Effectiveness of Project WILD Classroom Instruction at the Middle School Level in South Dakota

BY

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This thesis is approved as a creditable and independent investigation by a candidate for the Master of Biology degree and is acceptable for meeting the thesis requirements for this degree. Acceptance of this thesis does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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Abstract

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Project WILD, an environmental education curriculum, celebrates widespread use in the United States and several countries around the world. This study measures the effectiveness of Project WILD versus non-WILD methods of instruction in addressing environmental education objectives with South Dakota middle school students. South Dakota middle school teachers were randomly assigned to blind, non-WILD, or WILD treatment groups. Workshop-trained non-WILD and WILD treatment groups taught an ecosystem unit using either a non-WILD or WILD instructional approach. Pre-testing, post-testing, and retention student testing used an identical prompt requiring student written response. A scoring rubric was used to rate the responses of students. Results showed overall low scores and no significant differences. Student written responses reflected difficulty with written communication and reading skills. In future studies, use of such an alternative assessment approach might stand alongside a standardized approach, providing additional verification of findings.

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Executive Summary

In 1998, the South Dakota Department of Game, Fish, and Parks provided funding for a two-year study of the short and long-term effectiveness of Project WILD, a widely used environmental education curriculum, at the middle school level in their state. A South Dakota State University Department of Biology and Microbiology faculty member was chosen to guide these research efforts. Visions of a qualitative study informed by alternative elements of assessment began to take shape.

The Project WILD curriculum primarily consists of two guides, the basic guide and the aquatic guide. Each guide is divided into seven themes ranging from awareness to action components. Each of these themes is then comprised of a number of activities designed to promote specific knowledge and skills. A teacher-friendly approach to the study was desired. To this end, a unit designed around ecosystem function was designed. This unit on ecosystems included seven activities representing the seven themes and was selected from both the basic and the aquatic guides. The unit was complementary to enough of the grades six through eight science curriculum benchmarks and objectives that teachers and administrators found it a suitable addition to their students' studies.

The research assessment scoring rubric was designed during the first teacher training session and was built around the objectives as they were stated within each of the seven activities from the Project WILD guides. A dilemma statement was written that prompted students to respond, in writing, to a situation involving a conflict between the

development of a new golf course and a number of other interests. Students were to use their knowledge and skills gained from the unit on ecosystem function in order to address the questions presented in the dilemma.

With some of the initial design work in place, in the late winter of 1998, all middle school science teachers, listed by the State of South Dakota Department of Education, were notified, by mail, of the opportunity to participate in a research study on the effectiveness of Project WILD. Randomized phone contacts were also made and a list of teacher participants grew.

The study was made up of three groups: a "blind" control group, a group utilizing the Project WILD curriculum, and a group using a non-WILD approach to instruction. Some teachers were interested in participating as members of the blind treatment group as the commitment was minor compared to the necessary commitment of the other groups. The teachers in the control group needed to administer the assessment at three specified times during the school year. Their instruction during the school year was not altered in any way.

Teachers in the WILD and non-WILD treatment groups attended summer training sessions at the South Dakota State University's Oak Lake Field Station. They were presented with the ecosystem unit and its objectives. They were randomly placed into their treatment groups and after an introduction to the common objectives, broke into separate groups in order to brainstorm ways of presenting the unit material through either the Project WILD approach or through a non-WILD, more traditional, approach.

The teachers present during the first summer's training session participated in the design of the assessment rubric. A scoring system ranging from a zero, for no response, to a score of three, for a sophisticated response, was used. Groups of teachers, along with the researchers, put together some preliminary guidelines for determining the quality of performance at each level on each of the learning objectives from the seven activities. These were later edited.

Throughout the following school year, mailings were sent to all participating teachers reminding them of the guidelines for their participation and the deadlines regarding pre-testing prior to the delivery of the unit on ecosystems, post-testing immediately following the presentation of the unit, and the end-of-the-year retention testing.

Teachers were timely in their duties. Completed student written responses were mailed to the researchers for random numerical labeling allowing for a random scoring process. Each student written response was reviewed by a single scorer. The scorer was unaware of the treatment group and the time of assessment for the student responses. The assessment rubric, evaluating performance on the 18 learning objectives, was applied to each student response. Scores of zero to three were assigned on each of the 18 objectives. All scores were entered according to their random numerical labels. Scores were entered into an Excel file and later into a Statistix file for analysis.

Results showed overall low scores for student performance. Total percentage scores for the three treatment groups over the pre, post, and retention testing periods

ranged between 19% and 25%. Scores were consistently low among the treatment groups.

Possible explanations for such overall low scores include difficulty in the design and application of the alternative assessment tool, high variability in student literacy skills, a demand for higher order thinking skills that were developmentally advanced for many in this age group, and limited exposure of students to alternative assessments.

The alternative assessment tool was inadequate in its ability to accurately assess student knowledge and processing skills for some objectives. The inability to truly randomize the selection of teachers and to guarantee control in the instruction and assessment processes in the numerous classrooms across the state is of concern, also. Future studies interested in the use of alternative assessment procedures will need to address these challenges as well as others discussed in greater detail in the discussion section of this work.

Introduction

Humankind's environmental impact upon our planet is a growing concern to many. From our agrarian past to our technological present, human enterprises have left an increasingly immutable mark upon the land and its inhabitants – including our own species (Lubchenko, 1998). In an effort to initiate solutions to perceived environmental problems, the goal has arisen to enhance the education of people regarding how the world works, the ways human populations can affect varying levels of ecosystem-functioning, and the means by which individuals might make a positive difference.

Environmental education (EE) is a learning process that increases knowledge and awareness about the environment and develops skills that enable responsible decisions and actions regarding humankind and their environment. Environmental education encourages inquiry and investigation and enables the learner to develop critical-thinking, problem-solving, and effective decision-making skills. EE enables individuals to weigh various sides of an environmental issue. Environmental education does not advocate a particular viewpoint or course of action (United States Environmental Protection Agency, 1999).

Over the past few decades, dozens, if not hundreds, of curricula for environmental education have been developed. Many of the original curricular attempts to respond to the educational challenges stated in the Tbilisi declaration missed their mark through either a lack of objective foci or inconsistency. In response, in 1980, Dr. Harold Hungerford and peers established clear guidelines, informed by the guiding principles of Tbilisi (NAAEE and Environmental Literacy Council, 2002). While perspectives and values, and approaches to instruction have varied, the quality of EE curricula has improved. All the while funding sources for such programs have dwindled.

Project WILD, an environmental education program with a 20-year history, celebrates widespread use in the United States and in several countries around the world. Project WILD has provided a model for the design of more recently developed curricula. Teacher training is a centerpiece to the operation of Project WILD. Through post-workshop surveying, WILD has been able to document an extensive and generally enthusiastic response to the program from participating educators (Pitman, 1996).

Sufficient assessment of the program's effectiveness in achieving its goals with the students instructed using the Project WILD activities has been lacking.

This research project is one of the first attempts to measure the effectiveness of Project WILD with students. Our study measures the effectiveness of Project WILD versus non-WILD methods of instruction in addressing identical environmental education objectives with South Dakota middle school students.

Setting and Theoretical Background

In summarizing the history of the environmental movement in the United States, Benjamin Kline emphasizes the movement's roots in the early beliefs and philosophy of Western culture. This Western foundation, he states, colors the actions of our current day society, including those of the environmentally concerned. Kline stresses the severity of the impact of Western culture's use of technology and this same culture's excessive materialism upon the environment (Kline, 1997). He emphasizes the need for attending to the historical lessons of the past in attempting to act more wisely in our collective future (Kline, 1997).

The desire to act more wisely has guided many environmental-minded individuals the past few decades. Failing to protect our environment jeopardizes the well-being of human beings the world over, human generations to come, as well as that of many other species. Such thinking, based on an increasing number of scientific studies and common observations, has driven the environmentally concerned at both private and governmental levels in a search to find effective ways to educate their citizens in ecosystem functioning and sustainability. As Mark Bush (1997) puts it, "The greatest value of the

environmental movement is that it has increasingly sensitized our society to the relationship that exists between people, nature, industry, and development."

