and thinking;
- multiple resources and media for teaching and learning;
- use of technology;
- high expectation of student performance;
- a safe school climate; and
- authentic on-going assessment.

Many other researchers also believe that students learn best when they have an opportunity to discover and investigate (House 2002; NAAEE & NEETF 2001; WDFD 1999, etc.) as well as to make connections between their studies and real life (Krynock and Robb 1999).

Klavas (1994), Thomas *et al.* (2000) and others found that students show better achievement when teachers take into account students' varied learning styles. When teachers offer varied learning environments, students are more motivated, interested and engaged. Rainer and Guyton (1999) found that students have better attitudes towards learning when they have an opportunity to make their own choices. The opposite results are reported by Garton *et al.* (1999) who analyzed the learning style of 187 science students and 4 instructors and came to conclusion that there was no significant correlation between student achievement and learning style.

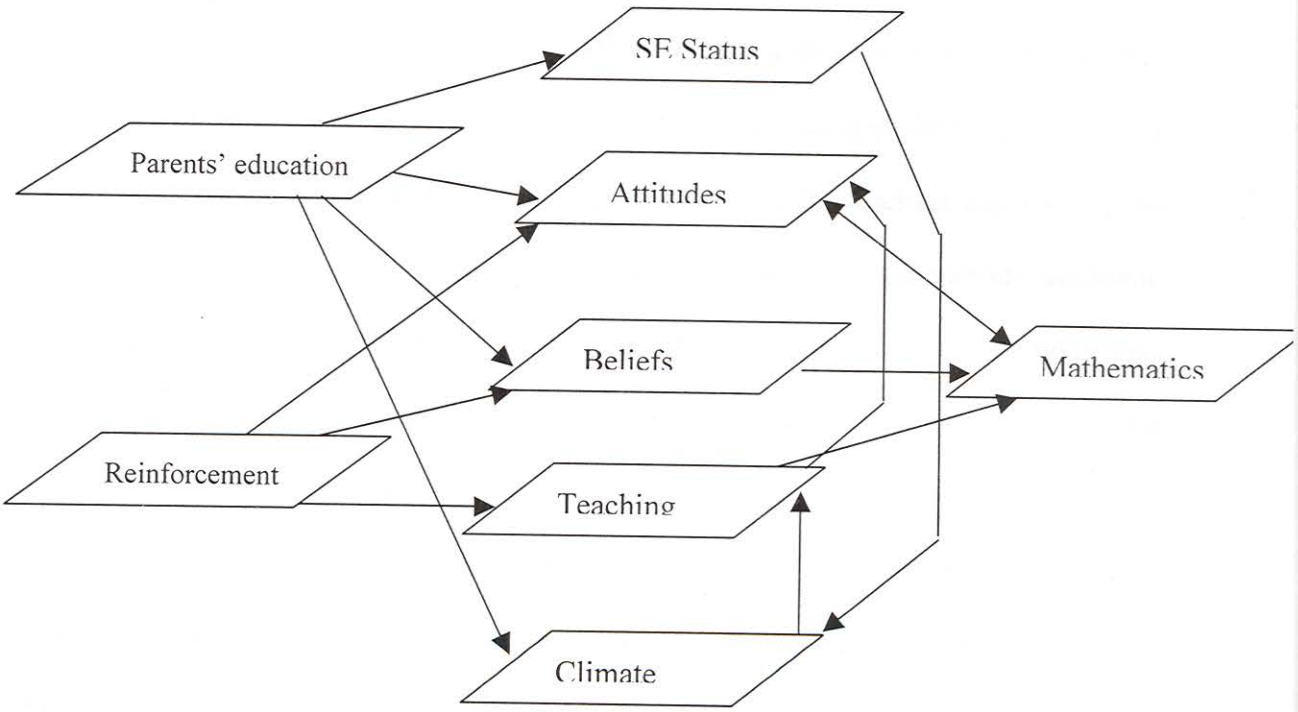
Many authors name technology and media as a promising tool for improving student learning. Schacter (1999) conducted a meta-analysis of the existing literature focused on the relationship between student achievement and technology use in the

classroom. According to his findings, students in technology-rich environments have shown increased achievement in all subject areas.

Almost all research names socio-economic status as one of the factors that affects student learning (Howley 1989; Howley *et al.*2000; House 2002). Students learn better if they are from above-average or average income family, with well-educated parents who participate in the schools' education process and encourage children to learn. When parents are involved in their children's education, children have better grades and test scores, better attitudes and behavior (Brown 1999; Peterson 1989, etc.). In addition, as argued by Harris and Mercier (2000), student achievement in school is affected not only by the family environment but also by the neighborhood where the student lives. Safe neighborhoods that value education and participate in school events and projects can provide additional reinforcement for students.

According to the literature, the method of instruction also affects student learning. Hitz and Scanlon (2001) state that students who attended traditional teacher-centered classes show better results immediately after the program. However, students who were taught using project-based methods had a greater level of retention and an ability to use received knowledge and skills over time. Similar opinions were expressed by Lord (1999) and Klein and Merritt (1994), who believe that constructivist teaching approach leads to improved student achievement because it develops critical thinking, interpretation and analytical skills.

Figure 11. Model of mathematics achievement process (adapted from Papanastasiou 2002).



An interesting model has been developed by Papanastasiou (2002) who has studied achievement in mathematics and factors that affect it. Figure 11 presents the factors influencing learning outcomes in math and the relationships between them. The author found that although attitudes toward the subject, students' beliefs and teaching methods can affect achievement, their impact is not statistically significant. On the other hand, family educational background is a very important factor. It affects school climate, socio-economic status, attitudes toward the subject and learning in general, and students' beliefs. Teachers', friends' and parents' reinforcement has a direct impact on students' beliefs, teaching environment and attitudes towards the subject. As we can see from the

model, the relationships between the components are numerous and diverse. It only supports our assumption that there are many factors that can contribute to an increase in student achievement. Although the model initially was developed to study achievement in mathematics, I believe that the same factors affect student achievement in other subjects.

According to many studies, one of the factors influencing student achievement is curriculum integration, which is seen as a promising way for teachers and students to make the "connections between and among the key ideas of the various academic disciplines" (Ellis and Stuen 1998, p. 3). According to the authors, an integrated curriculum creates the "opportunity to explore the relationships necessary to the development of deeper, fuller understanding of content" whereas the traditional curriculum "keeps academic subjects apart from one another" (p. 3). On the other hand, Lake (1994) analyzed the available research and concluded that there were "no detrimental effects on learning when students are involved in an integrated curriculum" (p. 7). However, because of the limited number of research on the topic, the authors did not make a conclusion about regarding the benefits of curriculum integration. As stated by Wineburg and Grossman (2000), there is no evidence that students in interdisciplinary programs achieve higher results compared to students in traditional programs. According to the authors, it is not because of lack of data on student achievement but because "the existing literature on this topic is almost entirely comprised of idealized descriptions of programs and how to put them in place, and almost entirely devoid of descriptions of what actually happens when theory meets school practice" (Wineburg and Grossman 2000, p. 9). Thus, although it is possible that integrated learning and teaching can

positively affect student achievement, it is necessary to take into account that there is not enough supporting evidence in research literature at this point.

Overall, it can be stated that an environment-based approach to teaching and learning described in the previous chapter can provide opportunities for simultaneous development of many factors described above and shown in Table 2 (above). It provides engaging material, problem-, project- and issue-based activities and opportunities for investigation, collaboration and participation. It develops connections between facts, knowledge and subjects and allows taking into account diverse student learning styles, abilities and interests. However, although there are several studies and reports that state that environment-based education improves academic achievement, more comprehensive quantitative and qualitative studies are needed.

4. Research: EE programs and their effect on student achievement on state standardized tests

4.1. Research needs, goals and research questions

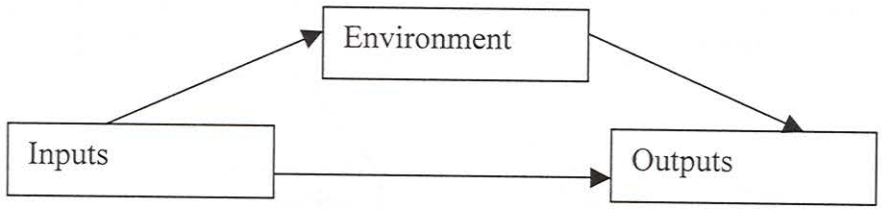
Analysis of the EE literature shows that the methodologies and approaches to environmental education vary greatly from isolated courses taught by a single teacher to interdisciplinary projects developed by a team of educators. Recently more and more educators have started to speak about environmental education not as a separate subject but as an integrator that will unite different isolated projects into one coherent system. EE practitioners emphasize the benefits and opportunities of thematic approaches that allow developing interdisciplinary programs and curriculum materials. However, educators still do not have sound statistical evidence that environmental education can be educationally beneficial for the schools and students, evidence that will prove the necessity to introduce integrated environmental programs in the school and university curriculum. Various state and national reports emphasize the lack of such quantitative and qualitative research on this topic. After a thorough analysis, I decided to investigate the relationship between the existence of environmental programs in schools and student academic achievement in traditional subjects in Washington schools.

The goal of the present research was to study the possible impact of environmental education programs on student achievement in such areas as math, writing, reading and listening. My question was whether the fully integrated environmental educational programs could improve student knowledge and skills in other

"non-EE" subjects. As a measure of student achievement I used the results on WASL and ITBS tests (which are standardized tests in Washington State)

As mentioned by Austin (1991), one of the most prolific and widely recognized researcher in higher education, thorough research on educational programs should include and analyze three variables: inputs (characteristics which subjects of the study bring to the program), environment (in which the program or objects of the study operate) and outputs (the results of the program). The author called this model "the I-E-O model". Figure 12 adapted from Austin (1991) presents its elements and relationships between them. As seen from the figure, the outputs of the program are affected not only by the qualities and characteristics that objects of the study possess and bring with them into the research but also by the environments in which they live and operate. However, as mentioned by the author, educational research and assessment studies often do not include all three variables, which make the results of such studies less reliable.

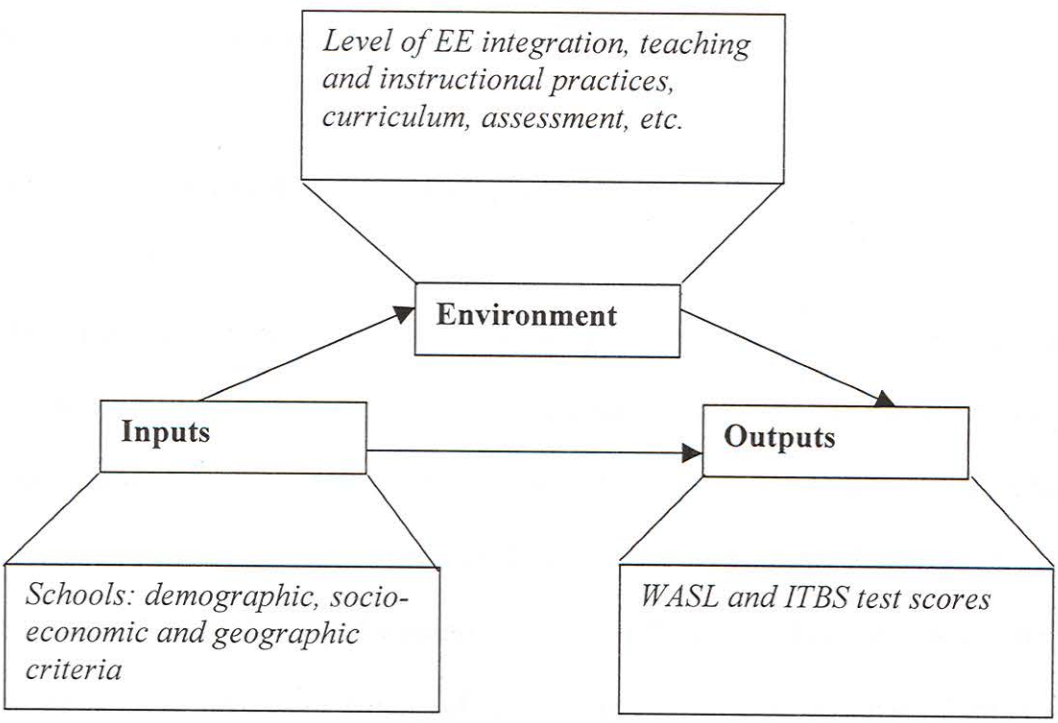
Figure 12. The I-E-O Model adapted from Austin (1991)



Because, like Austin, I strongly believe that the field of education with all its complexity cannot be described by a single linear relation, I made an attempt to include

all three variables in my research. I think that in order to explain the difference in outputs of several educational programs (which in my case is measured as the difference in WASL and ITBS test scores), it is necessary to take into account the teaching and learning environment in the schools. In those cases where it is impossible to put the object of the research in similar environments, it is important to understand the differences between them and take them into account when explaining the results. Also it is necessary to understand the differences in initial student knowledge or (because I studied schools in general) the differences between schools.

Figure 13. Usage of Austin's I-E-O model in the present research



Thus, I used Austin's model as a basis to design my research (Figure 13). In order to find out whether EE integrated programs improve student achievement in traditional subjects, I compared the test scores on two standardized state tests of two groups of schools: schools that have EE programs in their curriculum ("EE schools") and schools with "traditional" curriculum ("non-EE" or comparison schools). The outcome variable in my research is the WASL and ITBS test scores of the schools. For my research I selected pairs of schools (EE and non-EE) which are similar in their demographic, socio-economic and other criteria (input variable). However, there are many other factors which can affect test scores. Thus, I made an attempt to analyze the school teaching and learning environment, instructional and assessment practices, etc (this is environment variable of the model). I believe that such an approach allowed me to acquire more reliable and complete results.

4.2. Environmental Education Rubrics

As a part of the Environmental Assessment Project of the Environmental Education Consortium a set of environmental education rubrics has been developed by representatives of several environmental state agencies, business and educational organizations such as Dr. Margaret Tudor (WDFW), Lynne Ferguson (WFPA), Dr. Catherine Taylor (UW) and Kathryn Smith (WFPA), etc. These rubrics can be used to determine the level and extent of implementation and integration of environmental education in Washington schools (Tudor 2003). Using these EE Rubrics it was possible to evaluate each school building's activities in six areas:

- School commitment to integrate environmental education into their curriculum (measures number of years in EE, number of students and teachers participating in EE programs; frequency of EE programs or units, etc.);
- Curriculum development (evaluates how teachers design their curricula, whether they work alone or in a team, the type of curriculum and the links to natural environment);
- Instruction used in the classrooms (determines whether teachers work in teams integrating different subjects together, etc);
- Student learning (evaluates the way students learn and whether they are encouraged to construct their own knowledge);
- Assessment (determines whether students have an opportunity to make presentations and assess their own learning or if they are assessed through more traditional assessments); and
- Community commitment (studies the ties between school curriculum and community);

At this point of the project the most attention was given to the School Building Rubric (#1) (Table 5). According to this EE Rubric, the school fully integrating environmental education should have been implementing environmental education in its curriculum for at least three years. Overall, 33% of the school year should be spent on EE activities. Also 20% (or more) of school teachers and students should participate in EE units. In addition, the EE school should use natural areas such as environmental learning centers, national parks, zoos, etc on a regular basis throughout the year and implement best practices in curriculum development, instruction and assessment.

Table 5. EE Rubrics: characteristics of a school fully integrating environmental education developed by EE Consortium

School Building • # of years in EE: at least 3 years • % of teachers /classrooms involved: 20% or more • % of students involved: 33% or more
Curriculum • Integrated curriculum (around EE) • Linked to natural areas • Project-based contributing to the community and environment
Instruction • Teams of teachers work together • Teachers are coaches, helping students to develop their own knowledge • Support from parents, administration and community
Student learning • Is supported by state, district and school policies • Students know and understand standards and construct their own knowledge
Assessment • Best practices in assessment are used
Community • Participates in learning process and provides learning opportunities

The Environmental Education Rubrics described above were used to select those buildings that have well-developed environmental education programs for the study. Schools involved in the programs with environmental education were targeted initially and ranked on EE Rubrics in term of level of involvement. The rankings were conducted by several external EE providers and other EE and educational experts who work with the schools in Washington State and know how programs are implemented by the schools. For my study only the schools that have at least 3 years practicing EE strategies; have 20% of teachers/classrooms and at least 20% of students involved have been selected as "environmental" (or "EE") schools. A full description of the Environmental Education Rubrics can be found in Appendix A.

4.3. Groups of study and criteria for selection

Overall, for the research, two groups of schools were selected: a group of EE schools that had integrated environmental education programs in their curriculum and a group of comparison schools (or non-EE schools) that did not have a recognizable well-developed EE program. The EE schools were chosen by the Environmental Education Consortium on the basis of their knowledge of these schools programs and their level of EE school building implementation. All EE schools have been implementing environmental education for at least 3 years. Most of them participated in several state programs such as Model Schools and Model Links Schools programs. For each EE school, several comparison schools were identified using US census and OSPI information. All comparison schools were schools that were not involved in environmental education or are only beginning to develop EE programs. The criteria for choosing comparison schools were the following:

- School size;
- Economical status of students (the percentage of students receiving free or reduced lunch);
- Ethnic composition (the percentage of white, black, hispanic and minority students in the school building)
- Geographical location (Western, Central or Eastern Washington).

Several external experts (representatives of state organizations involved in environmental education in the state, members of non-profit educational and business organizations who work closely with WA schools) were asked to rate the schools

according to EE Rubrics. The complete list of experts and organizations who participated in rating schools can be found in Appendix B. After analyzing the external school ratings and demographic and socio-economic criteria, 77 final pairs of schools were identified. Appendix C presents the complete list of EE schools selected for the study, their comparison schools and schools' locations. Also I conducted the comparison of means of demographic, size and socio-economic variables for the groups of EE and comparison schools and compared them to the state data.

Table 6. Demographic comparison (means) of EE and comparison schools and state demographic data

	EE Schools (Means)	Comparison Schools (Means)	State (Means)
School Size	550	547	470 (2002)
Free /Reduced Lunch %	26.6	26.8	32.4
Ethnicity			
White %	83.9	80	74.8
Black %	4.2	4.3	5.3
Native Americans %	2.9	3	3
Asian %	6.8	6.9	6.9
Hispanic %	6.1	6.5	10

As seen from Table 6, all three groups have similar parameters. Means were calculated using OSPI data for the 1997-2002 period. The only exception is school size for the state. For this parameter the only available data was data for 2002. The mean comparison of demographic, socio-economic and geographic data for selected *pairs* of schools can be found in Appendix D. It presents the average for 1999-2002 period for each variable and allows comparing schools in each pairs.

As mentioned above, comparison schools were selected in the same location and where possible in the same school district as EE schools. Overall, as presented in Figure 14 below, 66 pairs of schools selected for the study were located in the Western Washington, 6 in the Eastern Washington and 5 in the Central Washington.