A Global Challenge / Educational Solutions

While environmental issues have been a public focus in the United States, to some degree, prior to the writings of Henry David Thoreau in the 19th century, it was not until the push for industrialization and its weighty impact upon the environment that environmental activism in the U.S. was born, making critical the messages of some of our nation's pivotal environmentalists, for example Rachel Carson and Paul Ehrlich (Neimark & Mott, 1999). Concern for the environment and a desire to find sustainable solutions has not been limited to the United States (Conca & Dabelko, 1998). Much of our world today – both developed and developing countries - has had to face similar challenges. An increased understanding of global ecosystem functioning, as well as a better grasp of the complexities of the (human) international system, made apparent that many national worries were oftentimes global in nature (Conca & Dabelko, 1998). Individual countries, with their independent environmental organizations, eventually began to address shared concerns (Conca & Dabelko, 1998). Throughout the past few decades, an essential component of finding solutions to environmental challenges has been the education of the citizenry.

History of Environmental Education

Alongside their scientific counterparts, educators of the past half-century have responded to scientific studies and common observations pointing to a need for thorough consideration of the full costs of certain human activities upon the environment. Dr. Bill

Stapp, with University of Michigan graduate students, was one of the first to define "environmental education" as being "aimed at producing 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 (Stapp,1969)."

The international Belgrade (1975) and Tbilisi (1977) conferences, were initiated by Dr. Stapp, the first director of environmental education for the United Nations Educational, Scientific, and Cultural Organization (UNESCO). Dr. Stapp saw the need for an international focus upon improving humans' relationships with their environment as well as with one another (United States Department of Education, 1996). An important innovator in environmental education, Dr. Stapp identified the need to work at a global level for sustainability while acknowledging the interplay of human needs and environmental quality.

The 1992 United Nations Conference on the Environment and Development determined education to be "critical for promoting sustainable development" (United States, 1996). Effective stewardship must begin with a fundamental understanding of ecological principles and the complex interplay of the natural-made and human-made worlds.

> *Environmental education, properly understood, should constitute a comprehensive lifelong education, one responsive to changes in a rapidly changing world. It should prepare the individual for life through an understanding of the major problems of the contemporary world, and the provision of skills and attributes needed to play a productive role towards improving life and protecting the environment with due regard given to ethical values.* (North American Association For Environmental Education [NAAEE], 2002).

EE programming began in the United States in the 1940s with the introduction of programs by the National Wildlife Federation and the Ohio Department of Education (Liebermann,1995). The EE field has experienced significant growth since that time, primarily in the past 15 years (Liebermann, 1995). Fifteen states mandate environmental education in elementary and secondary schools and degrees in environmental science are offered in more than 150 colleges and universities in the United States, while over 400 provide environmental-education programs (Williams, 2002). Following this surge in program development and implementation, there has been an accompanying need for program accountability including ongoing empirically based program evaluation. More recently, alongside these efforts and integral to some, is a growing impetus toward collaboration between EE program directors, curriculum designers, curriculum educators, and educational reformers.

Research Findings in Environmental Education

In a 1993 critical review of outcome research in Environmental Education, Leeming and colleagues conclude by stating, "Although several of the studies in this review appeared to have found positive effects on environmental attitudes, knowledge, and behavior, much of the utility of these findings was mitigated by problems of experimental design and data analysis." (Leeming et al.,1993).

Publication criteria in EE have not been so rigorous as to eliminate faulty research designs in much of the literature. In a review of classroom methodologies used in EE a number of research problems were cited: a shortage of well controlled studies, lack of rigorous research methodologies, and questionable validity (Lewis, 1982). The use of

meaningful control groups; reliable, valid dependent measures; follow-up data; and appropriate unit analysis are areas mentioned for improvement (Leeming et al., 1993).

In a review of 34 studies, by Leeming et al, only five measured or reported the presence of changes in environmentally relevant behaviors (Leeming et al., 1993). The authors noted the ultimate importance of desirable behavior change over an important gain in the areas of knowledge and/or attitude about and toward the environment. While the issue of behavior change is not investigated in this study, it is an inherent goal of the Project WILD curriculum. In an initial study by Bryant and Hungerford in 1979, the potential effectiveness of providing environmental education to the very young was thought to be very promising. However, environmental education of the very young is a neglected area of instruction (Childress, 1978) and research, with most studies focusing on children in 3rd grade and above (Leeming et al., 1993).

Reflecting a strong interest in environmental education, a great deal of literature in the field exists. Regardless of one's philosophy regarding the appropriateness of measuring outcomes, justification is necessary, in part, to ensure that a program is not only current but also is as effective as possible (Leeming et al, 1993). Often financially accountable to funding agencies, EE programs must provide data justifying their ongoing financial requirements. Large-scale assessment is expensive. Thus it is essential that guidelines for appropriate objectives must be clear and the methods for objectives measurement must be effective (Voss, 99). With limited resources available, spreading resources too thinly or inefficiently is wasteful (Schoenfeld, 1975). Traditionally, any curriculum should undergo a cycle of development, implementation, assessment, and

revision (Glatthorn, 1994; Pratt, 1994; Wisconsin, 1992). Curriculum for EE programs should follow a similar cycle that includes, as an essential piece, program evaluation including an empirically valid and reliable research component (Bennett, 1987).

Potential Role of Environmental Education

Some professionals consider the problem of sustainability to be our one overriding global challenge, one of crisis proportions (Orr, 1992). Yet, while sustainability is perhaps the agenda affecting so many others, its consideration or emphasis at all levels of education (kindergarten through university) is lacking (Orr, 1992). A new approach to educating about, in, and for sustainability is needed.

However, as reflected in budgetary cuts and the lack of serious integration of environmental science content across the curriculum of even a reasonable number of our nation's public schools (National Association for Environmental Educations and Environmental Literacy Council, 2000), environmental education tends to be seen as superfluous. In classrooms kindergarten through graduate school, environmental concerns are frequently not only overlooked but are not even in the picture (Cherif, 1992). This is highly unfortunate given that environmental content and skills have been found to be easily integrated into already existing courses without undue interference with the content and skills in place (Fleming, 1983; Ramsey et al., 1992; Schwartz, 1987). And actually, if based on rigorous standards, such content and skills enhance rather than detract from the basic curricula (United States Independent Commission on Environmental Education, 1997). Time has been considered a primary barrier to the teaching of EE by many teachers (Ham & Sewing, 1987). Such a misconception will hopefully be remedied as

use of environmental education curricula expands and word of its ease of integration does also.

Thus far, it appears that the most effective approaches to the successful attainment of environmental literacy are those which utilize instruction that is sustained over a longer period of time, that seem to be "thoughtfully and logically sequenced" (Volk & McBeth, 1998), and which actively promote the development of "understanding, intellectual skills, and social participation in learners" (Volk and McBeth, 1998). In order to provide sustained exposure, EE needs to be not only a part of a spiraling curriculum K-12 or higher, but also should be seriously considered as an integrated component of the complete curriculum.

> *If materials developed for use in K-12 schools focus on developing knowledge and understanding of options and tradeoffs, environmental education at all grade levels will be more effective and less controversial than is currently the case* (United States Independent Commission on Environmental Education, 1997).

The Independent Commission on Environmental Education (United States Commission on Environmental Education, 1997) has also recommended that the EE be taught as an upper-level capstone experience integrating learning from science, social science, and other upper-level courses. Some in the field go so far as to suggest that EE become the center piece of our educational process as a whole (Gigliotti, 1990).

Our educational institutions represent a potentially powerful means of conveying the knowledge and civic competencies necessary to prepare individuals to act responsibly in ways that lead toward sustainability. Our efforts toward educating about our environment will determine, in great part, the quality of our futures (Hudson, 2001).

Regardless of our educational methodology, ultimately, in response to the question, "What can be done?" David Orr (1994) states that all students graduating from educational institution should do so with a good comprehension of environmental concepts (Table 1).

Table 1. Required Concept Mastery Areas for College Graduates (Orr, 1994).