For the study, schools of different grade levels were selected. Forty-seven pairs out of all 77 pairs of schools were elementary schools, 21 pairs and 9 pairs were middle and high schools respectively. Figure 15 below presents the distribution of pairs by school type.

Figure 14. Distribution of pairs of schools by region

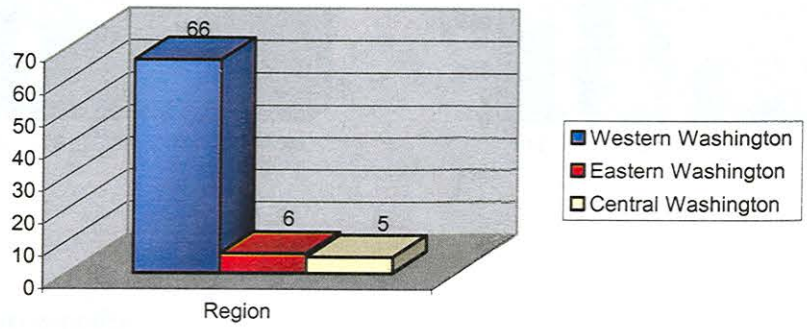


Figure 15. Distribution of pairs of schools by grade level

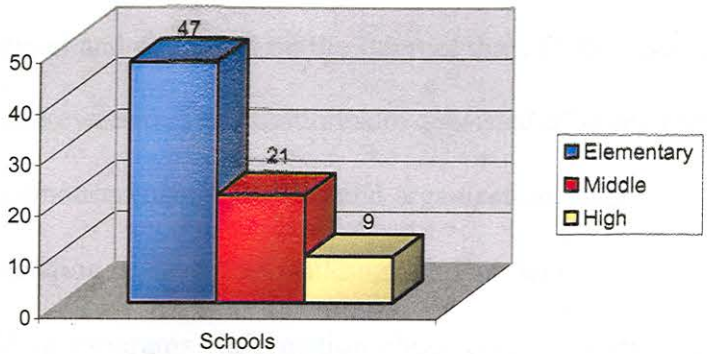
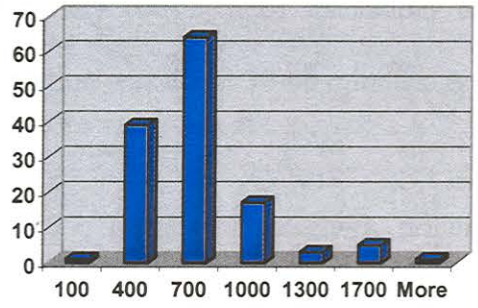


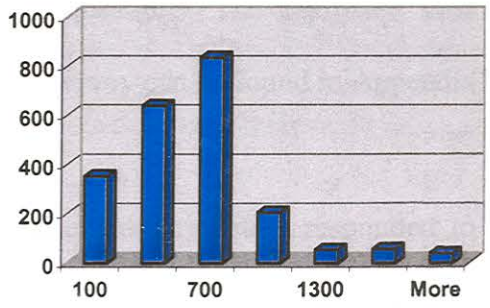
Figure 16 (a and b) presents the distribution of schools by size in the group of schools selected for the study (16a) and in the WA schools in general (16b). Because the distribution of both groups are similar, it can be stated that this group of selected schools are a representative sample of the WA schools regarding school size.

Figure 16. Distribution of selected schools by enrolments (or school size) compared to the distribution of all WA school sizes

16a. School size distribution for study schools



16b. School size distribution for all WA schools



4.4. Survey instruments

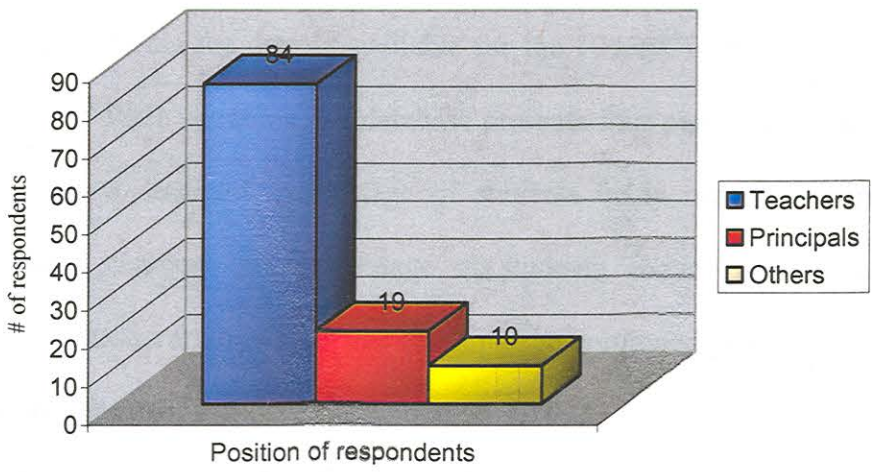
In order to assess the teaching and learning environments in these schools in more detail a survey was developed and published on the Internet through the "SurveyMonkey" web site (http://surveymonkey.com). The questionnaire consisted of seven sections:

- personal information (name, position and organization, etc.);
- EE implementation in the school building (EE Rubrics);
- school building programs (information about types of curriculum, existence of integrated programs, etc.);

- school staff background (percentage of staff with Master's and PhD diplomas, percentage of teachers attended professional development and environmental educational workshops and trainings, etc);
- attitudes towards EE (as well as questions about barriers and needs for EE implementation, etc),
- questions about WASL test (changes in the WASL policies, attitudes and instruction); and
- funding and costs questions.

The survey consisted of mandatory and optional questions. The estimated time for completion was about 30-40 minutes. A copy of the survey can be found in Appendix E.

Figure 17. Number of teachers, principals and other administrators responded to the survey



The invitation to complete the survey was sent to administrators and teachers of both EE and comparison schools. Overall, 113 responses were received, out of which 71

respondents were from 53 EE schools and 42 respondents from 31 comparison schools. Eighty-four respondents were teachers, 19 responses were received from school administrators and 10 – from other school staff such as educational assistants, etc. Figure 17 presents the number and distribution of respondents by position.

4.5. Data for analysis

To evaluate the impact of the EE programs on the student achievement in traditional subjects the data from the OSPI web site was used. I used WASL and ITBS test scores, assuming that they correctly represent level of student achievement. The OSPI database provides information about WASL and ITBS test scores for all schools in the state[1].

According to OSPI (2003), the WASL is a criterion-referenced test that is aligned to the Essential Academic Learning Requirements (state standards). It measures the basic skills in math, reading, writing and listening. Students are tested in the 4th, 7th and 10th grades. For most schools the data is available for the 1996(97)-2002 period. For each school, among the other variables, the database presents four percentages: percentage of students well below standard, percentage of students below standard, percentage of students meeting standard and percentage of students above standard, as well as combinations of these variables. For this research the combined percentage of students who meet or are above the standard was chosen.

In addition, students in the 3rd and the 6th grades are tested with the Iowa Tests of Basic Skills (ITBS) and in the 9th grade with the Iowa Tests of Education Development (ITED) (OSPI 2003). In the 3rd grade, students are tested in reading and mathematics. In

[1] OSPI's database can be found at http://www.k12.wa.us/edprofile/

the 6th and 9th grades, students were tested in reading, mathematics, and language arts. As stated by the OSPI (2003), "the tests require students to read critically and with understanding, to compute with accuracy, to solve mathematical problems, and to demonstrate their knowledge of important ideas, principles and procedures". For analysis the percentage of students who score in the two top quarters in reading and math were used (language arts scores were not included in the analysis because they were not available for all school grades). OSPI's database has information on ITBS tests for the 1999-2002 period. However, for some schools information is not available.

4.6. Statistical methods of data analysis used in the research

I used several statistical methods to analyze data received from the OSPI database and the electronic survey. First of all, I used the basic descriptive statistics to compare the two groups of schools. Means, 95% confidence intervals, variables and standard deviations were compared. Also, because I compared the pairs of schools, a Paired Samples T-Test was used to determine whether there was any significant difference between two groups studied.

In order to determine which variables discriminate between two groups of study I used discriminant analysis (Klecka 1980). Six variables were analyzed: the percentage of students meeting standards in math, reading, writing and listening on the WASL and the percentage of students who score in the two top quarters in reading and math on ITBS.

Also I conducted a longitudinal analysis to identify trends in student achievement in math, reading, writing and listening. The analysis focused on the data available at the

OSPI for the 1996-2002 (for WASL) and the 1998-2002 (for ITBS) periods. The evaluation of the results of the tests for the last 4-6 years allowed identifying the patterns of changes in student scores on two tests. The comparison of the trends for EE and comparison schools allowed me to make an assumption about the possible role of environmental education in this process.

4.7. Limitations of the study

The present research investigated the difference in the student achievement in two groups of schools on the standardized tests. Although there are many factors that affect the student achievement and test results, only few of them were selected. The main criterion for selecting schools for the study was the number of years the school has been involved in environmental education. I did not have an opportunity to assess other factors that can affect student achievement, such as student background, parents' education, etc.

Another limitation of the research is the fact that not all EE and comparison schools completed the survey. Overall, more responses were received from EE school teachers and administrators. One possible explanation is that teachers in EE schools are more interested in EE research. This research would be stronger if responses were received from all EE and non-EE schools in the sample (and even stronger if each teacher in those schools was surveyed).

5. Results of the research

This chapter will present the results of several statistical tests which were used to analyze the research data. It gives the comparison of descriptive statistics for two groups of the study, the results of the paired sample t-tests, and the results of discriminant and longitudinal analyses. The second part of the chapter presents the analysis of the data received through the electronic survey.

5.1. Descriptive statistics: results

As mentioned above, in the research I compared two groups of schools: a group of EE schools and a group of comparison (non-EE) schools. For each EE school a comparison school with similar demographic and geographic parameters was identified. Six variables were used in the analysis:

- WASL_M – mean percentage of students who meet standards in math on the WASL;
- WALS_R - mean percentage of students who meet standards in reading on the WASL;
- WASL_W - mean percentage of students who meet standards in writing on the WASL;
- WASL_L - mean percentage of students who meet standards in listening on the WASL;
- IT_R - mean percentage of students who were above the 50^{th} percentile in reading on the ITBS; and

- IT_M - mean percentage of students who were above the 50th percentile in math on the ITBS.

According to the descriptive statistics presented in Table 7, EE schools had higher means for all six variables. The variances for EE schools were consistently larger than the variances for comparison schools. Using a 95% confidence interval around the proportions, the overlapping confidence bands ranged from 0.47 to 2.01 percent.

Table 7. Descriptive statistics for six variables (WASL_M, WASL_R, WASL_W, and WASL_L, IT_R and IT_M) for two populations (EE and comparison schools)

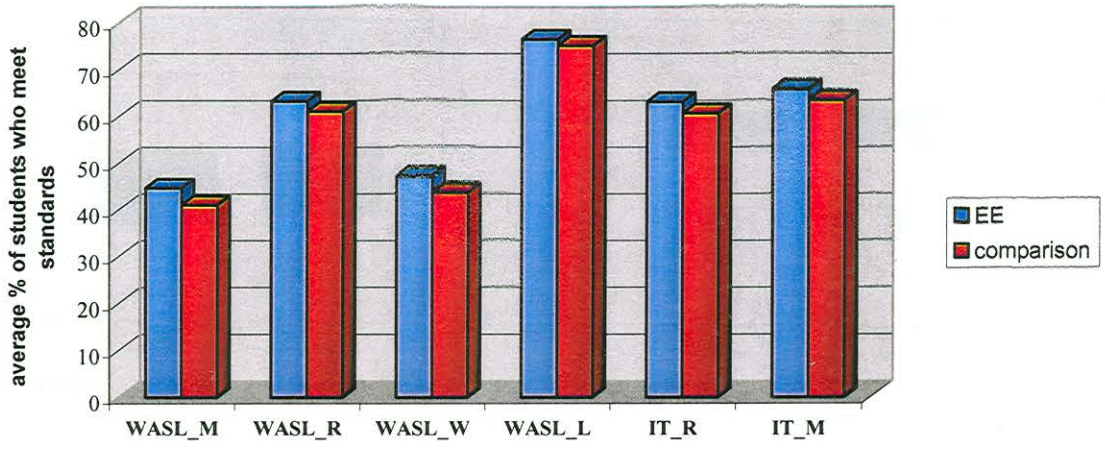
	STATUS			Statistic	Std. Error
WASL_M	comparison	Mean		41.070	1.0360
		95% Confidence Interval for Mean	Lower Bound	39.030	
			Upper Bound	43.110	
		Variance		288.705	
		Std. Deviation		16.9913	
		Minimum		5.9	
		Maximum		82.8	
		Interquartile Range		26.450	
		Skewness		-.045	.149
	EE	Mean		44.636	1.2237
		95% Confidence Interval for Mean	Lower Bound	42.227	
			Upper Bound	47.046	
		Variance		410.304	
		Std. Deviation		20.2560	
		Minimum		1.7	
		Maximum		92.8	
		Interquartile Range		27.950	
		Skewness		.099	.147
WASL_R	comparison	Mean		61.151	1.0139
		95% Confidence Interval for Mean	Lower Bound	59.155	
			Upper Bound	63.147	
		Variance		276.521	
		Std. Deviation		16.6289	
		Minimum		14.3	
		Maximum		90.9	
		Interquartile Range		24.300	
		Skewness		-.500	.149
	EE	Mean		63.301	1.0984
		95% Confidence Interval for Mean	Lower Bound	61.139	
			Upper Bound	65.464	
		Variance		330.577	
		Std. Deviation		18.1818	
		Minimum		10.3	

		Maximum		97.9	
		Interquartile Range		26.225	
		Skewness		-.477	.147
WASL_W	comparison	Mean		43.704	.9496
		95% Confidence Interval for Mean	Lower Bound	41.834	
			Upper Bound	45.574	
		Variance		242.590	
		Std. Deviation		15.5753	
		Minimum		8.8	
		Maximum		81.7	
		Interquartile Range		24.200	
		Skewness		.026	.149
	EE	Mean		47.133	1.0306
		95% Confidence Interval for Mean	Lower Bound	45.104	
			Upper Bound	49.162	
		Variance		291.023	
		Std. Deviation		17.0594	
		Minimum		6.2	
		Maximum		80.7	
		Interquartile Range		23.800	
		Skewness		-.287	.147
WASL_L	comparison	Mean		75.158	.7855
		95% Confidence Interval for Mean	Lower Bound	73.611	
			Upper Bound	76.705	
		Variance		165.985	
		Std. Deviation		12.8835	
		Minimum		25.0	
		Maximum		97.7	
		Interquartile Range		15.900	
		Skewness		-.904	.149
	EE	Mean		76.497	.8198
		95% Confidence Interval for Mean	Lower Bound	74.883	
			Upper Bound	78.111	
		Variance		184.141	
		Std. Deviation		13.5699	
		Minimum		20.7	
		Maximum		100.0	
		Interquartile Range		15.950	
		Skewness		-1.158	.147
IT_R	comparison	Mean		60.72	.941
		95% Confidence Interval for Mean	Lower Bound	58.87	
			Upper Bound	62.58	
		Variance		238.237	
		Std. Deviation		15.435	
		Minimum		14	
		Maximum		95	
		Interquartile Range		21.00	
		Skewness		-.633	.149
	EE	Mean		63.16	.894
		95% Confidence Interval for Mean	Lower Bound	61.40	
			Upper Bound	64.93	
		Variance		219.215	
		Std. Deviation		14.806	
		Minimum		18	
		Maximum		95	
		Interquartile Range		18.25	

		Skewness		-.557	.147
IT_M	comparison	Mean		63.49	.878
		95% Confidence Interval for Mean	Lower Bound	61.76	
			Upper Bound	65.22	
		Variance		207.415	
		Std. Deviation		14.402	
		Minimum		19	
		Maximum		94	
		Interquartile Range		21.00	
		Skewness		-.349	.149
	EE	Mean		65.75	.950
		95% Confidence Interval for Mean	Lower Bound	63.88	
			Upper Bound	67.62	
		Variance		247.090	
		Std. Deviation		15.719	
		Minimum		21	
		Maximum		97	
		Interquartile Range		23.00	
		Skewness		-.425	.147

Figure 18 below presents the comparison of average percentages of students who meet or exceed standards on WASL and ITBS tests for EE and comparison groups. As indicated on the chart, the average percentages of students who meet standards on the standardized test are higher for EE schools on all six variables.

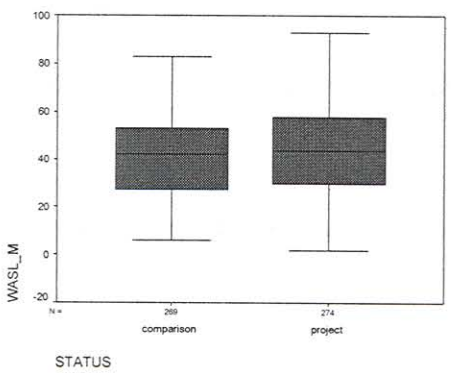
Figure 18. Comparison of average percentages of students who meet standards on WASL and ITBS for EE and comparison schools



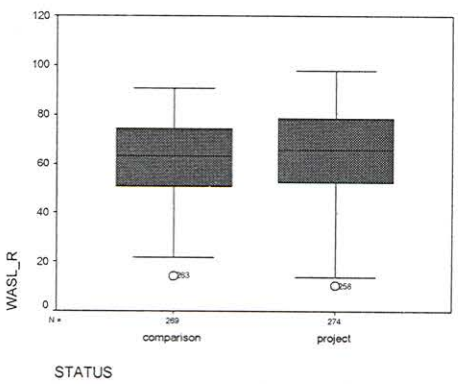
After analyzing boxplots for six variables (Fig. 19) we can state that the range, median, and quartiles are higher for the EE schools group for most pairs. However, the interquartile range, which shows the spread of 50% of the observations, is higher for EE schools in WASL_M(ath)and WASL_R(eading), WASL_L(istening) and IT_M(ath), whereas for the rest of variables it is higher for comparison schools.

Figure 19 (a-f). Boxplots of six variables (six pairs) for two populations: EE schools and comparison schools.

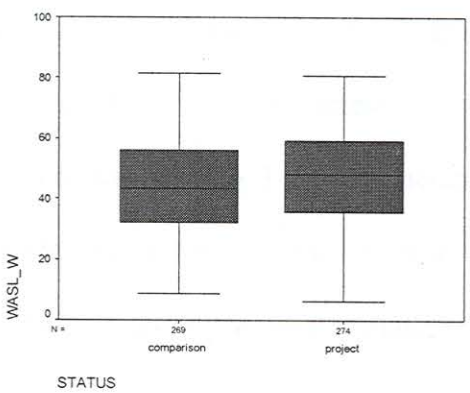
a. WASL math



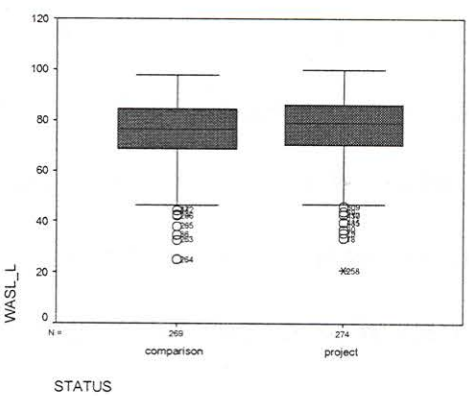
b. WASL reading



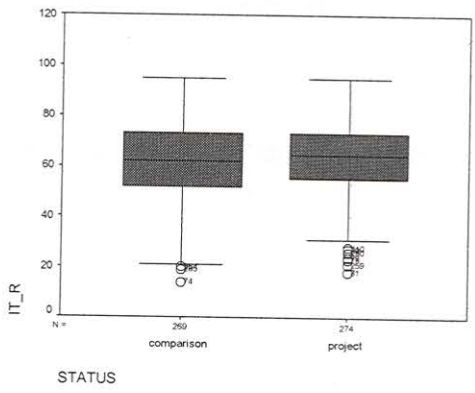
c. WASL writing



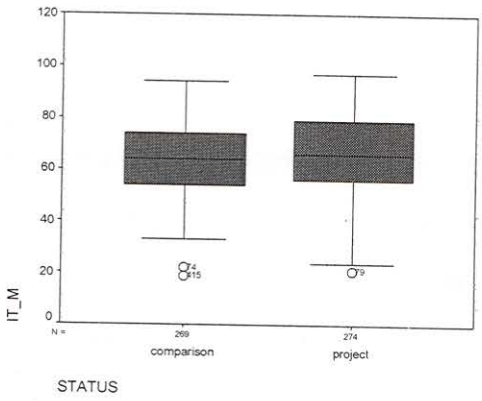
d. WASL listening



e. ITBS reading



f. ITBS math



Overall, on the WASL tests 50 EE schools did *better* in math, 51- in reading, 56 – in writing, and 46 EE schools did better in listening. On the ITBS tests 45 and 44 schools did better in math and reading respectively. In general, in 73 pairs out of 77 EE schools had higher scores in ***at least*** one subject.

5.2. Paired sample t-test results

According to a Paired Samples T-Test (alpha equal to 0.01, 0.05 or 0.1), the difference between the means of the percentages is significant for all six variables. Table 8 presents the results of the paired sample t-test. The last column in the table shows significance or p-value. Because I was interested in whether EE schools have ***higher*** results compared to comparison schools, I used a one-tailed p-value, (which is equal to two-tailed p-value divided by 2). To conclude, the descriptive statistics and t-test allow me to state that there is ***a significant difference*** in math, reading, writing, and listening on the WASL tests and

in math and reading on ITBS tests, ***with EE schools performing better than non-EE comparison schools in all tests.***

Table 8. Results of Paired Samples Test for six pairs of two populations

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	EE_WM - NE_WM (math)	4.289	14.8325	.7974	2.721	5.858	5.379	345	.000
Pair 2	EE_WR - NE_WR (reading)	2.844	12.6229	.6786	1.509	4.179	4.191	345	.000
Pair 3	EE_WW - NE_WW (writing)	4.224	14.3627	.7721	2.705	5.742	5.470	345	.000
Pair 4	EE_WL - NE_WL (listening)	1.791	11.0472	.5939	.623	2.959	3.016	345	.003
Pair 5	EE_ITR - NE_ITR (reading)	2.23	11.358	.691	.87	3.59	3.220	269	.001
Pair 6	EE_ITM - NE_ITM (math)	2.04	12.863	.783	.50	3.58	2.607	269	.010

5.3. Discriminant analysis results

As mentioned above, discriminant analysis is a statistical technique that determines which variables discriminate between two or more groups (Klecka 1980). Table 9 presents structural coefficients which show correlations between discriminant variables and standardized canonical discriminant function.

Table 9. Structure Matrix

Variable	Function (1)
WASL_writing	0.870
WASL_math	0.791
ITBS_reading	0.669
ITBS_math[a]	0.612
WASL_reading	0.512
WASL_listening[a]	0.444

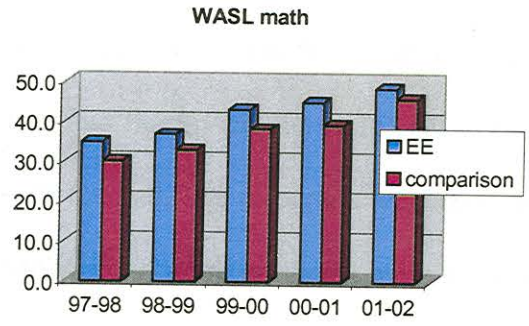
a. this variable not used in the analysis

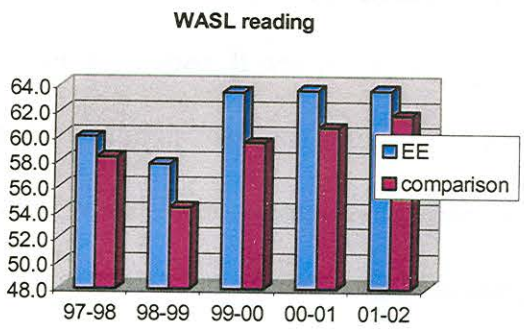
According to the test, the highest coefficient was WASL_writing, followed by WASL_math, ITBS_reading and WASL_reading. WASL_listening and ITBS_math did not have significant correlation with discriminant function. Thus, the variables that were most useful in discriminating between EE and comparison schools were WASL-math and WASL_writing.

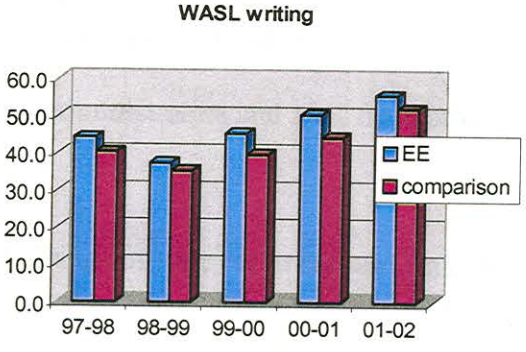
5.4. Results of longitudinal analysis

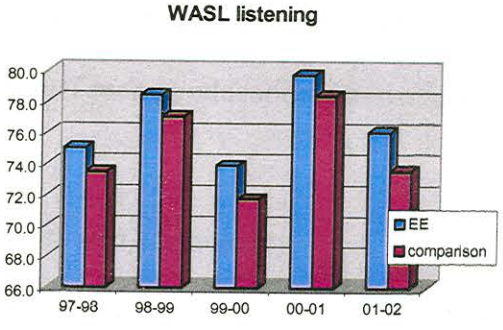
Longitudinal analysis showed that EE schools had higher mean percentages of students who met standards on the WASL and who were above average on the ITBS for the period of 1997-2002. Figure 20 (a-f) presents the results of the longitudinal analysis. Although EE schools had higher mean percentages of students who meet standards of both tests, the overall patterns of changes in the performances over time are similar for both groups of schools. This result indicates that there are likely to be other factors that affect both EE and comparison schools. According to the survey results, one such factor is the changes in the test itself, which over recent years has become less stressful and more age-appropriate. Another factor is the change in state educational policies and regulations, which affect all schools in the state. And finally, increasing teacher skills in preparing students to take these tests could also affect test results.

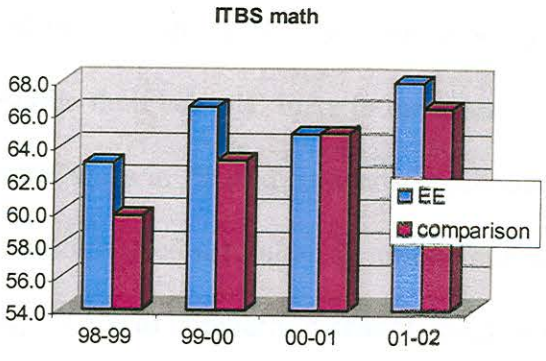
Figure 20 (a-f). Comparison of the mean percentages of students who meet standards in math, reading, listening and writing on the WASL and in math and reading on the ITBS for two groups of schools

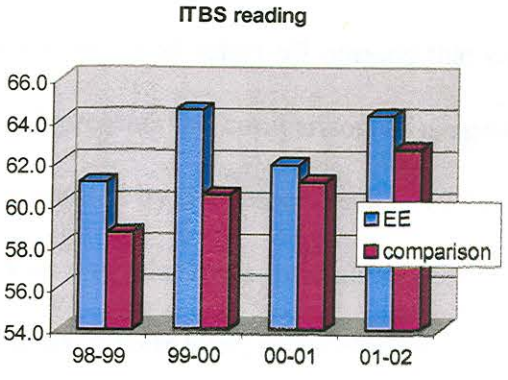












5.5. Survey results

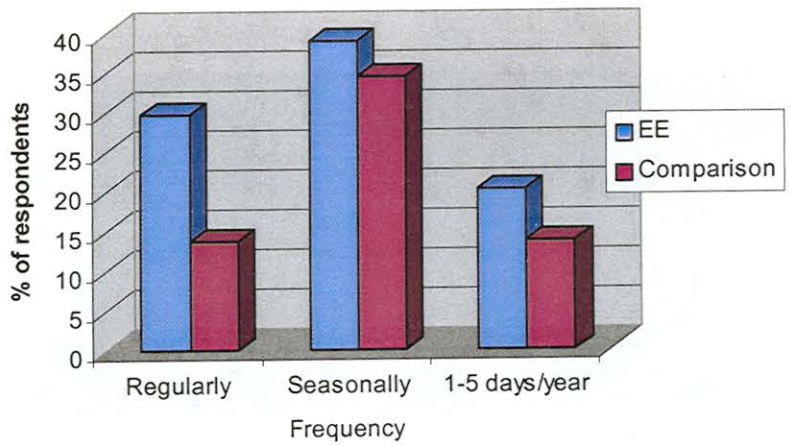
As described above, in order to discover more about the teaching and learning environments (which form the "environment" component of the Austin's model) of the EE and comparison schools, an electronic survey was developed. It was published on the Internet and the invitations were sent to teachers and administrators of the participating schools. Overall, 113 responses were received, out of which 71 respondents were from 53 EE schools and 42 respondents from 31 comparison schools. As seen from these figures, 69% of the 77 EE schools contacted completed the survey compared to only 40% of non-EE schools. Overall, 84 respondents were teachers, 19 responses were received from school administrators and 10 – from other school staff such as educational assistants, etc.

5.5.1. Usage of natural areas and links to outdoors and community

One of the survey questions asked respondents to evaluate how often natural areas were used in the learning process. The respondents were asked to select all options that can describe their schools' links to outdoors. Figure 21 presents the comparison of usage of natural areas in EE and comparison schools. As reported by the respondents, 29.7 % of EE schools used natural areas in their curriculum on a regular basis throughout the year. Only 13.8% of comparison schools used natural areas in their learning process regularly. About 40% of EE schools and about 35% of comparison schools use natural areas seasonally (at least 3-4 times a year). And finally, 20.3% respondents from EE schools

and 13.8% respondents from comparison schools reported that their schools use outdoors for a few concentrated days.

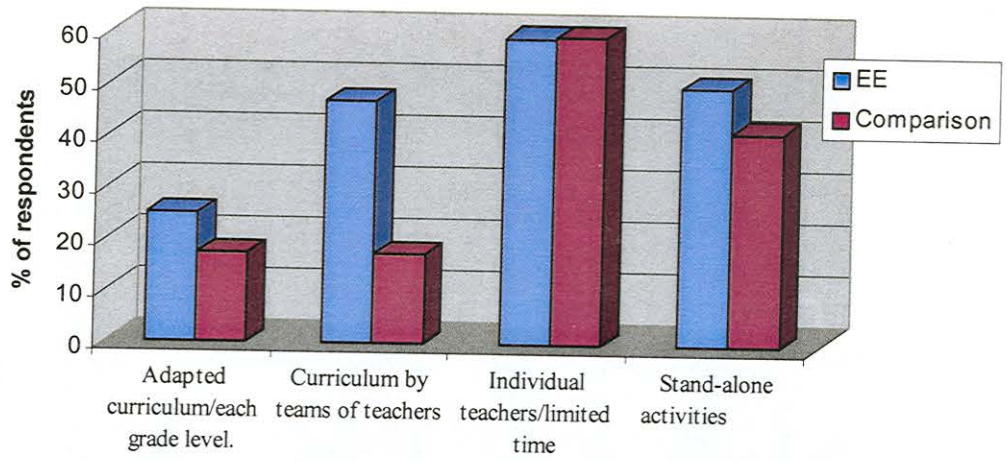
Figure 21. Reported frequency of usage of natural areas in the learning process



Question 2 asked respondents to evaluate the curriculum links to outdoors and community. Respondents chose all answers that applied to their school building (Figure 22). About 30% of EE participants claimed that teachers in their schools adapted curriculum based on students' interests and involved contributions from the outdoors/community, which included the natural environment/community at each grade level. The same option was selected only by 13.8% of respondents from comparison schools. About 50% and 17% of respondents from EE and comparison school respectively believed that in their schools, teams of teachers designed the curriculum to link students to outdoors/community. At the same time about 60% of respondents from both groups thought that individual teachers in their school buildings designed the curriculum which focused on specific natural areas or the community for limited time.

And finally, 50% of EE respondents and 41.4% of respondents from comparison schools claimed that teachers provided stand-alone activities using natural areas.

Figure 22. Reported curriculum links to outdoors and community for EE and comparison schools

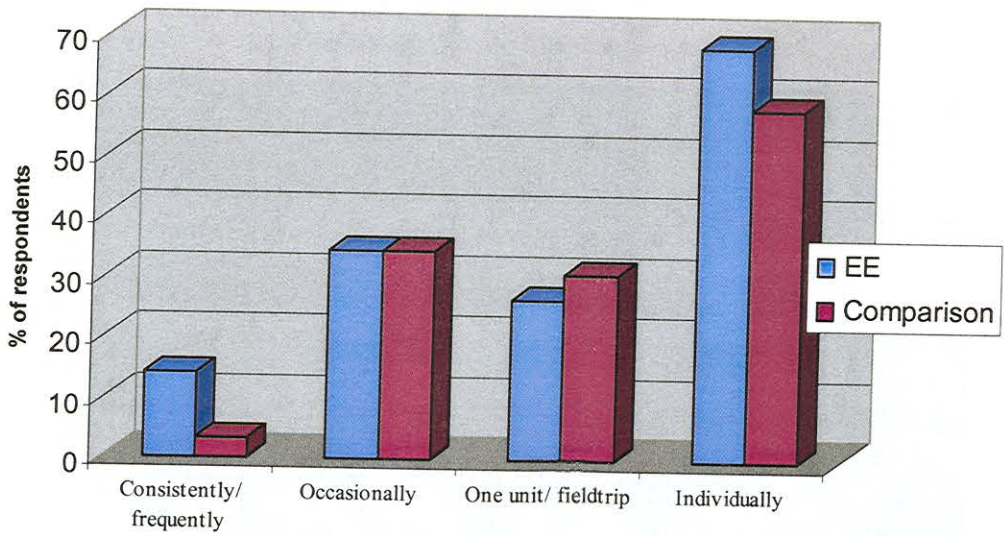


5.5.2. Teaching, assessment and learning practices

Describing teaching practices related to EE, 14.4% respondents from EE schools and 3.4% respondents from comparison schools claimed that teachers in their schools worked together *consistently and frequently* to design and facilitate EE workshops and projects. In addition, 34.4% and 34.5% of participants from EE and comparison schools respectively stated that teachers *occasionally* worked together in EE workshops and projects. Twenty six percent of EE respondents and 31% of respondents from comparison schools reported that in their school buildings teachers worked together just for one integrated EE unit or field trip each year. Sixty nine percent and 58.6% of respondents

from EE and comparison schools respectively claimed that teachers worked *individually* to provide activities using natural areas on the school site or in the nearby community. Figure 23 presents the comparison of different teaching practices related to environmental education existing in EE and comparison schools.

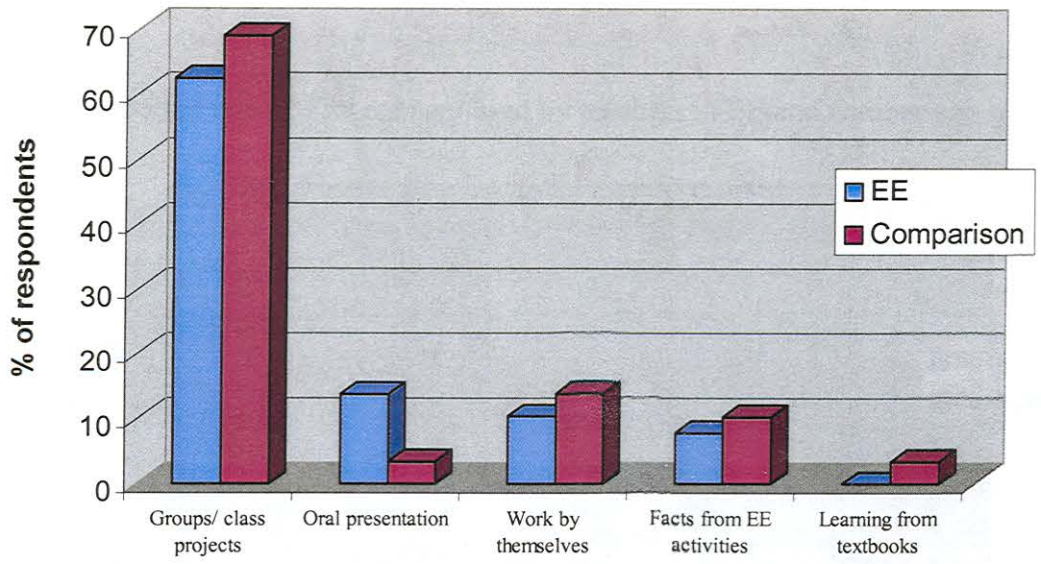
Figure 23. Reported teaching practices related to EE



Describing the style of student learning that is most widely used by teachers in the classrooms, 62.5% respondents and 69% of respondents from EE and comparison schools respectively claimed that in their schools students usually worked in groups on class projects that looked at different ways to solve problems. However, 18.8% of EE participants compared to only 3.4% of respondents from comparison schools stated that students had an opportunity to make oral presentations on what they have learned. Ten percent (EE) and 13.8% (comparison) of respondents believed that in their school buildings students generally worked by themselves on projects. In 7.8% of EE schools

students focused on learning facts from EE-based activities compared to 10.3% of comparison schools. None of the EE schools used textbooks as the only source of information compared to 3.4% of comparison schools in which students learned using textbooks provided.