- The laws of thermodynamics
- The basic principles of ecology
- Carrying capacity
- Energetics
- Least-cost, end-use analysis
- Limits of technology
- Appropriate scale
- Sustainable agriculture and forestry
- Steady-state economics, and
- Environmental ethic

This foundation, he believes, would provide individuals with an ability to achieve educated discernment, an ability to tell the difference between what is healthy and what is not, between what is sufficient and what is efficient, what is optimum and what is maximum, and between what humans should do and what they can do (Orr, 1994).

In considering the desirability of inclusion of EE in K-16 instruction, the importance of including EE instruction in teacher-preparation programs nationwide becomes apparent:

> *Teachers will not be able to provide students with a substantive, rigorous, experiment-based environmental science class if they do not have the background necessary to do so* (United States Independent Commission on Environmental Education, 1997).

At this time, such inclusion is "scarce and poorly developed" (McKeown-Ice, 2000; Knapp, 2000). Data from a 1994 study cites 13 percent of secondary-education majors and 14 percent of elementary-education majors were made to take a course in EE (Williams, 2000). Three of our fifty states require their education majors to take environmental science (Williams, 2000). So, despite the findings of studies indicating that teachers' time spent instructing students about the environment increases according to the amount of pre-service and in-service training they receive, teacher preparation is lacking (Knapp, 2000; Sterling, 2001). Following a recent survey of pre-service teacher education programs in the United States, researcher, Rosalyn McKeown-Ice (2000) recommended the development of national guidelines for an EE component in pre-service training that would guarantee consensus from program to program. Incorporating education for sustainability into our pre-service professional development can do much to improve our sustainability efforts (Haury, 2002) and such national guidelines ought to be a mandated part of the teacher preparatory curriculum and thus be required for state teacher certification (McKeown-Ice, 2000). Also, the EE community ought to encourage the hiring of faculty who care about EE and are knowledgeable in the area in order to bolster the quality of the EE component of their schools' programs (McKeown-Ice, 2000). The EE community needs to work to increase the awareness of academic advisors regarding the diversity of coursework, beyond science and science methods classes, that can enhance a teacher's ability to teach effectively about the environment

(McKeown-Ice, 2000) as "breadth and depth of relevant knowledge and skills" are essential to effective EE teaching skills (May, 2000). Lastly, McKeown-Ice recommends that future research investigate the possible correlations between environmental literacy, environmental education teaching competencies, and teacher-preparation program level of investment in EE. Recommendations gained from such a study would provide guidelines for modification of existing programs, identifying weaknesses, and building on strengths (McKeown-Ice, 2000).

Trends in Science Education

Shifts in science education have reflected social emphases through the decades. In the late 1940s and early 1950s, the theme of atomic energy was prevalent but was usurped in the late 1950s by our nation's emphasis on putting a person in space and reflected accompanying foci in science and technology (Voss, 1999). In the 1970s, the theme in science education again was replaced due to a period of reflection on numerous negative impacts of technology on the environment (Voss, 1999). Schools focused then on environmental and energy education (Voss, 1999). More recently, in the 1980s, an integrative view of science through the lenses of content, process, and societal context (as seen in STS or Science, Technology, and Society) has come to the fore (Voss,1999).

Currently, K-12 science education is being reshaped through the development and implementation of national science education goals (Voss, 1999). Presidents George Bush and Bill Clinton have promoted goals directing the development of national standards and testing affecting the area of science (Voss, 1999). Following these

prescriptions, diverse groups began the development of plans for attaining the national goals for future student achievement.

The American Association for the Advancement of Science (AAAS) developed *Science for All Americans* in 1989. AAAS objectives emphasize student literacy in the following areas (see Table 2):

Table 2. **Areas of student Environmental Education literacy (from American Association for the Advancement of Science, 1989).**

- Being familiar with the natural world and recognizing both its diversity and unity
- Understanding key concepts and principles of science
- Being aware of some of the important ways in which science, mathematics, and technology depend on one another
- Knowing that science, mathematics, and technology are human enterprises and what that implies about their strengths and limitations
- Having a capacity for scientific ways of thinking
- Using scientific knowledge and ways of thinking for individual and social purposes

Additional support for scientific literacy goals is provided by the National Research Council's 1995 *National Science Education Standards*:

> *Scientific Literacy for All Students is a national goal. The National Science Education Standards are a contribution toward achieving that goal. Increased scientific literacy will benefit our society: Citizens will be able to use scientific principles and processes in making personal decisions; all will experience the richness and excitement of knowing about and understanding the natural world; economic productivity will increase in a society that is becoming increasingly dependent on scientific and technological skills; and engage intelligently in public discourse and debate about matters of scientific and technological concern.* (Rutheford & Ahlgren, 1991).

Also, *National Science Education Standards* provides criteria (Table 3) for guiding the selection of fundamental content.

Table 3. Criteria for guiding selection of science education content (National Resource Council, 1996).

- Represents a central event or phenomenon in the natural world
- Represents a central scientific idea and organizing principle
- Has rich explanatory power
- Guides fruitful investigation
- Applies to situations and contexts common to every day experiences
- Can be linked to meaningful learning experiences
- Is developmentally appropriate for students at the grade level specified

Integrated schemes encourage student construction of connections between the sciences. These schemes clarify existing links and provide a more "global" view of scientific ideas (National Research Council, 1996).

- Order and organization
- Evidence, models, and explanation
- Change, constancy, and measurement
- Evolution and equilibrium
- Form and function

The National Science Teachers Association (NSTA, 1990) also align themselves with AAAS and the National Research Council by stating as one of their two major goals the preparation of a citizenry "prepared to understand and deal rationally with the issues and opportunities of a scientific and technological world (Voss, 1999)."

Contributions from these groups have provided a foundation for science education reform in the United States. Identification of appropriate science content, effective classroom teaching methods, and methods of alternative assessment provide criteria to evaluate the quality of student knowledge and skills (Voss, 1999).

School Reform

The unifying goal of the education reform movement is to improve learning. Many reformers are promoting new approaches in instruction and assessment, sometimes within the framework of fundamental systematic changes at school sites (United States Environmental Protection Agency, 1999). For example, reformers cite the need for:

- Providing a real world context for learning

- Instructing through hands-on, learner-centered, and cooperative learning approaches
- Developing the learner's critical-thinking, problem-solving, and decision-making skills
- Using interdisciplinary curricula that provide for the interconnections of fields of knowledge
- Setting higher academic standards along with the use of more performance-based assessments of learners' levels of achievement toward these standards (United States EPA, 1999).
- Building partnerships (Liebermann, 1995).

Environmental education teaches about real life issues that frequently impact the learner's own community. EE involves students in investigative learning experiences while encouraging critical-thinking, problem-solving, and decision-making skills. Frequently, EE uses interdisciplinary curriculum and readily lends itself to authentic assessments (United States EPA, 1999).

In this way, EE has provided a model for many, and to some degree, all of the changes advanced by education reform (United States EPA, 1999; Liebermann, 1995; Hoody, 1995). Innovative, creative approaches exemplify EE methodologies. This match between advanced pedagogical approaches in EE and the goals of education reform has caught the attention of some. In a survey of education reform specialists, many acknowledged the importance of the potential lessons to be learned from EE, while some saw EE as an effective hook for science, math, and literature (Liebermann, 1995).

The State Education and Environmental Roundtable (SEER) currently supports 12 state departments of education in implementing curricula that utilize the environment as the context for cross-curricular integration (United States EPA, 1999). Given the guidelines for sustainable education presented in *Sustainable America: America's Environment, Economy and Society in the 21st Century*, that includes as one of three major recommendations the interdisciplinary, hands-on approach to education, these movements seem on target (Sitarz, 1998).

Interestingly, while education reform is encouraging the building of partnerships between education and other fields, educators in EE are beginning to awaken to a pressing need for linking their efforts to those of the larger education community (Liebermann, 1998). EE overlaps with many of the primary goals of general education reform, thus providing opportunities for meaningful contributions to the K-12 educational process (Haury, 2002). Gerald Liebermann suggests that EE professionals take part in education reform (Liebermann, 1998). In so doing, they will need to become informed about the education reform process, increase their participation in the education community at various levels, alter their self-perceived role as proponents of environmental advocacy education, and work to fit their approaches to EE with the goals of education systems and educational reform (Liebermann, 1998). One advantage is to align EE with a reform movement that shows strong involvement with federal and state education agencies, university education professionals, think tanks, school districts, teachers, and parents, and that is well funded (Liebermann, 1998). In addition, as Clay Shoenfeld (1975), founding editor of the Environmental Education Journal, said,

"everything is connected to everything else…nothing exists in a vacuum, least of all a social movement." Dr. Schoenfeld was referring, in part, to the fact that EE cannot move forward without considering its place in the grand scheme of things. Capitalizing on competing stresses would be required (Shoenfeld, 1975). Education reform can be seen as a positive stress being applied to a cumbersome educational system in need of revision. EE has the opportunity to join forces with the reform movement in its attempt to positively impact our nation's educational processes and ultimately societal ones.

Throughout time, reform efforts have moved through our educational system in waves. The requirement of more math and science courses for high school graduation, concerns for the preparation of better courses, new curriculum standards, textbook improvements, and enhanced program assessment were all recommendations given in the mid-1990s (Tobin et al., 1994). In the area of science education reform, an initial focus of reform was on increasing graduation requirements, for example, requiring more science and math courses for high school graduation (Tobin et al., 1994). Following this was a more radical reform movement promoting integrated curriculum, use of technology, and the role of higher-order thinking skills in learning (Tobin et al., 1994). Now guided by *A Nation at Risk* (United States Department of Education, 2002), reform efforts continue.

Education reform is a response to current societal circumstances (Bybee & DeBoer, 1994). We are a nation hoping to provide our young citizenship with the skills and visions necessary to making positive contributions in an ever-changing world. Reform will impact environmental education. Will EE have the foresight to create a

collaborative partnership with the reform movement and contribute, as it ultimately aspires, to the guiding skills and visions that will help to shape a sustainable global future? A strong and functional partnership between EE and the reform movement currently underway could be critical to the transition from crisis to solution.

Proponents of EE can no longer afford to function outside the education system (Liebermann, 1998). Accountability of EE programs must address its effectiveness in the light of the growing knowledge base that informs and directs the current reform efforts. EE has led the way from the sidelines, providing a powerful model that needs little alteration for translation into reform-directed settings. However, EE faces challenges. The cry for accountability is loud. An effort to provide answers must be framed within the language and context of educational reform. Formation of a stronger, collaborative partnership with the general education community through a shared concern and effort toward educational reform is one of the major opportunities mentioned by Dr. Schoenfeld (Schoenfeld, 1975). A collaborative partnership between EE and the general education community may be crucial to program improvement as it relates to factors such as "time, money, human resources, information, and materials and equipment (Schoenfeld, 1975)."

Regardless, EE programs must assess more formally how their curricula address the needs identified by reform guidelines and the new standards-based guidelines in many subject areas.

Constructivism

Traditionally, education has viewed learning as a repetitive process, with the learner spitting back new information (Brooks, 1993). Constructivism, on the other hand,

attempts to aid learners in transforming new information. Constructivist methods provide opportunities to achieve a deeper understanding, which can then prompt reconsideration of prior ideas (Brooks, 1993). The emphasis focuses on the ability of learners to generate, demonstrate, and exhibit such understanding (Brooks, 1993). The teacher is the mediator and as such is responsible for ensuring that students are given opportunities for quality learning experiences that provide for learning with understanding (Tobin et al., 1994).

Central to constructivist pedagogy is the presentation of problems within the context of emerging relevance (Brooks, 1993). Environmental topics lend themselves readily to such an attempt and oftentimes do so through programs designed in a manner suitable to use in multidisciplinary and hands-on-explorations and thus are highly compatible with constructivist thought:

> *Situations that require 'higher order' or transformative learning always imply constructivist approaches, and this is very largely the case with sustainability issues because of their complexity and often deeply challenging nature* (Sterling, 2001).

In an investigation of the use of EE instructional methods and their effectiveness, highest effectiveness ratings were given to instructional methods involving students as active participants through the use of inquiry, debate, simulation games, field trips, and other methods (Schwaab, 1982-3). A set of constructivist teacher descriptors (Table 4) provides a quick summary of the philosophical underpinnings of constructivism (Brooks, 1993):

Table 4. Descriptors of constructivist teachers (from Brooks, 1993).

- Constructivist teachers encourage and accept student autonomy and initiative
- Constructivist teachers use raw data and primary sources, along with manipulative, interactive, and physical materials.
- When framing tasks, constructivist teachers use cognitive terminology such as classify, analyze, predict, and create.
- Constructivist teachers allow student responses to drive lessons, shift instructional strategies, and alter content.
- Constructivist teachers inquire about students' understandings of concepts before sharing their own understandings of those concepts.
- Constructivist teachers encourage students to engage in dialogue, both with the teacher and with one another.
- Constructivist teachers encourage student inquiry by asking thoughtful, open-ended questions and encouraging students to ask questions of each other.
- Constructivist teachers seek elaboration of students' initial responses.
- Constructivist teachers engage students in experiences that might engender contradictions to their initial hypotheses and then encourage discussion.
- Constructivist teachers allow wait time after posing questions.
- Constructivist teachers provide time for students to construct relationships and create metaphors.
- Constructivist teachers nurture students' natural curiosity through frequent use of the learning cycle model.

Highlighting these dozen teacher practices allows for the identification of a number of ways in which environmental education approaches to curriculum and instruction and a constructivist approach are compatible. Project WILD, along with Project Learning Tree and GEMS (Great Explorations in Math and Science), have been cited as outstanding examples of curricula that "share many of the goals of EE and constructivism" (Klein & Merritt, 1994). Of some concern, is the need for teacher training programs that consistently instruct new teachers using the methodologies they hope these teachers to emulate; oftentimes this is not the case (Lord, 1999). Along with these points we find a shared vision regarding the need for authentic assessment methods (Klein & Merritt, 1994).

Alternative Assessment

Teaching methods adopted for EE programs have been those same innovative methods being promoted in the general education community. So, it is not surprising that both groups of educators share a concern about appropriate evaluation methods – alternative assessments – for performance in either EE or general education.

As early as 1984, a prominent team of researchers recommended that an objective instrument capable of direct measurement of specific variables be developed to be administered nation-wide to assess student achievement relative to the goals for EE across all grade levels (Volk et al, 1984). The development of an assessment tool that would be applied internationally allowing for comparisons across programs, geographic regions, political boundaries, and so on, would help to direct and coordinate efforts in the EE field (Volk et al, 1984). Of primary interest in these assertions is the consideration of

a need to address assessment in a coordinated effort, in a manner sensitive to varying levels of competence in environmental knowledge, understanding, and skills to such a pervasive degree, and in a manner that might provide a meaningful baseline for further study. In a discussion of the role of science education in educating for the environment, A.M. Lucas cites a clear need for empirical science education research that attempts longitudinal studies of the impact of formal and informal EE programs on adult behavior (Lucas,1980). Increased consideration of specific impacts of EE upon adult behavior, whether it influences resource use, encourages conservation, or develops within individuals other behaviors which promote environmental improvements, should be made (Childress & Wert, 1976). Extensive, meaningful baseline data could provide a starting point for these studies.

A need to appropriately assess environmental education competencies continues to challenge professionals in the field (Hudson, 2001):

> *One of the greatest challenges for education generally is to produce measurable results. Unfortunately, reaching this goal is neither easy nor devoid of the politics of testing and the endless philosophic debates over what constitutes marked increases in learning and knowledge. Environmental education, though not exempt from these issues, provides some exciting opportunities for enhancing learning, sharpening observation and problem-solving skills, and producing measurable outcomes.*
>
> *Effective education requires the recognition of appropriate and meaningful strategies to help students discover more about the natural world, assemble information and facts, and solve problems. Detailed analyses are needed to more fully evaluate different learning styles and different areas of knowledge. Howard Gardner, a professor of education at Harvard University, posits several distinct types of intelligence, including one that relates directly to intelligence about the natural world. He therefore asserts the need to create different*

> *approaches to evaluate the impact of educational programs on these distinct forms of learning and knowledge*).