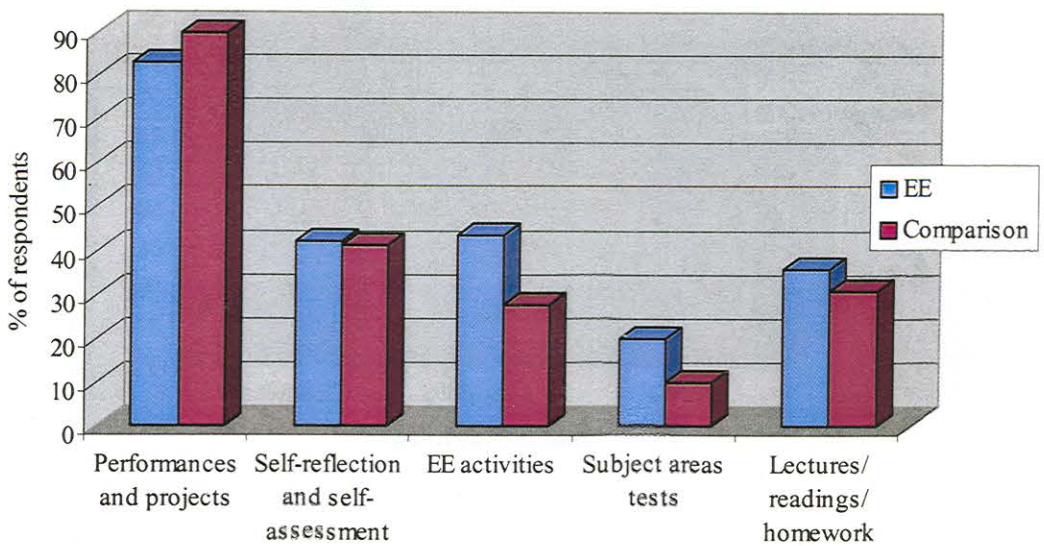
Figure 24. Reported approaches for student learning that are most widely used by teachers in the classrooms of EE and comparison schools



In question 5 respondents were asked to select all types of assessment, which teachers used in their classrooms. Figure 25 compares the types of assessment used by teachers in EE and comparison schools. Eighty three percent of respondents from EE schools and 89.97% of respondents from comparison schools reported that in their schools students frequently were assessed through performances, projects, discussions and presentations. Also 42.2% of EE participants and 41.4% of respondents from comparison schools claimed that students assessed their own work, and self-reflected on their learning. According to the survey, in EE schools students were assessed on what

they learn in integrated Environmental Education activities more often than in non-EE schools (43.8% and 27.6% respectively). Twenty percent of EE respondents and 10.3% respondents from comparison schools believed that in their school buildings in many cases students were assessed through subject area tests only. And finally, 35.9% respondents from EE schools and 31% of respondents from comparison schools reported that in their schools students were also tested on material covered in classroom lecture/discussion and assigned reading and homework.

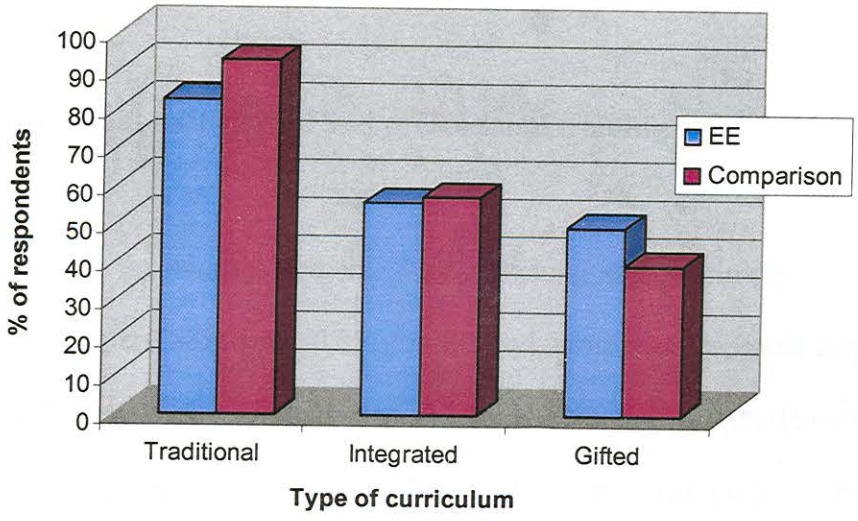
Figure 25. Reported types of assessment used by teachers in EE and comparison schools



In question 6 participants were asked to identify all types of curricula that were used in their schools. The results are presented in Figure 26 below. Eighty three percent of EE respondents and 92.9% respondents from comparison schools stated that their schools implement traditional curricula. Also along with traditional programs, 55.6% and 57.1% of respondents from both EE and comparison schools respectively c laimed that there were integrated curricula in their schools. In addition, 49.2% of participants from

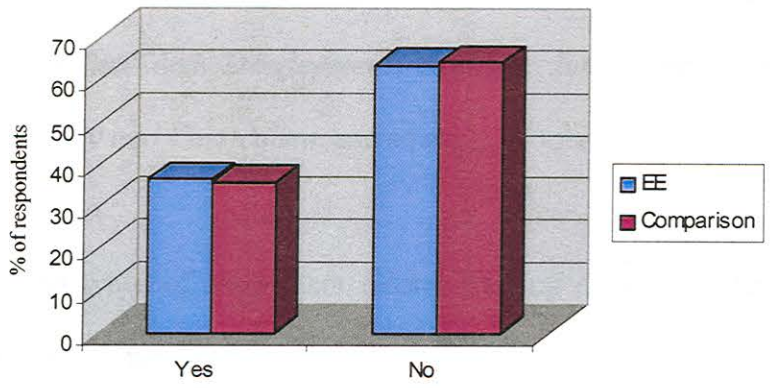
EE schools and 39.3% from comparison schools reported the usage of gifted programs in their schools. Although both EE and comparison schools reported the existence of integrated programs in their schools buildings, the number and subjects integrated are different. Comparison schools mostly integrate two or more traditional subjects together (such as math, science, history or language arts). On the contrary, EE schools reported integrating environmental units and themes into other subjects.

Figure 26. Reported types of the curriculum in EE and comparison schools



As seen from Figure 27, the patterns of participation in regional events and festivals are very similar for both EE and comparison schools. Overall, 36.5% and 35.7% of respondents from EE and comparison schools respectively reported that their schools participated in regional events, festivals and competitions.

Figure 27. Reported participation in regional events and festivals for EE and comparison schools



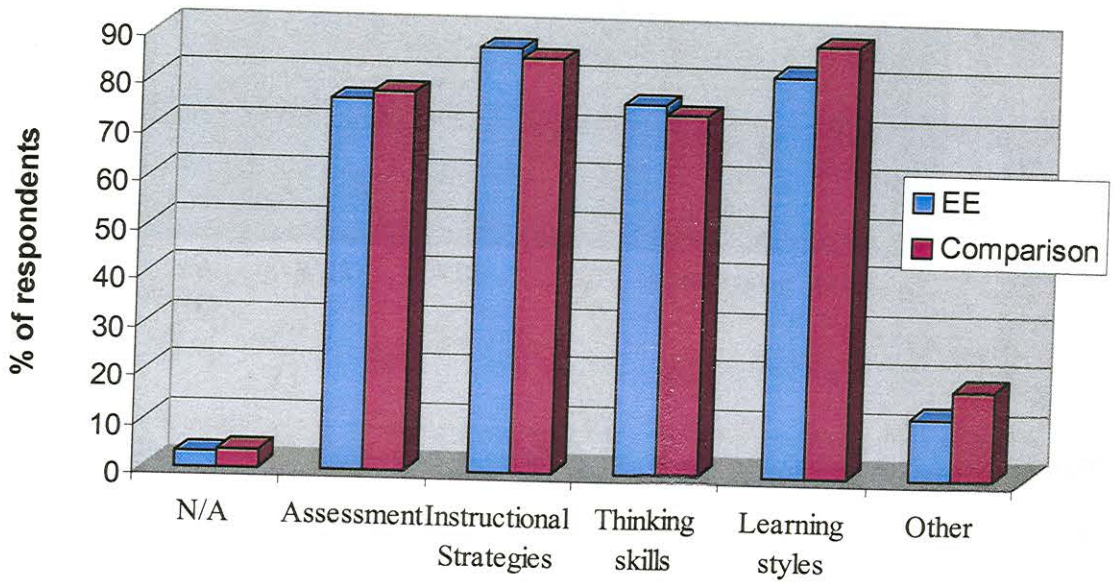
5.5.3. Staff educational background and professional training

According to survey, the average percentages of teaching and administrative staff who have Master's degree are 53% and 50.8% for EE and comparison schools respectively, ranging from 10% to 90% for EE schools and from 33% and to 75% for comparison schools. The percentage of school staff with PhD degrees varies from 0 to 10 for both EE and comparison schools. The average percentage of staff who have teaching certificates is 93% for EE and 100% for comparison schools. However, not every respondent answered these questions. Some of the respondents did not have enough information about amount and types of degrees the staff in their schools have.

Overall, the number of years of teaching experience of the respondents varies from 1 to 36 years with an average of 15 years for EE schools, and from 2 to 33 years with an average of 14 years for comparison schools.

Figure 28 presents the comparison of responses about the types of assessment-reform training or professional development courses the respondents attended. Besides the courses mentioned in the figure, some respondents attended such training as *Technology, Curriculum and Development, Multiple Intelligences, WASL scoring, Integrating Technology into Curriculum*, and so on.

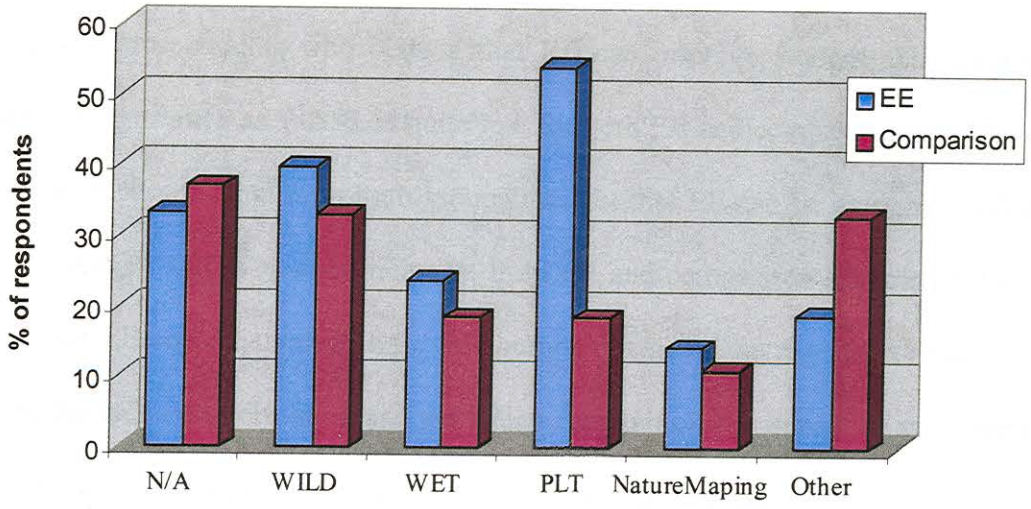
Figure 28. Reported types of assessment reform training or professional development courses the respondents attended



Although the number of respondents who participated in assessment-reform training or professional development courses is higher for comparison schools, the pattern of participation in environmental educational courses and training varies significantly (Fig.29). The most attended course is Project Learning Tree, followed by Project WILD and Project WET. Among other EE courses and training respondents

named *Forest of WA, Globe, Washington Science Teachers Association's Pathways, Woodland Park Zoo workshops, Nooksack Salmon Project, Kitsap Water Watchers*, etc.

Figure 29. Reported types of environmental educational courses and trainings attended by the participants



As for the school buildings in general, the average percentage of teaching staff who participated in environmental education courses and training is higher for EE schools (28% and 11% for EE and comparison schools respectively). On the other hand, the percentage of teaching staff who attend assessment-reform trainings or professional development courses are relatively similar for both groups of schools (65% and 70% for EE and comparison schools respectively).

5.5.4. Attitudes toward environmental education

Question 23 asked participants to rate the value of environmental education based on their experience. The suggested answers were "no value", "little value", "valuable" or "extremely valuable" (on the "Likert scale"). Table 10 and Figure 30 (a-d) compare the ratings EE and non-EE respondents assigned to EE. As seen from the table, the percentage of respondents who believe that EE can improve student achievement on standardized tests such as WASL is quite low for both EE and comparison schools. Only 16 percent of respondents from both groups thought that EE can be extremely valuable. Forty-six percent and 44% of participants from EE and comparison schools respectively claimed that EE could be valuable for this purpose. One of the reasons for such ratings could be the lack of information and published research on the impact of environmental education on student achievement in different traditional subjects.

Figure 30 (a-d) present the comparison of respondents who believe that environmental education could be valuable or extremely valuable for the development of factors described in Table 10. Overall, 95% of EE participants (compared to 88% of representatives from comparison schools) thought that EE could increase student motivation to learn. Ninety one percent of teachers from environmental schools strongly believed that environmental education was extremely valuable or valuable for increasing teachers' motivation. Teachers and administrators from comparison schools saw less value of EE in increasing teacher motivation: 88% of respondents from comparison schools claimed that EE could be extremely valuable or valuable for increasing teachers' motivation.

In addition, participants from EE schools stated that environmental education could be extremely valuable or valuable in

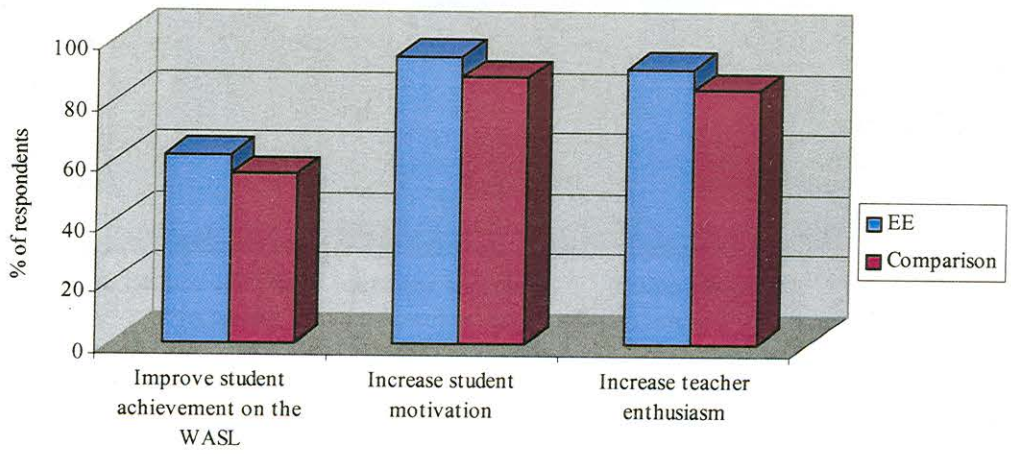
- strengthening student involvement in helping to resolve community issues (88%);
- improving student critical thinking and problem solving skills (100%);
- improving awareness of environmental issues (98%);
- developing a sense of citizenship (86%); and
- increasing student attendance and lowering rates of truancy (58%).

Ninety six percent of respondents from EE schools (compared to 84% participants from comparison schools) believed that EE could be valuable or extremely valuable for strengthening student cooperation and communication skills. Sixty-one percent of EE participants believed that environmental education could reduce behavioral problems, compared to 52% of respondents from non-EE schools who agreed with the statement. And, finally, 79% of EE participants and 68% of respondents from comparison schools thought that EE could be valuable or extremely valuable for increasing community involvement.

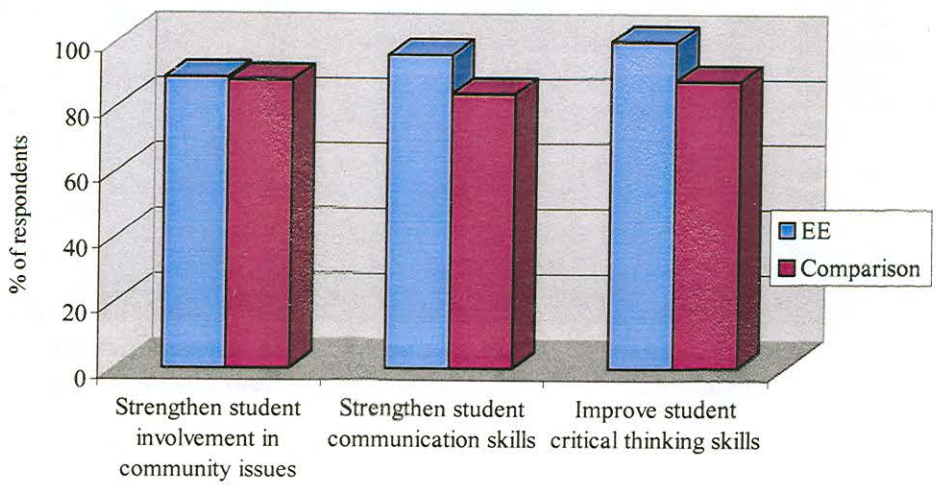
Overall, as seen from Table 9 and Figure 30 (a-d), more teachers and administrators who work in schools with strong environmental education programs believed that EE could be a very valuable tool for improving school environmental student learning, thinking and other skills and increasing links to community and natural areas. The percentage of EE respondents who thought EE was valuable or extremely valuable was ***higher in every category***.