Education as a whole is undergoing the laborious trial of yet another rebirth in order to address the task of preparing citizens for the challenges of the 21st century. While many of the new ideas have been around for decades and appear on the surface to simply be coming around again, these innovations are being surveyed and implemented with a stronger need and greater hope than in the past. A vast empirical understanding of learning now informs these hands-on, minds-on, learner-centered, inquiry-driven approaches. Educators face the challenge of applying these approaches in ways sensitive to a holistic curriculum. Systems face the challenge of revising their very foundations in order to provide a less structured, more meaningful and flexible environment, in both place and time, in which to succeed with reform efforts. Inherent to these challenges is the necessity for also rethinking the assessment process itself.

Whether in general education settings or when attempting to optimize the impact of any curriculum program, the demand for authentic assessment appears essential to a successful curriculum. The problem of accurately assessing reformed curriculum objectives demands the artful and scientific application of reformed assessment methods (Hoody, 1995). These new forms of student assessment often demand that students apply their learning to real-world problems. The EE field exists today because of an abundance of such problems! Naturally, most EE curricula will aim to foster skills essential to effective real-world problem solving. Effective assessment of these curricula must then be valid measures of not only knowledge gained, but of successful application of learning to realistic problems (United States Department of Education, 1996b).

Project WILD

With such innovations and concerns guiding its conception, Project WILD (Wildlife in Learning Design) was developed in the early 1980s. Via a workshop format, Project WILD provides educators with materials and experiences – hands-on, inquiry-based activities related to wildlife ecology and environmental issues. WILD trained teachers then take these activities back to regular classrooms for integration within the K-12 curriculum. As summarized by Project WILD's National Office, Project WILD is:

- An international network of students, educators, parents, community leaders, educational administrators, and representatives of resource agencies and conservation groups.
- A supplementary, interdisciplinary, instructional program for educators of students in kindergarten through high school.
- Ideal for integration into the teaching of science, social studies, language arts, math, art, physical education, health, music, and other curriculum areas.
- Appropriate for use by classroom teachers, as well as resource specialists, naturalists, rangers, scout and youth leaders, camp counselors, and other non-formal educators.
- A source of innovative techniques for teaching basic skills.
- Helping to meet the national objectives of high standards for all students through activities that will engage all learning styles and learners.
- Balanced and fair, neither pro nor con on value-sensitive issues.
- Concept-oriented.
- Effective methods for teaching problem solving and decision-making.
- Extensively reviewed, tested, and evaluated.
- Praised by professional educators, wildlife biologists, parents, and students.
- Captivating education – its lively, hands-on instructional strategies make learning fun.

Project WILD is one of the most widely used environmental education programs (Lieberman, 1995). The program has provided workshops and materials to over 600,000 educators, reaching more than 35 million students, since 1983, with a distribution of over 1,000,000 copies of its materials (Dierking et al, 1998).

History of Project WILD

In 1970, the Western Regional Environmental Education Council (WREEC) was founded in an effort to form a partnership between education and natural resource professionals. Governmental funding supported WREEC. WREEC and the American Forest Institute, a private, non-profit agency, developed project Learning Tree in 1973. This interdisciplinary environmental education program spread throughout the west and later from coast to coast. Following Project Learning Tree's success, a new affiliation was formed between the Western Association of Fish and Wildlife agencies to develop Project WILD in 1980.

In early efforts to ensure a high-quality environmental education program, Project WILD provided the following:

- The initial development of its conceptual framework through intensive collaboration, critique, and revision of over 500 professionals, followed by
- Ongoing review of new materials by science, curriculum, and environmental experts.
- Pilot testing by classroom teachers to evaluate the effectiveness of the program objectives, grade level appropriateness, and the overall quality of the activities.
- A prepublication series of regional writing conferences involving teachers, school administrators, university faculty members, wildlife professionals, and representatives of private environmental, youth, community, and conservation groups.
- Following reviews, evaluation, and widespread field-testing, final activity selections were made prior to publication of the guides.
- Use of workshop participant surveys for assessment of workshop quality.
- A comparative study involving 6,000 students gauging Project Wild's effectiveness in educating students in knowledge, skills, and an appreciation of wildlife

After three years of development, Project WILD Activity Guides (elementary and secondary) became available to both national and international sponsoring organizations in 1983. Three years later the Project WILD Aquatic Education Activity Guide began its

development with cooperation from the U.S. Fish and Wildlife Service and became available for use in 1987. By 1991 all 50 states, and six national and five international organizations, were active sponsors of Project WILD. In 1992 updates were made of the Elementary, Secondary, and Aquatic Education Activity Guides. Guides were, again, updated in 2000, reflecting increased correlation to general and science curriculum standards.

In 1995, WREEC transitioned into the Council for Environmental Education (CEE). Following this changeover, a long-range action plan was designed through the united efforts of Project WILD Coordinators, state agency directors, the Project WILD Program Committee, the Western Association of Fish and Wildlife Agencies, and the Council for Environmental Education. A comprehensive evaluation of all program activities was given highest priority. Results of this process guide the revision of current future programs.

A 1995 long-range plan included the following goals as priorities for action:

- Project WILD will perform comprehensive and on-going evaluation of all programs and make necessary changes accordingly.
- Project WILD will expand on its commitment to integrate the concept of "responsible action" into all programs.
- Project WILD will increase its effectiveness with existing under-served audiences and expand its reach to newly identified audiences.
- Project WILD will demonstrate the relevancy and benefits of its programs to sponsors and partners.
- Project WILD will provide continuing education for coordinators to enhance their knowledge, skills, and abilities (KSAs).
- Project WILD recognizes the complexities of the learning process and will apply appropriate methods and technologies to all programs.
- Project WILD will seek partners in the development and implementation of its program.

In response to the first goal, Project WILD, with the assistance of the Institute of Learning Innovation, developed an evaluation to assess projects, needs, and mechanisms for ongoing formative feedback, and summative evaluation (Dierking, 1998). Dierking and colleagues have recommended comparison studies of teachers and students following a control group design similar to that contained in this study believing that such studies, while costly and time consuming, would provide more reliable data regarding the impact of participation in the Project WILD curriculum (Dierking et al, 1998). Their study also recommends an impact-oriented study be given priority (Dierking et al, 1998). A recommended model includes educators/facilitators and students involved with Project WILD in formal and informal settings in rural and urban settings that include short and long-term WILD users. Such a model would follow an experimental design inclusive of treatment and control groups and would potentially allow for collection of retrospective data. This current design is suggested as such a model, one that could be expanded into a broader (inclusive of more states or regions) study, although perhaps in a scaled-down version (Dierking et al, 1998). Desirable assessments include observation protocols, an interview protocol with both open and close-ended questions, and performance-based and written assessment tools for students (Dierking et al, 1998). Such tools would investigate questions of interest to our study, such as:

- Can students demonstrate acquired skills and knowledge?
- What critical skills and judgment changes do students demonstrate?
- How are activity use and implementation correlated with learning?

Both natural resource and educational agencies have indicated a need for Project WILD to broaden its scope to reflect the more holistic/systems approach now common to both agencies (Dierking et al, 1998). Concepts of interdisciplinary learning, human interaction with the environment, individual and community participation in the environment, and ways that both individuals and communities apply increasing understanding are all to be worked into a revised mission statement for Project WILD (Dierking et al, 1998).

Regarding the conceptual framework, reviewers have determined that Project WILD's current framework fails to address some essential EE concepts: ecosystem-based resource management, human dimensions, and wildlife/biodiversity as reflected in current natural resource agency concerns (Dierking et al, 1998). Sustainability and the interaction of people and wildlife as a crucial piece in attaining long-term viability should be dealt with more effectively (Dierking et al, 1998).

Assessment of Project WILD

In a summary of research findings from 1983 through 1995, a variety of research strategies are shown in use at both national and state levels in the evaluation of different aspects of Project WILD (Pitman, 1996). During this time period, short-term and long-term studies sometimes utilizing single-classrooms while other times involving classrooms across the nation, using either quantitative or qualitative approaches were noted in use (Pitman, 1996). Personal interviews, focus groups, phone and mail surveys, and questionnaires were the common methodologies used across the twenty-eight studies

(Pitman, 1996). Research documented represents efforts of the National Project WILD office, Project WILD sponsoring agencies, and other researchers (Pitman, 1996; Table 5).

Table 5. Areas researched specific to Project WILD (from Pitman, 1996).

- Educator awareness of Project WILD
- Reasons for teacher participation in workshops
- Participant objectives
- Quality of materials and WILD approach to Environmental Education
- Quality of workshops
- Rate of implementation by workshop participants
- Reasons for non-use by workshop participants
- Reasons for multiple workshop attendance
- Current uses and appropriate audiences for program
- Use of Project WILD guide – number and types of activities used most frequently
- Curriculum placement and implementation strategies
- Student gains as a result of Project WILD use
- Student action component – developing personal competencies
- Project WILD facilitators network – the delivery system
- Educator needs assessment

Briefly, educator awareness of Project WILD was indicated as an area needing promotion (Pitman, 1996) although additional assessment in this area could clarify the reliability of these findings. Workshop participants were motivated by a personal interest in the environment and indicated a desire to learn effective methods of sharing concepts and strategies with their students in order to raise student awareness, understanding, and appreciation of wildlife and the environment (Pitman, 1996). Such needs are compatible with the mission statement and goals of Project WILD (Pitman, 1996).

Project WILD materials were rated as excellent, useful, and effective (Pitman, 1996). Their interdisciplinary flexibility, and ease of implementation, are appreciated by users (Pitman, 1996). A majority of educators surveyed thought that Project WILD provided a relatively unbiased approach to environmental and wildlife issues (Pitman, 1996).

Project workshops received consistently high ratings by educators, even years later, showing not only long-term positive regard but long-term recall of workshop components. Suggestions for improvement are simply additional ideas for further expansion of the program rather than criticisms of its current structure. However, Pitman (1996) points out, many of these findings are drawn from a "self-selected" population – attendees of WILD workshops. As Project WILD is more widely used with other audiences, such as in-service teachers, a broader representation will possibly provide more satisfying results when these populations are surveyed (Pitman, 1996).

In a survey of EE coordinators and state education agencies, Project WILD was listed by 80% of those surveyed as one of the three most commonly attended in-service

programs, while over half of the respondents indicated that Project WILD, as well as Project Learning Tree, were the predominant workshops attended by teachers in their states (Wade, 1996).

Most teachers trained in Project WILD report resultant changes in both their teaching and personal practices (Pitman, 1996). These teachers not only incorporated more wildlife and environmental emphases in their classrooms, but also found that their general teaching approach became more constructivist-based (Pitman, 1996). Such impact on teaching practices positively positions Project WILD and other similar EE curriculum to contribute to current goals in education reform.

Lack of planning time, shortage of available school time, difficulty for incorporation of WILD into secondary education curriculum, and a paucity of opportunities or administrative support were common reasons for lack of use of Project WILD by participants (Pitman, 1996). The complementary relationship of WILD activities to state or district objectives could prove useful in increasing support of its use with some factions (Pitman, 1996) and might also allow teachers more comfort and ease in its implementation into their curricula and classrooms.

Jensen's 1992 random survey of North Dakota teachers showed a significant difference in the likelihood that WILD-trained teachers would include environmental education in their curricula and over a longer period of time when compared to untrained teachers. Traditionally, materials are given only to workshop participants. As workshop attendance, and degree of attendance, is highly associated with the actual use of the WILD materials (Jensen, 1992) such continued policy seems wise.

In Pitman's (1996) study, the Project WILD guide appeared to be used more in the elementary grades than in other grade levels by a margin of 3:1. But the Aquatic Guide is more frequently used at the secondary level, especially with students in grades 7–9 (Pitman, 1996). In evaluating the urban versus rural use of WILD, one can say that an urban emphasis is on the increase, with urban instructors actually using more activities than rural instructors (Pitman, 1996). There are, however, no significant differences in student gains between rural and urban populations (Pitman, 1996).

In evaluating student gains, these studies looked at the following measures of success:

1. Teacher perception of student gains
2. What students have learned from Project WILD (based on their own perceptions and on measurements from instruments such as tests, interviews, surveys, and observation)
3. A comparison of student achievement in groups who participated in Project WILD activities and those who did not

Most teachers in these studies (over 90% in all cited) not only noted a positive increase in student awareness, knowledge, and skills related to wildlife and the environment, but also perceived a change in student attitude toward the environment and wildlife (Pitman, 1996). Such recent findings of positive changes in student attitudes toward wildlife reflect similar teacher perceptions in earlier studies (Jensen, 1992). An interesting aside to these perceptions are those shared by both teachers and students,

when surveyed, that the most memorable, successful wildlife activities carried out during the school year were those from Project WILD (Pitman, 1996).

Beyond the memorable aspects of a program and beyond its impact upon student knowledge and attitude, is the potential of an EE program guiding students toward an empowered position in which they feel capable of taking action at some level to serve wildlife and the environment in a way fitting with their environmentally friendly ethics. Fifty-five percent of the survey respondents who had attended Project WILD workshops in West Virginia, prior to 1993, indicated that Project WILD had inspired their students to take responsible environmental action (Shomo, 1993). These results conflict, however, with those from a study indicating that students felt powerless to act individually to help wildlife or to make any difference (Fleming, 1991). Research in this area is relatively new with few studies prior to 1990 mentioning the action component of Project WILD (Pitman, 1996). With a growing emphasis on student behaviors and actions along with teacher guidance in these areas, new curriculum materials designed specifically to address the action component, such as Project WILD's *TAKING ACTION: An Educator's Guide to Involving Students in Environmental Action Projects*, are being used (Pitman, 1996). Opportunities for increasing positive student behaviors and for the assessment of WILD's effectiveness in doing so will be forthcoming.

At the state level, Project WILD sponsors use delivery systems that frequently make use of volunteer facilitators. In two separate studies addressing important characteristics of these program facilitators, Gomon (Gomon,1991) and Greene (Greene, 1992) both found the following:

- A commitment to EE and a high personal level of environmental concern were identified as primary motives for volunteering as facilitators.
- Those facilitators who are able to conduct Project WILD workshops as an integral part of their jobs are more likely to maintain a high degree of involvement with the program.
- Proper training is essential and is best accomplished by pairing experienced trainers with novices. Ongoing training allowing for the acquisition of new skills while honing existing ones is important.
- Regular communication channels between facilitators and the sponsoring agency are a necessity.
- Monetary compensation for services and/or expenses does act as a motivator and impacts effectiveness.

Throughout, Project WILD has responded to all revealed needs with necessary program adjustments and by providing additional desired materials and workshops (Pitman, 1996). Yet, challenges remain. Outreach and marketing efforts aimed at reaching the underserved and newly identified audiences are underway as are efforts for the larger program evaluation mentioned elsewhere in this paper (Dierking, 1998).

As seen in this summary, during the time period from 1983 to 1995, most studies attempted to measure the effectiveness of Project WILD teacher workshops and the materials used (Pitman, 1996). While data from some studies show a very high rating of

the program by teachers using Project WILD activities with their students, studies on the project's impact on involved students were underrepresented (Pitman, 1996).

While this report mentions the fact that it is difficult to isolate the effectiveness of Project WILD regarding student gains due to the myriad of EE materials and experiences to which students are exposed and their potential to confound results (Pitman, 1996), it is quite possible that this is in high degree due to the methodologies followed in many studies. Within the professional EE community, pleas for improvement in the quality of the methodologies found in a majority of EE research studies are common (Leeming et al., 1993; Smith-Sebasto, 1998). As recommended by the Institute for Learning in their evaluation design for Project WILD (Dierking at al, 1998), more rigorous experimental designs involving the use of control-groups are needed to better assess WILD's impact on student learning, attitudes, and actions. Although, qualitative studies will continue to offer measurement of outcomes otherwise missed, the way forward in EE assessment needs to be more quantitative in nature. Efforts to raise EE to the status of a "hard science" or even continue in the direction of professional maturity depend upon increasing the rigor of its research component.