Figure 30 (a-d). Reported attitudes toward environmental education for EE and comparison schools

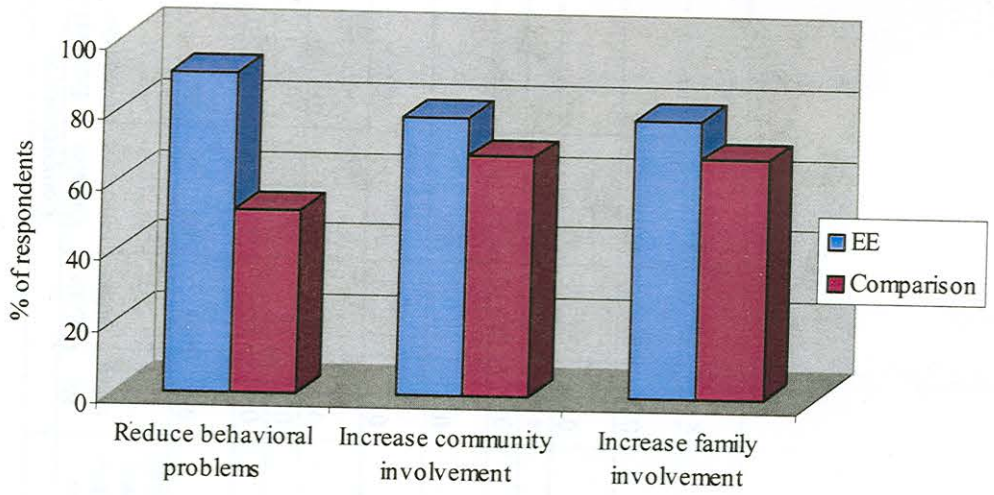
a) Role EE in increasing student achievement and teachers' and students' motivation



b) Role EE in strengthening student involvement in solving community issues and improvement of critical thinking and communication skills



c) Role of EE in increasing community and family involvement in the learning process and decreasing behavioral problems



d) Role EE in increasing student attendance and improvement of environmental awareness and development of a sense of citizenship

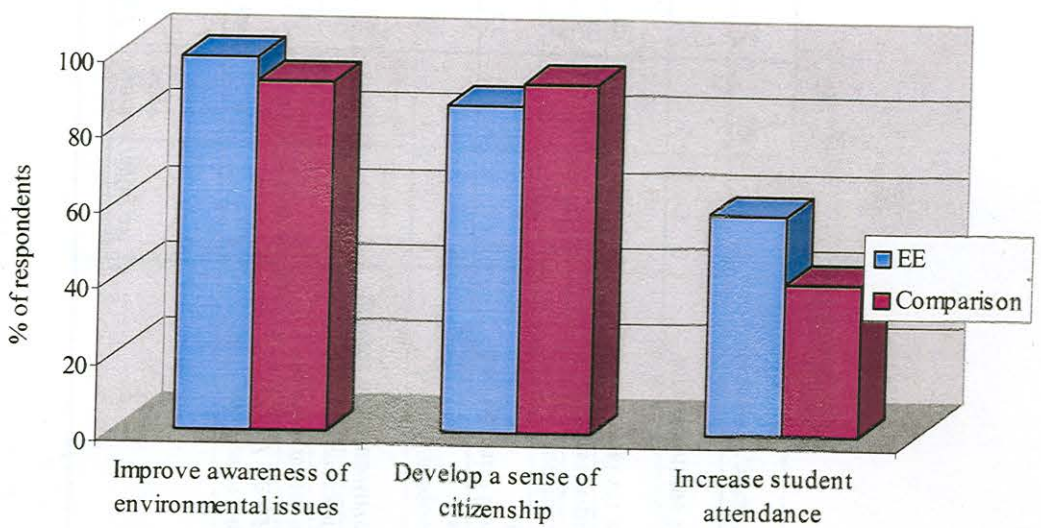


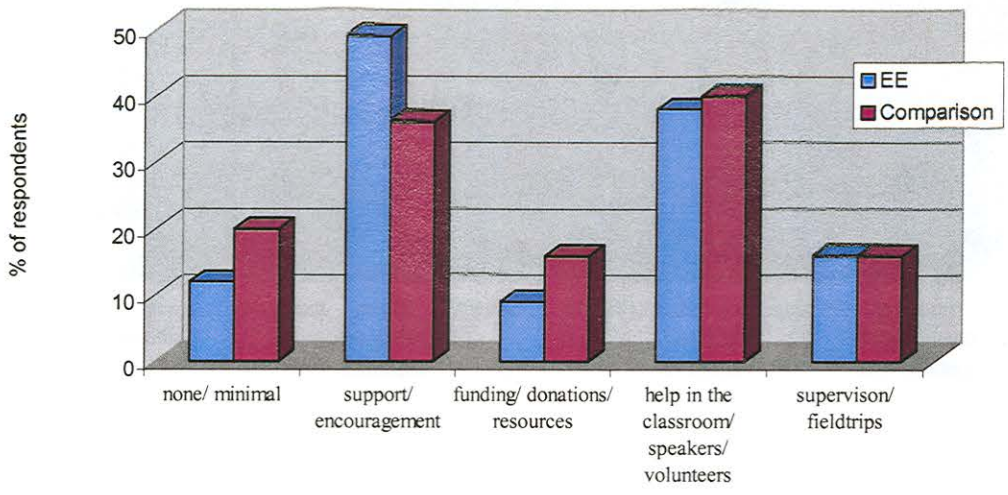
Table 10. Rating of the value of environmental education by respondents from EE and comparison schools

	EE (%)					Comparison (%)				
	No value	Little value	Valuable	Extremely valuable	Total (valuable/ extremely valuable)	No value	Little value	Valuable	Extremely valuable	Total (valuable/ extremely valuable)
Improve student achievement on standardized tests, like the WASL	4	35	**46**	16	62	0	44	40	16	56
Increase student motivation to learn	2	4	44	**51**	95	0	12	44	44	88
Increase teacher enthusiasm	2	7	**54**	**37**	91	0	16	48	36	84
Strengthen student involvement in solving community issues	2	10	43	**46**	89	0	12	52	36	88
Strengthen student cooperation and communication skills	0	4	**56**	**40**	96	0	16	48	36	84
Improve student critical thinking and problem solving skills	0	0	53	**47**	100	0	12	60	28	88
Reduce behavioral problems	4	35	**42**	**19**	61	0	48	36	16	52
Increase community involvement	2	19	**51**	**28**	79	4	28	44	24	68
Increase opportunities for family involvement	4	18	**56**	23	79	0	32	40	28	68
Improve awareness of environmental issues	0	2	35	**63**	98	0	8	40	52	92
Increase student attendance, lowers rates of truancy	11	42	23	**25**	58	8	52	24	16	40

5. 5. 5. Parents, administration and community involvement in the learning process and environmental education

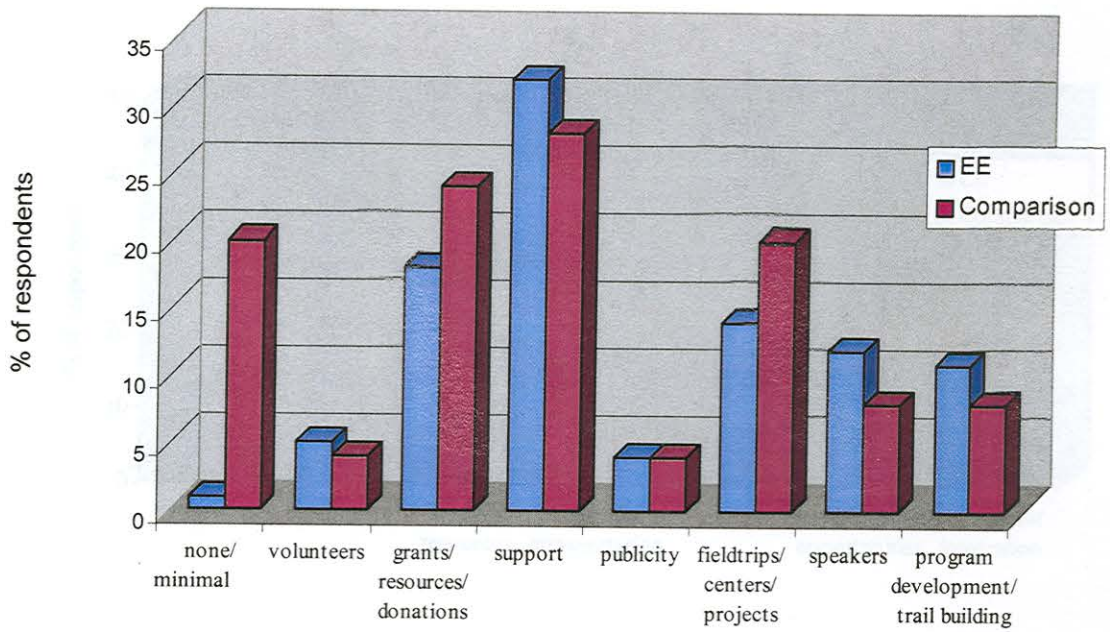
Several questions in the survey asked respondents to evaluate support from the administration, parents and community in the learning and teaching activities including implementation of environmental education. According to the survey, 12% of EE respondents and 20% of respondents from comparison schools received none or minimal support from parents (Figure 31). Forty-nine percent of participants from EE schools (compared to 36% of non-EE respondents) claimed that the parents of their students are very supportive and participate in school activities as well as express positive attitudes and encouragement at home. On the other hand, a higher percentage of respondents from comparison schools stated that parents in their schools provided funding, resources and help in the classrooms as volunteers and guest speakers.

Figure 31. Reported parental involvement in the school learning and environmental education for EE and comparison schools



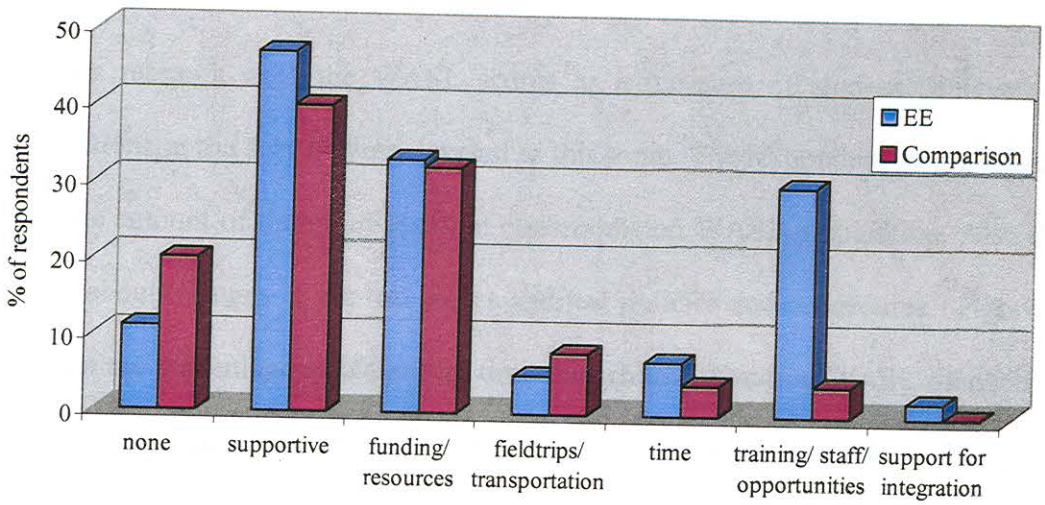
As seen from Figure 32, 32% of EE respondents (compared to 28% of participants from comparison schools) believed that their schools received strong support from their communities: in EE schools, the community seems to be more involved in program development and trail building (11%), plus participate in the learning process as guest speakers (12%) and volunteers (5%). However, a higher percentage of participants from comparison schools reported that they received support for fieldtrips, funding, and resources. On the other hand, 20% of participants from comparison schools (compared to only 1 % of EE respondents) stated that they did not receive any (or minimal) community support.

Figure 32. Reported community involvement in the learning process and environmental education for EE and comparison schools



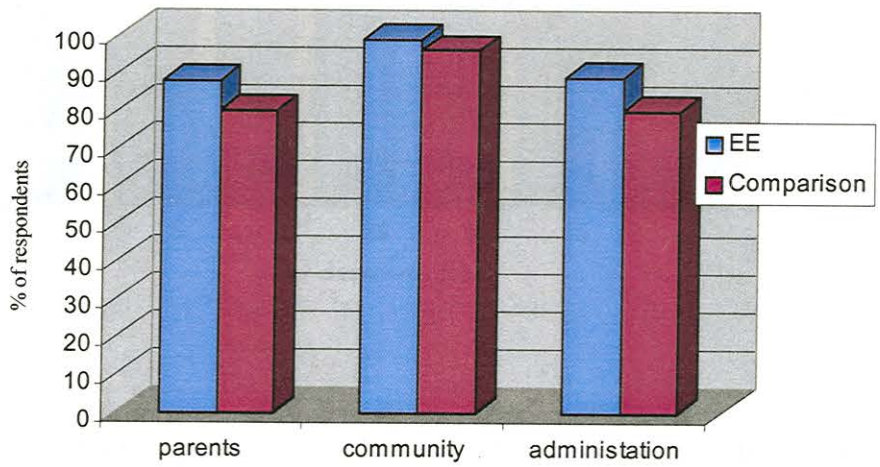
As seen from Figure 33, EE schools seem to have more support from their schools and district administration compared to non-EE schools in almost all categories. They have more support from administration for doing EE, more resources, more time and training. Forty-seven percent of EE participants (compared to 40% of respondents from comparison schools) claimed that their administration is (very) supportive. Seven percent of EE respondents (compared to 4% of respondents from comparison schools) reported having more time for planning and curriculum development. **Thirty percent** of EE respondents (compared to **only 4%** of respondents from non-EE schools) claimed that they have training and other opportunities and special staff in their schools who help to implement EE activities.

Figure 33. Reported administrative involvement in the learning process and environmental education for EE and comparison schools



Overall, as seen from Figure 34, more respondents from EE schools claimed that they receive any support from their students' parents, administration and community.

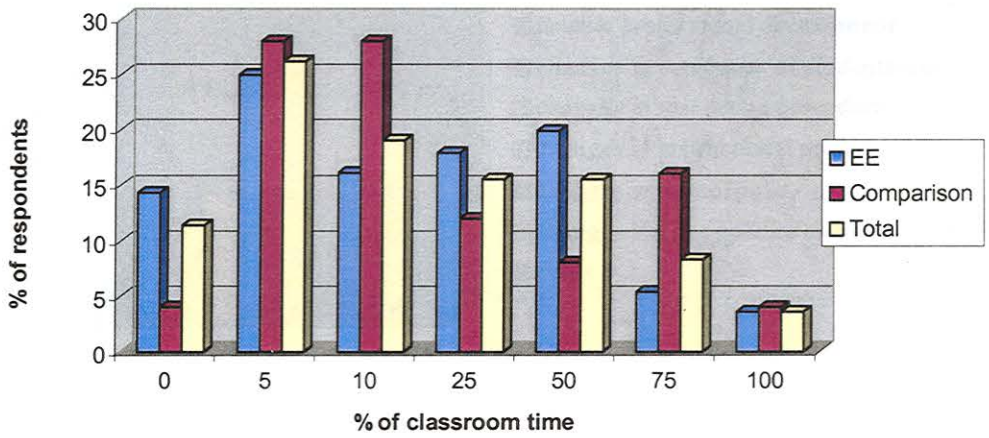
Figure 34. Reported support from parents, community and administration



5. 5. 6. WASL: time for preparation and possible factors affecting WASL scores

Because this research used the WASL scores as a measure of student achievement, several questions in the survey were devoted to this topic. The respondents were asked to reflect on the amount of time they spent in classrooms on WASL preparation. Also they were asked about changes in the test scores and test policies and procedures. Figure 35 below shows the percentage of classroom time the schools spend on WASL preparation. As seen from the figure, the amount of time spent on preparing students to the WASL varies from 0 to 100 percent. For the model preparation time, 27% of respondents said they spent on average about 5% of their classroom time on WASL preparation. About 4 percent give all their classroom time to preparing for the test.

Figure 35. Reported amount of time spent on WASL preparation

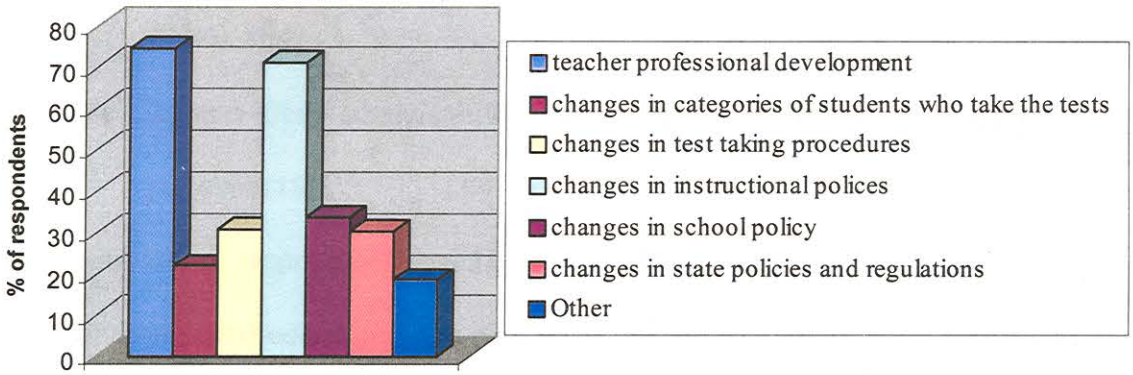


Overall, about 14 percent of respondents from EE schools claimed that they did not spend time on the WASL compared to 4 percent of participants from comparison schools. About 20% of respondents from EE schools spent 50% of their classroom time on WASL preparation compared to 8% of respondents from comparison schools. On the other hand, the percentage of teachers who stated that they spent 75% or 100% of their classroom time to prepare their students for the WASL is higher for comparison schools.

When asked about changes in the test scores, teachers and administrators from both comparison and EE schools named several similar reasons such as:

- professional development on test preparation,
- changes in state and school policies that encourage teachers to prepare students for the WASL , and
- "increased focus on learning target and constant push from school administration to improve test scores" .

Figure 36. Factors that influence changes in test scores on the WASL



According to respondents to the survey results (presented in Figure 36), teachers are encouraged to teach to the test by focusing on developing thinking skills and essential learning outcomes described in the state standards. Respondents indicated that professional development and teacher training has increased over the past several years. Some respondents mentioned changes in teaching style, and changes in school and district policies.

5.5.7. Needs and barriers for doing environmental education in the classrooms

Several questions of the survey focused on needs for improving EE in the classrooms and the barriers they experience. According to the survey, there were several main needs for improving EE in the classrooms. Teachers indicated that they needed

- more funding (40%),
- more time for planning and instruction (47%),
- more materials (18%),

- curricula and activities (19%),
- more opportunities for professional development and teacher training (29%), and
- support from administration and districts to develop and maintain EE program (18%).

About 8% of respondents stated that less WASL preparation would give more time for environmental education. Ten percent of respondents wanted more information about the impact of environmental education on student achievement and sought an opportunity to communicate with state environmental organizations and institutions. Other needs mentioned by the respondents were more flexibility in the curriculum, more motivation and leadership, more knowledge about the environment and more confidence in teaching EE.

Accordingly, the main barriers identified for implementing environmental education in schools were

- lack of time (58.8%);
- money (48%);
- lack of support and understanding from school administration (8.9%);
- lack of training (15.8%);
- and necessity to devote time to preparing for the WASL (11.7%).

According to the survey, other barriers to emphasizing EE are curriculum expectations and administrative pressure that do not allow teaching EE, lack of commitment from other teachers, lack of teacher's own environmental knowledge and skills, and parental attitudes.

6. Discussion

As I have already mentioned, I used the I-E-O[1] model developed by Austin (1991) as the basis for my research design. Like Austin, I believe that in order to more fully interpret the outcome (or outputs) of the program/ or model, it is necessary not only to compare similar groups (or understand and take into account the differences between them) but also to understand and analyze the educational environments in which these groups operate. Tables 12 and 13 below present the summaries of my findings and the questions still to be answered.

Input component

As described earlier, for the present research, 77 pairs of EE and comparison schools were selected. Each school was rated by different EE and other experts according to the Environmental Education Rubrics for school buildings. Table 11 below presents the characteristics of EE and comparison schools on the EE Rubrics. All EE schools have environmental programs which have been implemented for more than three years and 20% of teachers (or more) as well as 33% of students (or more) participated in EE programs.

Table 11. Characteristics of EE and comparison schools on the EE Rubrics developed the EE Consortium

	EE	Comparison
School Building Rubric		
• # of years in EE	• At least 3 years	• less than 3 years

[1] The Input - Environment - Output model

• % of teachers /classrooms involved • % of students involved	• 20% or more • 33% or more	• less than 20% (or none at all) • less than 33% (or none at all)
Curriculum	• Integration • Links to natural areas	• No integration around EE • Stand-alone EE activities or none at all
Instruction	• Teams of teachers who help students to develop their own knowledge	• Teams are only forming OR only individual teaching OR no teaming
Assessment	• Best practices	• Traditional practices
Student learning	• Construct their own learning	• Traditional approaches
Community	• Participates in learning process and provides EE opportunities	• Few community partners OR no participation OR do not provide EE opportunities

Table 12 below presents the summary of my research. The findings from the survey, statistical analyses, external rating, etc. are organized using the elements of the I-E-O model.

As mentioned above, the pairs of EE and comparison schools were selected in such a way that they were similar in their socio-economic, demographic and geographic parameters. This allowed me to assume that the schools in each pair are fairly comparable. Also, according to the survey, teachers in both groups of schools have similar educational background, and similar professional and assessment training. In most schools 90-100% of the staff have teaching certificates. The percent of the staff who has a PhD degree varies from 0 to 10 percent for both EE and comparison schools. The average percentage of Master's degrees is also quite similar: 53% for EE and 50.8% for comparison schools. Similarly, the average percentage of staff who participated in professional development courses is 65% and 70% for EE and comparison schools respectively.

However, I acknowledge that there could be other variables which I did not have an opportunity to investigate. For example, I did not study teachers' motivation to teach EE in their classrooms, their skills and knowledge in this area as well as teachers' level of confidence in teaching environmental education. Also, focusing on the schools in general, I did not take into account individual students' backgrounds, and their individual skills. Although I compared schools using socio-economic parameters, I did not study parents' background and education. I think that all these factors can affect student achievement. However, at this point I could not include them in my research.

Environment component

The rating of schools conducted by external experts to a degree describes an environment where integrated environmental education is being introduced, supported and valued, or conversely where little EE has been developed to date, or is just being introduced. Building on that second hand knowledge about these schools, I used my survey results to evaluate and compare teaching and learning environments of the EE and comparison schools. Using the survey responses I analyzed teaching practices, instructional and assessment strategies reportedly used in schools, amount of time spent on preparation for the state WASL test, types of school curriculum and school staff educational background. Although I planned to evaluate the amount of funding the schools receive from different sources, most respondents could not provide enough information about it. Most of them (especially teachers) stated that they did not have such information.

Table 12. Summary of the research organized by components of the I-E-O model

<table>
<tr><th colspan="3">Inputs</th></tr>
<tr><th>Similar</th><th colspan="2">What I do not know</th></tr>
<tr><td>• Demography
• Socio-economic status
• Ethnicity
• Location
• Teachers' professional training
• # of teaching certificates</td><td colspan="2">• Individual students' background
• Individual students skills, strengths and weakness
• Parents' background and education
• Amount of reinforcement from parents
• Teachers' motivation, skills, knowledge and area of expertise</td></tr>
<tr><td colspan="3"></td></tr>
<tr><th colspan="3">Environment</th></tr>
<tr><th>Similar</th><th>Different</th><th>What I do not know</th></tr>
<tr><td rowspan="2">• Pedagogy
• Assessment practices
• Time spent for the WASL preparation
• Needs and barriers for doing EE in the classrooms
• State/district educational policies and regulations</td><td rowspan="2">• Rating on EE Rubrics by EE experts
• Degree of usage of natural areas
• Level of integration around EE
• EE training
• Support from parents, community and administration for doing EE
• Valuing EE</td><td>• Level of teachers' confidence teaching EE
• Amount of funding schools receive from various sources
• Teachers, parents' and student attitude toward the WASL
• Nature of the WASL preparation</td></tr>
<tr><th>What I did not do</th></tr>
<tr><td></td><td>• I did not observe the schools/classes directly
• I did not survey each teacher in each school
• I did not interview teachers, parents, students and community partners</td></tr>
<tr><td colspan="3"></td></tr>
<tr><th colspan="3">Outputs</th></tr>
<tr><th>Different</th><th colspan="2">What I do not know</th></tr>
<tr><td>• Test Scores (higher for EE schools)</td><td colspan="2">• How correct standardized tests results reflect school learning and changes in student skills and knowledge.
• Reasons for changes in the individual student's scores on the WASL/ITBS</td></tr>
</table>

Table 13. Summary of the similar, different and unknown parameters of the research

EE and comparison schools are SIMILAR in		
• Demography • Socio-economic status • Ethnicity • Location • Amount of professional educational training • Time spent on the WASL preparation • Proportion of faculty with teaching certificates, and Masters and PhD's • Subject to the same state/district policies • Needs/barriers for doing EE • Pedagogy • Assessment methods		
EE and comparison schools are DIFFERENT in		
• EE Rubrics		
	EE	***Comparison***
% of years of engagement with EE	*3 years or more*	*less than 3 years*
% of teachers involved	20% or more	less than 20%
% of students involved	*33% or more*	*less than 33%*
• WASL/ITBS scores	*higher scores*	*lower scores*
• Usage of natural areas	*on a regular basis*	*occasionally or not at all*
• EE training	*more teachers attended EE training*	*Less EE training*
• Integration around EE	*integrated curriculum*	*no integration around EE/ stand-alone EE activities*
• Support from parents	*more*	*less*
• Support from community	*more*	*less*
• Support from administration	*more*	*less*
• Attitudes towards EE	*teachers value EE more (higher in every category)*	*less*
What is UNKNOWN		
• Students' background and skills • Parents' education • Parents' and community reinforcement • Teachers' motivation for doing EE • Teachers' skills and knowledge for teaching EE and the level of confidence in teaching this discipline • Nature of preparation for the WASL test • Parents', students' and teachers' attitude toward the WASL test • School funding for EE or other reform or improvement efforts		

EE and comparison schools use similar types of assessment. In most schools, teachers assess through performances and projects and allow students to assess their own work. In addition, both types of schools use "traditional" forms of assessment such as subject area tests, assessment through lectures, readings and homework, etc. However, the percentage of teachers who assess students through EE activities is higher for EE schools.

Along with traditional curricula both groups of schools tend to implement integrated and gifted programs. However, many EE schools use environmental topics and themes for integration (by merging several subject areas using this context) whereas comparison schools appear to interpret integration by the merging traditional subjects such as math, history, language arts, or social studies.

Because the pairs of schools were selected from the same state and, when possible, in the same district, they were subject to the same state (and district) educational policies. However, school policies vary from school to school. In some cases, respondents described their school's policy regarding WASL. However, this information was not available for each school.

Teachers in EE schools attended more EE training and workshops compared to their colleagues from comparison schools. The average percentage of teaching staff who participated in environmental educational courses and training is higher for EE schools. About 30% of EE participants (compared to 13.8% of non-EE respondents) claimed that teachers in their schools adapted curriculum based on students' interests and involved contributions from the outdoors and community, which included the natural environment and/or community at each grade level.

According to the results, EE schools use natural areas more regularly. The teachers in these schools try to link their curriculum to the environment and community. On the contrary, comparison schools reported that their teachers use natural areas occasionally, for a short period of time or do not use them at all.

The amount of time spent on the WASL preparation varies greatly for both EE and comparison schools. According to the survey, it is not possible to make a conclusion that any of the group schools devoted more time for WASL preparation than the other group. However, what I did not investigate in my research is the nature of the WASL preparation schools undertake. Also I did not have an opportunity to study the attitudes toward the WASL test of parents, students and teachers. I believe that these attitudes could be a factor that affects students' performance on the test. Positive attitudes of parents and teachers could reinforce students' positive attitude to the test and their willingness to do their best on the WASL whereas negative attitudes of parents and teachers and lack of reinforcement for them would probably result in a worse performance.

According to the survey results, teachers in EE schools receive more support from parents, administration and community. A really dramatic difference was found in the amount of support from administration. Teachers in EE schools seemed to receive more training, time, etc. Thus, ***30%*** of EE respondents (compared to ***only 4%*** of respondents from non-EE schools) claimed that they have training and other opportunities and special staff in their schools who help them to implement EE activities. However, in order to develop a clearer picture about types and amount of support provided by community and parents, it is necessary to conduct interviews of parents and community members who are

involved in the learning process. Unfortunately, I did not have an opportunity to survey these two groups. On the other hand, the results received through the teacher survey are similar to the school evaluations conducted by external experts who stated that most of the EE schools have a high level of community and parental support.

And finally, a difference between EE and comparison schools was found in how teachers rated the value of EE in developing critical thinking and communication skills, improving student achievement, increasing family and community involvement, improving student attendance and engagement, reducing behavior problems, and some other components. Ratings of EE school teachers were ***higher in every category***.

Overall, the survey data provided valuable information about EE and comparison schools. However, the results would be more complete if every school responded to the survey. Obviously, if I were able to survey each school (and each teacher in the school), I would have more complete understanding of their school environment.

Outputs

I used the WASL and ITBS test scores as measures of student achievement in math, reading, writing and listening. The descriptive statistics and t-tests showed that there is a ***significant difference*** in math, reading, writing, and listening on the WASL tests and in math and reading on ITBS tests with EE schools performing ***better*** than non-EE comparison schools in all tests.

According to the longitudinal analysis, although EE schools had higher mean percentages of students who meet standards on both tests, the overall patterns of change in performance over time are similar for both groups of schools. This result indicates that

there are likely to be other factors that affect both EE and comparison schools. According to the survey results, one such factor is the change in the test itself which over recent years has become less stressful and more age-appropriate. These changes affected all schools in the state and could explain the similar patterns of change in the test scores for EE and comparison schools.

Overall, I believe that environmental education can be one of the causes for EE schools' success on the WASL. Investigating environmental topics requires students to apply knowledge and skills from different subjects. Used as a basis for integration, environmental education can allow for integration of math, science, language arts, social sciences and other subjects. In addition, it asks students to become investigators and to search for the solutions to very multidimensional questions. By doing this, students can develop their analytical, problem solving and critical thinking skills valuable in any traditional subject.

Also it is necessary to emphasize that the study indicates ***a correlation*** rather than a cause-effect relationship between student achievement and the role of environmental education in the school. It is necessary to point out that environmental education is only one of many possible factors that affect student achievement and test results. There are many other internal and external factors such as school funding, teaching and learning practices, administrative school policies, students' individual characteristics, etc. that affect student achievement. The test results are also affected by the extent of teacher professional development in specific subject areas, especially math, reading and writing. The present research does not take these factors into account. Finally, according to the research not every EE school is higher on the WASL and ITBS compared to its non-EE

pair. This also does not allow me to claim that there is a cause-effect relationship between EE and student achievement.

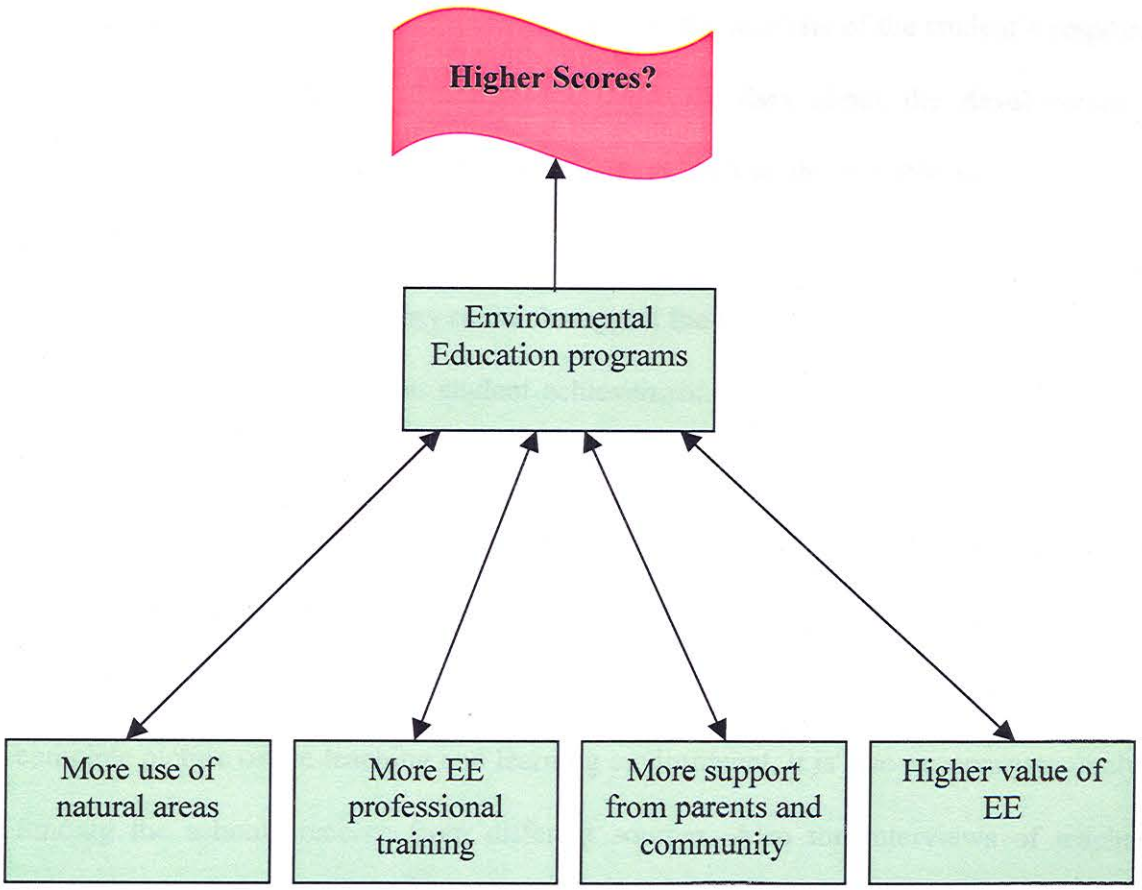
However, the research shows a pattern (Figure 37) indicating that in schools with environmental educational programs teachers

- tend to use natural areas more;
- have more EE professional development/training;
- have more support from parents, community and administration; and
- see more value in environmental education.

In addition, most schools for which these parameters were true, had higher scores on the WASL/ITBS compared to their comparison schools. However, the research did not make it possible to determine how this translates to student learning, plus what particular skills have been improved, and what scientific concepts have been mastered.

These results ***validate the EE Rubrics*** developed by the EE Consortium and used as a basis for school selection for this study. Initially, EE schools and their pairs were rated by EE providers and other EE and educational experts. The data from the survey support the external ratings. According to the results, the schools which were rated high on the EE Rubrics, were reported as having higher level of community, administration and parents involvement, using well developed practices in assessment and instruction more, and more consistently and regularly using natural areas, etc. Thus, I think that the present research also proves that the EE Rubrics can be used for assessing school building's EE implementation.

Figure 37. Patterns found by the research



Next steps in the EE Assessment Project

The Environmental Educational Consortium continues to investigate student learning performance and differences through EE Assessment Project research. For this next phase of the research, WASL-like performance tests were administered to 15 pairs of EE and their comparison schools. These 15 pairs were chosen out of the 77 pairs studied in the present research. The WASL-like tests are aligned with EALR's (state standards) and the EE standards (or Integrated Benchmarks). They assess how students mastered EE

concepts and skills as well as the main concepts in math, science, social studies, language arts, history and arts. Comparing the results on the EE WASL-like tests for each student with his or her WASL and ITBS scores as well as the analysis of the student's responses on the WASL-like test, will reveal more precise data about the development of environmental and other knowledge and skills, as well as the possible impact of EE on the student learning.

Overall, the results of my research suggest the need for further study of the impact of environmental education on student achievement. Although my research shows that the scores are higher for the schools with environmental educational programs, we still need to learn more fully why this is occurring, what factors affect tests scores and what practices are making the difference. I think that the next step for this research is a more in-depth qualitative study of the selected pairs of schools. In order to receive a more complete picture of the teaching and learning environment, it is also necessary to analyze funding the schools receive from different sources. Also the interviews of teachers, principals, students as well as students' parents and community partners involved into the learning process would provide very valuable information. Finally, we also need to know the complete professional development received by the faculty for the past several years, for this may have contributed to their school's WASL scores. Such research would not only give evidence of the positive impact of environmental education but also would add to the theory of educational research.

7. Conclusions and recommendations

The comparison of the student achievement on two state standardized tests (WASL and ITBS) for two groups of schools (EE and non-EE) and analysis of the results of the survey allow me to state that environmental education could positively affect student achievement in other subjects. According to this research, schools that undertake systemic environmental education programs consistently have higher test scores on the state standardized tests over comparable schools with "traditional" curriculum approaches. The mean percentages of the students who meet standards on WASL and ITBS tests are higher in all six areas in the schools with environmental programs. According to the statistical analysis, schools with EE programs performed significantly better compared to non-EE schools on the state standards tests. There were no EE schools that had lower percentages of students who meet or test above standards in all six areas. Overall, 73 pairs out of 77 project schools had higher scores in ***at least*** one subject.

My longitudinal analysis over 5 years reveals that EE schools had higher mean percentages of students who met standards on the WASL and who were above average on the ITBS for the period of 1997-2002. However, the fact that both groups have similar patterns of change in the test performances over time indicates that there are other factors that affect both EE and comparison schools. Such factors can be changes in the tests themselves, changes in test preparation approaches as well as changes in the state educational policies and regulations, which affect all schools in the state.

Both qualitative and statistical evidence suggests that one factor in the success of these EE schools is the use of environmental education in their curriculum. On a qualitative dimension teams of EE and educational experts rate EE schools higher on EE

Rubrics. On a quantitative dimension, survey respondents indicate that EE schools use natural areas more regularly; receive more support from parents, administration and community; teachers have more EE professional training and value EE higher compared to respondents from comparison schools. However, the study indicates a correlation rather than a cause-effect relationship between student achievement and the level of integration of environmental education in the school. I would like to emphasize that environmental education is only one of many possible factors, which affect student achievement and test scores.

I believe that environmental education provides tremendous opportunities for schools, teachers and students. It not only improves student learning (as the present study allows to state), but also it makes learning more relevant and interesting for students and teachers. It improves students' behavior and motivation to learn. It encourages parents and members of the community to take part in the school learning activities. Also students have a unique opportunity to participate in the real-life projects and try to solve issues and problems in their communities. They see the relationships between knowledge and skills they receive in the classrooms and the real world around them. Environmental education can help students to believe that they can *make a difference*.

Based on my analysis of the research literature and reports existing in this field and the results of the present study some additional conclusions are the following:

1. It is necessary to expand the focus area of EE research. Although there are many studies on the development of environmental knowledge, behavior and attitudes, there are other components of environmental education which require research attention. It is necessary to conduct more thorough in-depth studies on the effect

of environmental education on student achievement and on the development of critical thinking skills. Such studies would allow further understanding of environmental education processes, and ultimately, promotion of its benefits. Positive results would provide supporters of environmental education with research evidence about the positive impact of EE on student achievement.