Project WILD in South Dakota

In South Dakota, specifically, Project WILD has been active since 1989 and in the decade since has instructed well over 4,000 South Dakota teachers. On a national level, research has shown repeated effectiveness in WILD teacher instruction. However, as mentioned earlier, little research has been done to evaluate WILD's effectiveness in realizing its many goals with students. Program accountability obviously cannot rest on

its proven positive effectiveness with teachers alone. Project WILD acknowledges the need for statewide and multi-state studies evaluating the impact of Project WILD on students (Dierking et al, 1998).

Just as the various EE programs have questioned the appropriate assessment tools for use in evaluating student performance at a classroom level, the same concern has arisen regarding program evaluation, and has been addressed specifically by evaluation professionals designing a long-range assessment plan for Project WILD (Dierking et al, 1998). This study, addresses two particular needs: (1) assessment of Project WILD's effectiveness in using hands-on activities with students in South Dakota classrooms while (2) using assessment tools that are appropriate and sensitive to hands-on instructional methods used in the delivery of Project WILD.

As pointed out by Benjamin Kline, the environmental issues we face are often linked to past actions (1997). Imperative in our attempt to educate for environmental literacy is a forward approach. In a powerful consideration of differing approaches to the evaluation of EE, Ian Robottom argues for a critical approach to evaluation as it is the method able to "resonate constructively with the spirit, character, and intentions of EE" (Robottom, 1985).

Research Objectives and Hypotheses

The objective of this research is to assess both short and long-term effectiveness of Project WILD activities within middle-school EE curricula in South Dakota.

Given the results of this inquiry into environmental education (Project WILD in particular), the primary methodologies used, and the current research pointing to such

methodologies as "best practices," we anticipate seeing a positive difference in concept mastery and skills application in groups of students taught through the use of WILD activities, both in the short and long term, over those in the "blind" and non-WILD groups.

Research Methodologies

Student responses were evaluated through the use of a rubric designed to assess middle-school students' mastery of specific WILD objectives (e.g., knowledge of ecology, environmental science, and use of problem-solving skills). The use of an evaluation tool, designed by the researchers and first-year workshop teachers for this study, capable of assessing the "quality and sophistication" of the information contained in student responses was to provide insight into varying levels of student understanding (McRel High Plains Consortium for Mathematics and Science, 1995). The assessment used in this study was meant to measure the depth of student understanding, while providing the state of South Dakota with information regarding the effectiveness of the Project WILD curriculum in its classrooms. The assessment was designed in a format accessible to the instructors teaching the objectives and the students being assessed (Nielsen, 2002).

All South Dakota middle school science classroom educators, current with the state's education office, were notified by mail (winter of 1998) about the opportunity to participate in this research project. As many South Dakota middle school classroom teachers as possible were recruited for participation in the study (to be completed during two separate years due to an unanticipated level of recidivism during year one).

Randomization was limited by the necessity of allowing voluntary rather than required participation. It was also easier to recruit teacher participants for the blind control group as this role demanded less commitment. Over one-third of these representative classrooms were a blind control (n=11). A sample of seven classrooms represented instruction without Project WILD materials (n=7). Eight classrooms represented instruction with Project WILD materials (n=8). Demographically, our sample represents rural (n=14), small town (n=4), and mid-size central city (n=8) school districts across the state of South Dakota.

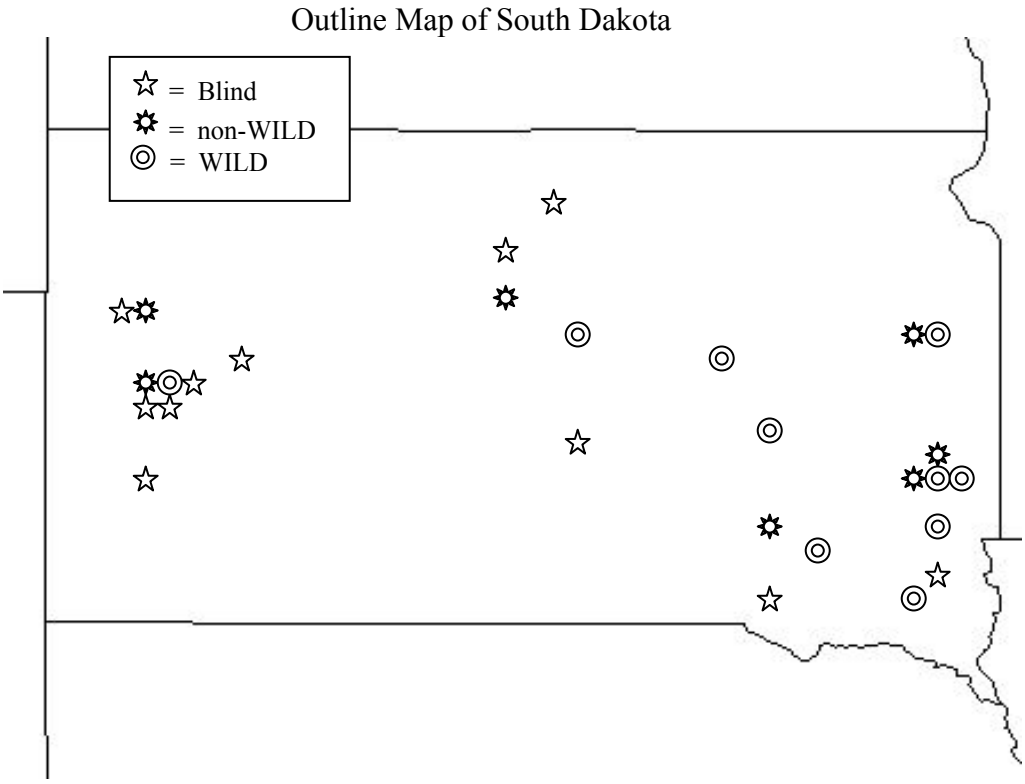

Figure 1. South Dakota map showing distribution of locations of participating South Dakota classrooms for Blind, non-WILD, and WILD research groups.

Table 6. School demographics for Blind, non-WILD, and WILD treatment groups (National Center for Educational Statistics, 2003).

Name of School	City/County in S. Dakota	Treatment Group/ Number of Repetitions	Location Code	School Population	Student Teacher Ratio
Armour Middle	Armour/Douglas	Non-WILD/1	Rural	79	11.0
Chamberlain Middle	Chamberlain/Brule	Blind/1	Rural	267	10.3
Crow Creek Middle	Stephan	WILD/1	Rural		
Dakota Middle	Rapid City/ Pennington	Blind/1	Mid-size Central City	855	13.4
Deadwood Middle	Deadwood/ Lawrence	Blind/1 Non-WILD/1	Rural	351	13.7
Douglas Middle	Box Elder/ Pennington	Blind/1	Mid-size Central City	578	13.2
Edmunds Central Jr. High	Roscoe/ Edmunds	Blind/1	Rural	36	18.9
George S. Mickelson Middle	Brookings/ Brookings	Non-WILD/1 WILD/1	Small Town	642	15.0
Gettysburg Middle	Gettysburg/Potter	Blind/1	Rural	83	12.2
Hanson Jr. High	Alexandria/Hanson	WILD/1	Rural	33	6.0
Hot Springs Middle	Hot Springs/ Fall River	Blind/1	Small Town	224	12.0
Huron Middle	Huron/Beadle	WILD/1	Small Town	557	15.8
Lennox Middle	Lennox/Lincoln	Blind/1	Rural	182	13.7
North Middle	Rapid City/ Pennington	WILD/1	Mid-size Central City	651	12.9
Patrick Henry Middle	Sioux Falls/ Minnehaha	Non-WILD/3	Mid-size Central City	1,016	15.5
Sully Buttes Jr. High	Onida/Sully	Non-WILD/1	Rural	51	14.6
Sacred Heart School	Yankton/Yankton	WILD/1	Rural	--	--
Tea Middle	Tea/Lincoln	WILD/1	Rural	180	--
Tripp-Delmont	Tripp/Hutchinson	WILD/1	Rural	59	12.0
Wagner Jr. High	Wagner/ Charles Mix	Blind/1	Rural	115	12.6
West Middle	Rapid City/ Pennington	Blind/2	Mid-size Central City	559	14.0