2. More qualitative research should be done. As seen from the literature, about 90% of all educational research in this field is quantitative in nature. Although statistical methods provide good quantitative results, it is necessary to conduct more interviews, and classroom observations. Such qualitative data would be able to provide information that is impossible to capture through statistical functions. In my opinion it is necessary to combine both approaches, because the field needs more in-depth analysis of these programs. If both qualitative and quantitative studies produce the same results, that would indicates that the results are not affected by methodology and are more reliable.

3. In order to make a case for integrated environmental education, more research is needed on the positive impact of integrated programs in general. At the moment there are few such research examples. Both K-12 and higher education are calling for more and better curriculum integration, but good measures of student learning in these educational environments are still lacking.

4. Overall, environmental education needs more theoretical analytical and less anecdotal studies and reports. At the moment, the field of education suffers from a lack of educational theory in general about the development of complex learning environments which attempt to foster complex skills.

To conclude, I believe that the present research provides statistical evidence that one factor in student academic achievement can be implementation of integrated environmental education programs. The results presented in the study suggest the need for further study of the impact of environmental education on student achievement, and the particular practices within EE that are most promising in fostering such achievement.

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Appendix A.

Environmental Education Rubrics K-12 for school buildings developed by the Environmental Education Consortium

	4 Full implementation	3 Partial implementation	2 Implementation of EE emerging	1 Attempts to implement EE	0 No interest to implement EE
School Building	• At least 3 years practicing EE strategies • 33% school year spent on EE • 20% of teachers/classrooms involved in EE or more • Significant identifiable population of students 20% of more involved in EE	• At least 2 years practicing EE • One unit in school year reflects EE • 10-20% of teachers involved • 20-33% of students involved	• At least 1 years practicing EE • One week in school year focuses on outdoor EE • 1-10% of teachers involved • 10-20% of students involved	• Less than one year using EE strategies • EE found in parts of units. • 1-5% of teachers involved • 5-10% of student s involved	• No attempt to use EE strategies • No apparent attempt to include EE • No apparent EE classrooms • Less than 5% students involved in EE
Curriculum	Curriculum design includes a way to contribute to the community including their environment through their learning. Intentional integrated curriculum design Curriculum design takes advantage of natural areas in school and/or community	Curriculum design includes a study of the natural environment and the link to students lives. Unit design includes other disciplines. Takes advantage of natural areas in school or community	One week or less of experience in a natural setting. Unit design focuses on the science the natural area offers for learning. Planned focus on specific natural area by school or group of teachers.	Curriculum design taking advantage of non-formal sources for curriculum ideas and learning opportunities that address the natural environment. Teachers provide activities using the natural area. Natural areas addressed through individual teachers interest	Curriculum design does not include a study of the natural environment and the link to students lives. No attempt to use natural areas. Natural areas not addressed through curriculum.
Instruction	Teacher teams apparent Classrooms intentionally used as a workshop with teachers as coaches and students responsible for their learning. Clear support from parents, administrators and community	Teacher teams forming Classrooms actively incorporating best practices instruction Growing support from parents, administrators and community	Some teachers collaborate when possible Teachers actively seeking/receiving professional development in best practices instruction Emerging support from parents administrators and community	Teachers largely work on their own ideas. Teachers trying/testing instructional innovations Parent, administrators and community seeking how to support instruction.	No apparent teaming of collaboration of teachers. Teachers focus on direct instruction Parents, administrators and community not seeking to support this type of instructional approach.
Student Learning	Intentional student understanding of EALR's they are learning. Stated policy and implementation	Best practices for student learning apparent in classrooms	One week experience has elements of best practices in learning.	Students get hands-on experience through EE activities	Traditional student learning approach in place

	supporting student learning through best practices				
Assessment	Best practices in assessment in place in policy and practice.	Best practices for assessment apparent in classrooms	One week experience assesses performance.	Students assessed on learning that results from classroom work that includes EE activities	Traditional student assessment approach in place.
Community	Community partners with school as coach, supporter, and provide learning experiences	School has at least two community partners to support EE unit work.	School partners with a community member to provide a one week experience	School aware of teachers working with community supporters for classroom EE work	School may works with community partners on support other than EE.

Appendix B

List of experts (individuals and organizations) participated in school rating

Organization association	**Individual consulted**
Chehalis River Basin Project, ESD 113	Kathy Jacobsen
Tacoma School District	Marlene Rossi
King Co. Parks	Chuck Lennox
Snohomish County	Roger Kelly, Suzie Wong Swint
Belfair	Karen Lippy
Yakima Area School Districts with BOR	Julie Larsen
Vancouver Water Center	Cory Samia
WSU Pullman	Kim Frier
U.S. Forest Service, WA	Susan Thomas
West Valley School District Outdoor Learning Center	Tom Moore
Kennewick Area	Ron Okarma
Wakiakum CISPUS Area	Marty Fortin
Bellingham Area Schools	Wendy Sherrer
Nisqually Basin Area Schools	Chris Maun
Bud Deschutes Area Schools	Debra Wood
Thurston County Schools	Suzie Vanderberg
Seattle Area Schools	Pat Otto
Olympic Peninsula Area Schools	Woody Franzen
Washington Forest Protection Association Schools	Susan Duncan
Model Links Schools 1992-1999	Margaret Tudor

Appendix C

Pairs of schools (EE and comparison) selected for the analysis

Pair_ID	Project School	Location	Comparison School	Location
1	A G West Black Hills High	WW	Anacortes High	WW
2	Alternative Elementary #1	WW	Greenwood	WW
3	Apollo Elementary	WW	Glenridge	WW
4	Artondale Elementary	WW	Canyon Creek Elementary	WW
5	Belfair Elementary	WW	Chimacum Elementary	WW
6	Black Lake Elementary	WW	Purdy Elementary	WW
7	Cedar River Middle	WW	Centennial Middle	WW
8	Challenger	WW	Mcauliffe Elementary	WW
9	Carson Elementary	CW	Stevenson Elementary	CW
10	Cleveland High	WW	Rainier Beach High	WW
11	Concord Elementary	WW	Highland Park Elementary	WW
12	Crestwood Elementary	WW	Jenkins Creek Elementary	WW
13	Daniel Bagley Elementary	WW	Alki (Elem)	WW
14	Discovery Elementary	WW	Totem Falls (Elem)	WW
15	Dry Creek Elementary	WW	Hood Canal Elementary&High	WW
16	Endeavour Elementary	WW	Mill Creek Elementary	WW
17	Environmental & Adventure Middle	WW	Northstar (07-0)	WW
18	Fairview Elementary	WW	Riverside Elementary	WW
20	Grapeview Elementary	WW	Lyman	WW
21	Jemtegaard Middle	WW	Rochester Middle	WW
22	McLane Elementary	WW	Evergreen Heights Elementary	WW
23	Lake Wilderness Elementary	WW	Chinook Elementary	WW
24	Issaquah Valley Elementary	WW	Brier Elementary	WW
25	Millennium Elementary	WW	Martin Sortun Elementary	WW
27	Tumwater Hill Elementary	WW	Brownsville Elementary	WW
28	Kennewick High	CW	Moses Lake High	CW
29	Key Peninsula Middle	WW	Eatonville Middle	WW
30	Madison Middle	WW	Baker	WW
31	Michael T Simmons Elementary	WW	Bonney Lake Elementary	WW
32	Monroe Elementary	WW	Stewart Elemenatry	WW
33	Moran Prairie Elementary	EW	Woodridge Elementary	EW
34	Peter G Schmidt Elementary	WW	Hearthwood Elementary	WW
35	Port Ageles High	WW	Shelton High	WW

36	Dearbon Park	WW	Van Asselt	WW
37	Gateway Middle	WW	Washington Middle	WW
38	Goldendale High	CW	Stevenson High	CW
39	Harbor Ridge Middle	WW	Goodman Middle	WW
40	Harbor Heights Elementary	WW	Pinewood Elementary	WW
41	Heatherwood Middle	WW	Harbour Poimte Middle	WW
43	Komachin Middle	WW	Cedarcrest Jr High	WW
44	Larrabee Elementary	WW	Columbia Elementary	WW
45	Laurelhurst Elementary	WW	View Ridge	WW
46	Lawton Elementary	WW	Lafayette	WW
48	Lincoln Middle	EW	Mountain View Middle	EW
49	Littlerock Elementary	WW	Gold Bar Elementary	WW
50	Madrona Elementary	WW	Allen Creek Elementary	WW
51	Maltby Elementary	WW	Cottage Lake Elementary	WW
52	Maple Hills Elementary	WW	Clark Elementary	WW
53	Meadowdale High	WW	Edmonds Woodway High	WW
54	Monroe Middle	WW	Post Middle	WW
55	North Tapps Middle	WW	McMurray (Middle)	WW
56	Orchard Middle	CW	Mount Baker Middle	CW
57	Point Defiance Elementary	WW	Sherman Elementary	WW
58	Ridgeview Elementary	CW	McKinley Elementary	CW
59	Roosevelt Middle	WW	White River Middle	WW
61	Schmitz Park	WW	Green Lake	WW
62	Scriber Lake High	WW	Forks High	WW
63	Shelton Middle	WW	Cascade Middle	WW
64	South Colby Elementary	WW	Geneva Elementary	WW
65	Stevens Middle	WW	Blaine Middle	WW
66	Tonasket Elementary	EW	Oroville Elementary	EW
67	Voyager Elementary	WW	Dutch Hill Elementary	WW
68	Wahkiakum High	WW	Best Sr High/ Best Night High	WW
69	Whitman Elementary	WW	Arlington Elementary	WW
70	Hockinson Middle	WW	Chief Kanim Middle	WW
71	Parkview Elementary	WW	Nooksack Elementary	WW
72	Kendel Elementary	WW	Orchards Elementary	WW
73	Washington Middle	WW	Eckstein Middle	WW
74	Woodward Middle	WW	Kopachuck Middle	WW
76	Tumwater High	WW	Sequim Senior High	WW

77	Grass Lake	WW	Frank Love Elementary	WW
78	East Olympia Elementary	WW	Emerald Hills Elementary	WW
80	Seth Woodard Elementary	EW	Pasadena Elementary	EW
81	Ness Elementary	EW	Orchard Center Elementary	EW

Appendix D

Demographic comparison (means) of EE and comparison schools

#	Schools	Status	Size	Free Lunch (%)	Ethnicity (%)				
					White	Black	Indians	Asian	Hispanic
1	A G West Black Hills High	Project	968.7	12.1%	90.4%	1.9%	1.5%	3.3%	2.9%
1	Anacortes High	Comparison	849.0	14.9%	91.5%	1.2%	1.3%	2.8%	3.2%
2	Alternative Elementary #1 (k-8)	Project	249.0	28.0%	59.3%	12.5%	8.7%	6.0%	13.5%
2	Greenwood	Comparison	280.3	32.8%	55.8%	12.3%	4.2%	15.7%	12.0%
3	Apollo	project	605.7	8.3%	81.0%	2.2%	0.6%	11.2%	5.1%
3	Glenridge	Comparison	553.7	17.3%	73.2%	4.1%	0.5%	15.5%	4.4%
4	Artondale Elementary	Project	502.7	9.4%	362.1%	6.8%	7.5%	3.4%	3.1%
4	Canyon CreekElementary	Comparison	459.0	11.8%	86.1%	1.8%	1.9%	5.9%	4.3%
5	Belfair Elementary	Project	566.7	30.4%	92.3%	3.9%	2.0%	3.0%	1.8%
5	Chimacum Elementary	Comparison	520.3	33.1%	91.4%	1.6%	2.3%	2.6%	2.1%
6	Black Lake Elementary	Project	535.7	16.9%	93.1%	1.1%	1.4%	2.7%	1.7%
6	Purdy Elementary	Comparison	501.7	15.9%	90.0%	1.6%	1.4%	4.2%	2.9%
7	Cedar River Middle	Project	722.7	12.1%	93.0%	1.2%	1.0%	2.5%	2.4%
7	Enumclaw Middle	Comparison	804.0	13.4%	94.3%	0.5%	1.3%	1.2%	2.6%
8	Challenger Elementary	Project	706.0	1.7%	80.4%	0.8%	0.3%	16.1%	2.5%
8	Mcauliffe Elementary	Comparison	658.0	1.2%	86.4%	1.6%	0.6%	9.9%	1.5%
9	Carson Elementary	Project	268.3	44.6%	88.4%	0.4%	4.5%	0.5%	6.3%
9	Stevenson Elementary	Comparison	237.3	36.1%	88.2%	1.0%	3.6%	3.5%	3.6%
10	Cleveland High	Project	739.0	53.0%	11.5%	32.2%	1.8%	45.5%	9.0%
10	Rainier Beach High	Comparison	749.3	54.9%	8.9%	50.4%	30.9%	32.9%	8.9%
11	Concord Elementary	Project	309.7	80.1%	19.7%	12.7%	4.3%	22.6%	40.7%
11	Highland Park Elementary	Comparison	444.3	65.6%	23.8%	16.4%	4.0%	30.5%	24.9%
12	Crestwood Elementary	Project	600.3	13.7%	83.9%	5.6%	1.2%	4.1%	5.2%
12	Jenkins Creek Elementary	Comparison	547.3	20.3%	86.5%	4.5%	1.5%	4.2%	3.2%
13	Daniel Bagley Elementary	Project	197.7	51.5%	50.3%	16.1%	4.4%	14.9%	14.3%
13	Alki (Elem)	Comparison	339.0	41.9%	46.8%	12.3%	4.6%	27.9%	8.3%
14	Discovery Elementary	Project	718.7	1.5%	90.9%	0.7%	0.8%	6.6%	1.1%
14	Totem Falls (Elem)	Comparison	641.7	2.2%	90.0%	0.5%	1.1%	6.4%	1.8%
15	Dry Creek Elementary	Project	382.7	54.7%	73.4%	2.5%	22.0%	1.1%	1.0%
15	Hood Canal Elementary&High	Comparison	398.3	66.3%	66.5%	0.5%	31.3%	0.4%	1.3%
16	Endeavour Elementary	Project	713.7	5.2%	82.7%	1.5%	0.4%	13.6%	1.7%
16	Mill Creek Elementary	Comparison	674.3	5.4%	80.4%	2.9%	0.5%	13.5%	2.7%
17	Environmental & Adventure Mdl	Project	104.5	1.7%	92.1%	0.6%	1.3%	5.3%	0.9%
17	Northstar (07-0)	Comparison	90.0	2.9%	88.9%	2.6%	0.0%	5.9%	2.6%
18	Fairview Elementary	Project	253.0	25.5%	92.2%	1.6%	4.5%	0.7%	1.1%
18	Riverside Elementary	Comparison	235.0	22.6%	89.5%	1.0%	5.0%	2.5%	2.0%
19	Frank Wagner Middle	project	286.3	26.7%	79.7%	0.9%	1.9%	2.5%	14.8%
19	Lyle Middle&High	Comparison	217.7	35.2%	86.9%	0.9%	6.8%	3.2%	4.1%

20	Grapeview Elementary	Project	185.0	35.8%	90.1%	0.3%	6.8%	2.2%	0.6%
20	Lyman Elementary	Comparison	171.3	35.2%	92.4%	2.0%	2.1%	0.0%	3.3%
21	Jemtegaard Middle	Project	558.0	29.6%	95.7%	0.2%	1.0%	1.7%	1.4%
21	Rochester Middle	Comparison	413.0	47.5%	83.0%	0.8%	5.8%	2.2%	8.0%
22	McLane Elementary	project	301.3	20.1%	84.1%	4.5%	3.3%	4.3%	5.9%
22	Evergreen Heights Elementary	Comparison	280.0	26.4%	79.7%	2.9%	3.7%	5.9%	7.5%
23	Lake Wilderness Elementary	Project	1100.0	10.9%	90.2%	2.8%	1.4%	2.8%	2.8%
23	Chinook Elementary	Comparison	755.0	7.5%	93.3%	1.2%	0.6%	3.2%	1.8%
24	Issaquah Valley Elementary	Project	506.3	10.7%	86.2%	2.7%	0.6%	4.9%	5.7%
24	Brier Elementary	Comparison	500.3	8.7%	86.8%	2.3%	1.2%	4.7%	5.0%
25	Millennium Elementary	Project	527.0	36.3%	65.8%	11.4%	0.6%	15.4%	6.8%
25	Martin Sortun Elementary	Comparison	566.3	31.9%	70.3%	11.4%	1.1%	11.8%	5.4%
27	Tumwater Hill Elementary	Project	452.7	22.1%	84.5%	3.3%	1.9%	7.2%	3.1%
27	Brownsvill Elementary	Comparison	474.3	21.4%	81.0%	5.9%	0.4%	10.4%	2.3%
28	Kennewick High	Project	1530.7	26.5%	77.4%	1.5%	0.2%	1.8%	19.2%
28	Moses Lake High	Comparison	1678.0	27.7%	73.9%	2.1%	0.7%	2.0%	21.3%
29	Key Peninsula Middle	Project	503.3	32.6%	89.4%	1.3%	5.0%	2.1%	2.2%
29	Eatonville Middle	Comparison	475.7	30.8%	93.0%	0.3%	2.4%	1.7%	2.6%
30	Madison Middle	Project	897.0	41.8%	44.3%	11.3%	3.0%	30.9%	11.3%
30	Baker	Comparison	875.0	51.2%	32.4%	16.3%	2.5%	22.1%	6.9%
31	Michael T Simmons Elementary	Project	470.3	29.1%	87.8%	2.0%	3.8%	3.1%	3.4%
31	Breidablik Elementary	Comparison	515.3	22.5%	91.0%	1.0%	1.3%	2.7%	4.1%
32	Monroe Elementary	Project	297.0	39.5%	89.4%	1.1%	4.7%	1.5%	3.2%
32	Stewart Elemenatry	Comparison	290.3	48.6%	81.6%	2.8%	4.4%	3.2%	8.0%
33	Moran Prairie Elementary	Project	526.7	4.2%	92.8%	1.9%	0.6%	4.0%	0.8%
33	Woodridge Elementary	Comparison	457.3	5.2%	94.7%	1.5%	0.6%	1.6%	1.6%
34	Peter G Schmidt Elementary	Project	552.7	40.3%	85.3%	2.9%	3.4%	3.1%	5.3%
34	Hearthwood Elementary	Comparison	575.3	39.9%	86.8%	3.0%	1.5%	2.9%	5.9%
35	Port Ageles High	Project	1568.0	17.0%	89.8%	0.7%	5.3%	2.6%	1.5%
35	Shelton High	Comparison	1534.7	22.1%	83.6%	0.4%	10.2%	2.1%	3.7%
36	Dearbon Park	Project	337.7	73.4%	4.2%	27.9%	1.8%	59.0%	7.2%
36	Van Asselt	Comparison	407.7	76.2%	6.1%	28.7%	0.7%	54.9%	9.7%
37	Gateway Middle	Project	740.7	10.3%	82.1%	2.6%	1.0%	10.7%	3.6%
37	Washington Middle	Comparison	695.3	7.7%	84.3%	0.7%	0.9%	10.7%	3.2%
38	Goldendale High	Project	424.0	27.4%	86.9%	0.9%	4.6%	2.6%	5.0%
38	Stevenson High	Comparison	405.3	23.3%	89.5%	0.9%	3.5%	3.3%	2.8%
39	Harbor Ridge Middle	Project	569.0	11.6%	93.5%	1.6%	0.4%	2.6%	2.0%
39	Goodman Middle	Comparison	582.3	8.7%	90.7%	1.9%	1.7%	2.8%	2.9%
40	Harbor Heights Elementary	Project	569.3	16.2%	87.8%	3.3%	1.3%	4.3%	3.3%
40	Pinewod Elementary	Comparison	592.7	23.7%	86.2%	1.2%	1.6%	5.6%	5.3%
41	Heatherwood Middle	Project	924.7	7.2%	79.0%	2.1%	1.0%	14.2%	3.6%
41	Harbour Poimte Middle	Comparison	816.0	8.6%	81.7%	2.1%	1.0%	13.0%	2.2%
42	Jefferson Elementary	Project	285.3	40.4%	87.0%	2.6%	6.9%	0.8%	2.7%
42	Progress Elementary	Comparison	339.0	44.4%	94.5%	1.9%	1.9%	0.3%	1.4%
43	Komachin Middle	Project	741.3	24.5%	72.6%	8.7%	12.2%	10.8%	5.8%

43	Cedarcrest Jr High	Comparison	828.7	27.9%	70.1%	12.1%	2.1%	10.3%	5.3%
44	Larrabee Elementary	Project	200.3	33.7%	86.6%	0.7%	1.3%	5.1%	6.3%
44	Columbia Elementary	Comparison	223.0	30.1%	90.6%	0.9%	0.9%	3.5%	4.2%
45	Laurelhurst Elementary	Project	414.3	21.2%	66.6%	6.2%	0.7%	18.4%	8.1%
45	View Ridge	Comparison	392.3	24.8%	69.2%	8.5%	1.5%	14.5%	6.4%
46	Lawton Elementary	Project	395.7	17.3%	62.5%	4.3%	1.6%	21.0%	10.6%
46	Lafayette	Comparison	442.0	22.6%	60.0%	11.7%	2.2%	12.8%	7.3%
48	Lincoln Middle	Project	466.0	38.3%	93.3%	1.3%	2.7%	0.9%	1.9%
48	Mountain View Middle	Comparison	507.7	33.0%	94.1%	0.8%	2.8%	1.5%	0.9%
49	Littlerock Elementary	Project	453.7	30.2%	91.4%	1.0%	2.3%	2.6%	2.6%
49	Green Mountain Elementary	Comparison	431.3	31.3%	88.3%	2.3%	3.0%	3.2%	3.3%
50	Madrona Elementary	Project	641.7	8.3%	86.8%	2.6%	0.9%	7.9%	1.8%
50	Allen Creek Elementary	Comparison	638.0	9.8%	85.9%	2.3%	1.3%	7.6%	3.0%
51	Maltby Elementary	Project	523.3	7.8%	90.9%	1.1%	1.6%	3.8%	2.5%
51	Cottage Lake Elementary	Comparison	434.3	5.7%	89.1%	1.0%	2.2%	4.0%	3.6%
52	Maple Hills Elementary	Project	484.3	6.0%	94.3%	0.1%	0.3%	2.8%	2.3%
52	Clark Elementary	Comparison	412.7	7.4%	91.2%	0.6%	0.8%	3.5%	3.8%
53	Meadowdale High	Project	1414.3	9.3%	81.4%	2.9%	1.4%	7.6%	3.2%
53	Edmonds Woodway High	Comparison	1765.7	9.6%	85.2%	2.6%	1.5%	9.7%	3.0%
54	Monroe Middle	Project	755.3	14.3%	91.3%	0.8%	1.1%	2.6%	4.3%
54	Post Middle	Comparison	834.0	12.9%	92.4%	0.7%	1.7%	2.2%	3.0%
55	North Tapps Middle	Project	372.3	3.6%	94.9%	0.5%	0.6%	2.5%	1.5%
55	McMurray (Middle)	Comparison	392.0	9.3%	90.8%	2.0%	1.3%	3.1%	2.9%
56	Orchard Middle	Project	469.3	52.4%	60.2%	0.1%	2.5%	1.2%	36.0%
56	Mount Baker Middle	Comparison	422.3	43.4%	64.1%	1.0%	1.4%	2.7%	30.8%
57	Point Defiance Elementary	Project	456.3	35.1%	81.0%	8.7%	0.5%	5.3%	4.4%
57	Sherman Elementary	Comparison	324.3	41.4%	85.4%	6.9%	0.6%	4.9%	2.3%
58	Ridgeview Elementary	Project	554.3	26.8%	46.1%	1.9%	2.2%	1.0%	48.8%
58	McKinley Elementary	Comparison	416.3	23.8%	48.3%	3.4%	3.7%	0.7%	43.9%
59	Roosevelt Middle	Project	554.0	23.5%	90.3%	0.9%	4.7%	2.2%	1.8%
59	White River Middle	Comparison	616.0	21.4%	93.0%	0.8%	2.9%	1.6%	1.7%
61	Schmitz Park	Project	333.0	23.8%	66.2%	10.8%	3.0%	12.1%	7.9%
61	Green Lake	Comparison	317.3	32.4%	61.3%	15.4%	2.2%	13.8%	7.3%
62	Scriber Lake High	Project	296.7	20.6%	81.4%	5.7%	3.6%	4.1%	5.3%
62	Forks High	Comparison	400.0	21.3%	84.4%	0.2%	7.0%	2.0%	6.4%
63	Shelton Middle	Project	819.0	35.1%	81.2%	0.4%	8.4%	3.7%	6.3%
63	Evergreen Middle	Comparison	917.3	33.1%	82.7%	4.5%	2.4%	5.7%	4.6%
64	South Colby Elementary	Project	485.0	14.2%	92.4%	1.0%	1.9%	3.6%	1.1%
64	Geneva Elementary	Comparison	501.3	17.5%	91.7%	1.2%	2.0%	2.4%	2.8%
65	Stevens Middle	Project	605.3	35.9%	86.8%	1.3%	9.3%	1.1%	1.5%
65	Blaine Middle	Comparison	452.7	36.3%	85.9%	2.3%	3.3%	4.2%	4.3%
66	Tonasket Elementary	Project	526.7	72.3%	72.8%	0.6%	1.3%	1.1%	24.3%
66	Oroville Elementary	Comparison	478.3	68.3%	70.6%	0.6%	4.5%	0.7%	23.6%
67	Voyager Elementary	Project	537.0	8.5%	90.5%	1.0%	2.8%	3.0%	2.6%
67	Dutch Hill Elementary	Comparison	571.0	11.0%	95.6%	1.2%	0.3%	1.1%	1.7%

68	Wahkiakum High	Project	193.7	5.9%	92.7%	0.5%	4.3%	0.7%	1.8%
68	Best Sr High/ Best Night High	Comparison	210.7	3.8%	84.8%	1.9%	1.4%	8.7%	3.1%
69	Whitman Elementary	Project	405.3	72.7%	57.4%	23.0%	1.0%	12.9%	5.7%
69	Arlington Elementary	Comparison	350.7	75.2%	59.5%	17.2%	2.1%	11.6%	9.7%
70	Hockinson Middle	Project	479.0	10.0%	95.8%	0.3%	0.1%	1.2%	2.5%
70	Chief Kanim Middle	Comparison	540.3	12.4%	94.4%	0.6%	1.0%	1.3%	2.6%
71	Parkview Elementary	Project	313.7	35.8%	83.2%	1.4%	2.2%	2.0%	11.3%
71	Nooksack Elementary	Comparison	338.3	37.6%	80.6%	0.5%	3.7%	1.2%	61.7%
72	Kendel Elementary	Project	559.0	64.4%	87.6%	0.1%	3.8%	1.2%	7.5%
72	Orchards Elementary	Comparison	610.0	51.6%	82.6%	5.5%	1.1%	4.6%	6.1%
73	Washington Middle	Project	1022.3	33.8%	44.9%	29.6%	1.6%	18.1%	5.9%
73	Eckstein Middle	Comparison	1208.0	20.4%	56.7%	9.3%	2.5%	23.3%	8.2%
74	Woodward Middle	Project	662.7	5.0%	90.1%	1.4%	1.4%	5.4%	1.7%
74	Kopachuck Middle	Comparison	618.3	5.2%	93.9%	1.4%	0.6%	1.8%	2.2%
75	Chase Middle	Project	908.3	30.1%	87.6%	4.3%	2.2%	3.5%	2.7%
75	Lake Stevens Middle	Comparison	794.3	24.6%	89.7%	1.3%	1.1%	3.1%	4.5%
76	Tumwater High	Project	932.7	16.9%	90.4%	1.3%	2.1%	2.2%	4.0%
76	Sequim Senior High	Comparison	902.3	20.1%	89.0%	0.3%	4.6%	2.7%	3.2%
77	Grass Lake Elementary	Project	412.7	13.2%	92.5%	0.9%	0.3%	3.9%	2.4%
77	Frank Love Elementary	Comparison	461.3	13.7%	86.2%	1.8%	1.7%	5.9%	4.4%
78	East Olympia Elementary	Project	542.7	21.5%	92.1%	0.7%	2.2%	2.9%	2.1%
78	Emerald Hills Elementary	Comparison	619.0	21.0%	93.0%	1.1%	0.9%	1.3%	3.7%
79	Columbia Crest Elementary	Project	174.0	43.7%	94.7%	1.2%	0.8%	1.9%	1.4%
79	Lyman Elementary	Comparison	171.3	33.2%	92.4%	2.0%	2.1%	0.0%	3.5%
80	Seth Woodard Elementary	Project	285.7	41.4%	92.1%	1.7%	2.3%	1.6%	1.9%
80	Pasadena Elementary	Comparison	263.7	28.5%	93.1%	2.0%	1.2%	2.3%	1.3%
81	Ness Elementary	Project	281.3	61.0%	89.7%	1.7%	3.0%	1.3%	4.4%
81	Orchard Center Elementary	Comparison	259.0	59.1%	88.9%	1.6%	4.1%	1.2%	4.3%

Appendix E

Questionnaire

I. Personal Information*

(* - required questions)

Name _____

Address _____

Organization and Position _____

Phone _____ E-mail _____

Do you wish to receive a set of posters? Yes _____ No _____

II. School Building K-12 Environmental Education Rubric *

(* - required questions)

1-5*. Rate your school building.

1. EE implementation

1a. Number of years the school has participated in EE (*Choose one of the following)*

____ 3 or more years practicing EE strategies
____ 2 years practicing EE strategies
____ 1 year practicing EE strategies
____ Less than one year using EE strategies
____ No attempt to use EE strategies

1b. Amount of school year spent on EE (*Choose one of the following)*

____33% school year spent on EE
____ One instructional unit in school year reflects EE.
____ One week in school year focuses on outdoor EE
____ EE is used in parts of units throughout the year.
____ No attempt to include EE

1c. Percent of teachers/classrooms involved in EE (*Choose one of the following)*

____ 20% (or more)
____ 10-20%
____ 5-10%
____ 0%

1d. Percent of students in the building involved in EE. (*Choose one of the following)*

____ 33% or more
____ 20-33%
____ 10-20%
____ 5-10%
____ Less than 5%

1e. How often are natural areas/outdoors used by your school in the learning process. (*Choose any that apply)*

____ School uses natural areas /outdoors for learning on a regular basis throughout the year
____ School uses natural areas /outdoors for learning seasonally (at least 3-4 times a year)
____ Students do outdoor nature studies for a concentrated few days (1-5 days)
____ A few learning activities involve taking the classroom to natural areas
____ No attempt to use natural areas

2. Curriculum links to outdoors and community (*Choose any that apply)*

____ Teachers adapt curriculum based on students' interests and involve contributions from the outdoors/community, which includes the natural environment/community at each grade level.
____ Teams of teachers design the curriculum to link students to outdoors/community
___ Individual teachers design the curriculum which focuses on specific natural areas or the community for limited time
____ Teachers provide stand-alone activities using natural areas
____ No attempt to use natural areas/community

3. Teaching Practices related to EE (*Choose any that apply)*

____Teachers work together consistently and frequently to design and facilitate EE workshops and projects
____Teachers occasionally work together to design and facilitate EE workshops and projects.
____ Teachers work together just for one integrated EE unit or field trip each year.
____ Teachers work individually or collaboratively to provide activities using natural areas on the school site or in the nearby community.
____ Teachers primarily use didactic instruction
____ Teachers do not teach EE content at all.

4. Instructional Strategies: Describe the style of student learning that is most widely used by teachers in the classrooms at your school. (*Choose one of the following)*

____ Students work in groups on class projects that look at different ways to solve problems
____ Students have an opportunity to make oral presentations on what they have learned.
____ Students generally work by themselves on projects
____ Students focused on learning facts from EE-based activities
____ Students learn using textbooks provided.

5. Assessment. Describe the type of assessment which teachers use in their classrooms most frequently. (*Choose any that apply)*

____ Students assessed through performances, projects, discussions and presentations
____ Students assess their own work, and self-reflect on their learning.
____ Students assessed on what they learn in integrated Environmental Education activities
____ Students assessed through subject area tests only
____ Students tested on material covered in classroom lecture/discussion and assigned reading and homework

___ PhD in Education or Education Leadership
___ Doctorate in Education
___ Other (specify)

14. What is the percentage of teaching and administrative staff of the school in each category (if available).
Master's _____ PhD _____ teaching certificates _____ other _____

15*. How many years of teaching experience do you have? _____

16*. Which assessment reform training or professional development courses have you participated in

Environmental Education Development programs:
___N/A
___Project WILD
___Project WET
___Project Learning Tree (PLT)
___NatureMapping
___ Other
(Please list) _____

Educational Reform& Professional programs:
___ N/A
___ Assessment
___ Integrated Curriculum Development
___ Instructional Strategies
___ Thinking skills
___ Learning styles
___ Other
(Please list) _____

17. What percentage of teachers in your school has attended such courses?

Environmental Education related courses_____ %
Education Reform & Professional Development Programs _____%

18. Are you a member or do you play a lead role on a curriculum development committee? Yes ____ No_____

19. Is there an environmental learning center, a community resource such as a museum, or other formal community partners etc. that participates in the learning process? Yes ___ No___

If yes, which one(s)? _____
_____

V. Your attitudes
(* - required questions)

20*. How has integrated curriculum, including EE, improved your students' learning? (Please describe what factors of your teaching/learning environment you think are making the difference)
in your classroom program _____
_____
_____

at your school building _____

_____

_____

21. What are the long-term benefits of your program for students, community and/or the environment? _____

_____

22*. Describe what support educators involved in this effort receive from
a. administration (school building or district, etc.)_____

_____

b. parents_____

_____

c. community_____

_____

23*. Based on your experience, rate the value of environmental education for the following:

		No Value	Little Value	Valuable	Extremely Valuable
a.	Improve student achievements on standardized tests, like the WASL	☐	☐	☐	☐
b.	Increase student motivation to learn	☐	☐	☐	☐
c.	Increase teacher enthusiasm	☐	☐	☐	☐
d.	Strengthen student involvement in solving community issues	☐	☐	☐	☐
e.	Strengthen student cooperation and communication skills	☐	☐	☐	☐
f.	Improve student critical thinking and problem solving skills	☐	☐	☐	☐
g.	Reduce behavioral problems	☐	☐	☐	☐
h.	Increase community involvement	☐	☐	☐	☐
i.	Increase opportunities for family involvement	☐	☐	☐	☐
j.	Encourage an appreciation/stewardship for natural world	☐	☐	☐	☐
k.	Improve awareness of environmental issues	☐	☐	☐	☐
l.	Improve skills to participate in environmental concerns or possibilities	☐	☐	☐	☐
m.	Develop a sense of citizenship	☐	☐		☐
n.	Increase student attendance, lowers rates of truancy	☐	☐	☐	☐

24. What are your top three needs for improving or strengthening environmental education in your program, class, or school? _____

_____

_____

25. What are the three top barriers to improving or strengthening environmental education in your program or class or school? _____

_____

_____

VI. WASL/ITBS Questions*

(* - required questions)

26*. How much class time (%) do you spend on direct preparation for the WASL tests?
___0% __5% __10% __25% __50% __75% _100%

27*. To what do you attribute the changes in the scores on the standardized tests on your school? (select all that apply)

___ teacher professional development
___ changes in categories of students who take the tests (ESL students, etc)
___ changes in test taking procedures
___ changes in instructional practices
___ changes in school policy
___ changes in state policies and regulations
___ other

28*. Please elaborate on the changes (be specific)

_____
_____
_____
_____
_____
_____
_____
_____
_____

VII. Funding and Costs

29. What are the total estimated annual costs associated with running programs in your school (costs of curriculum and material development, teacher and volunteer training, program support, etc. not including teachers salaries, utilities, insurance, school maintenance)? _____

30. In order to determine how the funding is distributed, please indicate the percentage of your school's annual budget (named above) spent on each of the following:

a. Costs of developing curricula _____
b. Cost of developing instructional materials _____
b. Cost of using instructional materials _____
c. Costs of teacher or volunteer training if any _____
d. Costs of maintaining and operating education sites if any _____
e. Costs of supplies and equipment, if any _____
f. Costs of transportation of learners to the field or community-based learning sites _____
g. Other _____

31. If you answered "other" in question 30, please let us know what other costs are associated with running your school programs. _____
_____

32. What percentage of your funding sources for your school programs come from the following
Business donations ___
Foundation grants ___
Individual donations ___
Membership funds ___
Participant fees ___
School, School District, ESD support ___
Federal Agency funds ___
State Agency funds ___
State Grants ___
Other ___

33. If you answered "other" in question 32, please indicate what other sources of funding your **school** has and their percentages _____
_____

34. What percentage of your in-kind donations/support your **school programs** receive annually come from the following:
Volunteer Hours ___
Teacher volunteer hours____
Material Donations ___
Supply Donations ___
Technical Support Donations ___
Other
(specify)_____

35. What percentage of school funding (if any) goes to EE programs? _____

36. What percentage of school funding (if any) goes to your classroom program? _____

37. What are the sources of funding for your classroom program? _____
_____
_____
_____

38. How many volunteers are involved with your **classroom program**?_____

39. How many cumulative hours/year do those volunteers provide for your **classroom program**?
_____

40*. May we use the quotes and information anonymously from your response in the report that we will be preparing? Yes ____ No____

Thank you