Representative activities were chosen from both the Basic and the Aquatic Project WILD guides. One activity from each of the seven sections of the program's conceptual framework became a part of a unit on ecosystem structure and function. A unit approach was used, reflecting the need to integrate EE curriculum so that the unit might be

presented in a pedagogically meaningful way (Samuel, 1993). Since measures should be aligned with program goals (Gribbons & Herman, 1997), the objectives (Table 6) to be measured by the study's scoring instrument (rubric) were those taken from the Project WILD guides under each of the seven activities (Table 7):

Table 7. Objectives measured in study

Theme 1: Observation and Expression
Objective 1: Students will learn the importance of the role of observation in the scientific method [or] Students will demonstrate awareness of using observation in the solving/answering of problems/questions.
Objective 2: Students will be able to describe in writing and drawing their observations.

Theme 2: Awareness and Appreciation
Objective 1: Students will become familiar with common environmental problems.
Objective 2: Students will recognize that wild plants and animals, domesticated plants and animals, and humans share many needs and concerns.

Theme 3: Ecological Principles
Objective 1: Students will be able to describe the basic characteristics of riparian habitats.
Objective 2: Students will be able to identify examples of organisms living in riparian habitats.
Objective 3: Students will be able to describe ecological roles played by organisms within riparian habitats.
Objective 4: Students will demonstrate an ability to evaluate potential positive and negative effects of changes in riparian habitat quality.

Theme 4: Management and Conservation
Objective 1: Students will be able to categorize plants and animals into native and exotic species.
Objective 2: Students will be able to trace the origins of several species of local plants and animals.
Objective 3: Students will be able to describe the potential effects of exotic species.

Theme 5: Plants and Animals in Our Culture
Objective 1: Students will be able to identify the use of wildlife and other natural images in their culture and other cultures, the emotional component of these images (biases), and their appropriate and inappropriate uses.
Objective 2: Students will be able to recognize the importance of plants and animals in human culture.

Theme 6: Evaluating and Solving Environmental Issues
Objective 1: Students will learn the definition of a natural resource.
(1) is a portion of the environment
(2) has value
(3) is available for use to humankind
Objective 2: Students will demonstrate an ability to address different human perspectives and conflicting issues in multiple-use management.

Theme 7: Responsible Human Actions
Objective 1: Students will be able to define and identify different types of pollution.
Objective 2: Students will be able to identify potential cause and effect relationships involving aquatic-related pollution.
Objective 3: Students will be able to generate and evaluate alternative solutions to problems of aquatic pollution.

Table 8. WILD Themes and activities used in study (Council for Environmental Education and Western Association of Fish and Wildlife Agencies, 1992a and 1992b).

Theme	Title	Activity Name	Guide	Page
1	Awareness and Appreciation	We're in This Together	Basic	60
2	Diversity of Wildlife Values	Wild Words	Basic	66
3	Ecological Principles	Blue Ribbon Niche	Aquatic	72
4	Management and Conservation	Aquatic Roots	Aquatic	100
5	People, Culture, and Wildlife	Does Wildlife Sell Cigarettes	Basic	232
6	Trends, Issues, and Consequences	Planning for People and Wildlife	Basic	284
7	Responsible Human Actions	Something's Fishy Here	Aquatic	176

Recruited middle school educators attended workshops held at the Oak Lake Field Station during June of 1998 (pilot study) and June of 1999. The blind control group educators did not participate in the workshop.

Prior to the beginning of the workshops, participating teachers were randomly placed into experimental groups of WILD or non-WILD. At the time of the teacher workshops, the designated objectives were delivered to both the WILD and non-WILD teachers in a joint, large group setting. After discussion of the objectives, the two groups were separated. The WILD teachers were guided through each of the seven Project WILD activities one theme/activity at a time. At the same time, the non-WILD group of teachers met elsewhere to explore alternative methods of meeting these same objectives. The non-WILD teachers were informed that they were not to use Project WILD activities or other similar hands-on approaches during their delivery of the unit. Potential alternatives were discussed, such as lecture, guest speakers, field trips, etc.

Educators were orientated regarding project objectives and responsibilities during the workshop and repeatedly during their ongoing participation throughout the following school year (Attachments C – H). Participating educators and facilitators worked cooperatively to develop a student assessment scoring tool (rubric) during the June, 1998 workshop using the Project WILD activity manuals and materials on alternative, performance-based assessment methods (See attachment A). The instrument was then reviewed by a number of prominent EE professionals, (e.g., Dr. Harold Hungerford with the Center for Instruction, Staff Development and Evaluation in Carbondale, Illinois). The analytic rubric provided a 4-point scale rating system. Predefined criteria were determined for every objective in the seven-theme unit in order to enhance rater reliability (Moskal, 2000).

A dilemma statement, designed by the researchers, was developed that addressed all objectives of each activity within the seven themes (See attachment B). The statement was broken into simple chunks, allowing middle-school students easier access to the concepts being communicated (Moorcroft et al, 2000). The dilemma statement was tested for readability level and refined to a sixth grade ability level. This same dilemma statement was delivered to all students in each of the three study groups ("blind," non-WILD, and WILD) during the three testing periods throughout the given school year. Student responses to the dilemma statement were scored using the rubric. Together, these tools—the dilemma statement and rubric - served as the basis for student assessment.

Participating educators assessed student understanding of ecological and environmental science concepts and environmentally oriented problem solving skills

using the assessment tools at defined intervals during the project period. Students were evaluated three times during the course of the study (Pre-assessment – Early Fall 1998 [pilot group I] and Early Fall 1999 [group 2]; Immediate Post-assessment – Mid-Fall 1998 [pilot group I] and Mid-Fall [group II]; Delayed Post-assessment – Late-Spring 1999 [pilot group I] and Late-Spring 2000 [group II]).

Results for each student were tracked (anonymously) throughout the study period. Each student's dilemma response paper was coded to indicate the assessment period and school identification. A random selection from the entirety of responses from each assessment period was then be made. These responses were then scored. A single rater scored all student responses. Intra-rater reliability was strengthened by continual review of the established rubric criteria (Moskal & Leyden, 2000). Consistency was also enhanced though random, blind scoring.

Results of student assessments were then tabulated and analyzed through two-way analysis of variance (Moorcroft et al, 2000). Data collected from student responses was used to examine differences in student understanding between treatment groups ("blind," non-WILD, and WILD) and also the retention of EE material over the period of study.

Statistical Design and Analyses

Both years of data, 1998 and 1999, were combined and were summarized by school and examined for differences among times (Pre, Post, Retention) and treatment (WILD, Non-WILD, and Blind). Data collected were analyzed using a two-way analysis of variance for statistical significance, $p < .05$ (Snedecor & Cochran, 1980). Data was also analyzed for total theme as well as for individual activities within each theme.

Due to missing values in the data set, an additional statistical procedure requiring running reduced models of the original model statement was used and simple descriptive statistical analyses were also run (Analytical Software, 1996).

Results

Overall Scores

Based on the instrument used in the study, total scores could have ranged from 0 to 54. Overall, scores were in the low range (Figure 1, Table 8), with all three treatment groups scoring 19% on the pre-test; 22% (Blind), 19% (WILD) and 25% (non-WILD), on the post-test; and 19% (Blind), 23% (WILD), and 25% (non-WILD) on the retention test.

No significant differences in student scores were observed among treatment groups (ANOVA, $p = 0.25$) or times (ANOVA, $p = 0.14$).

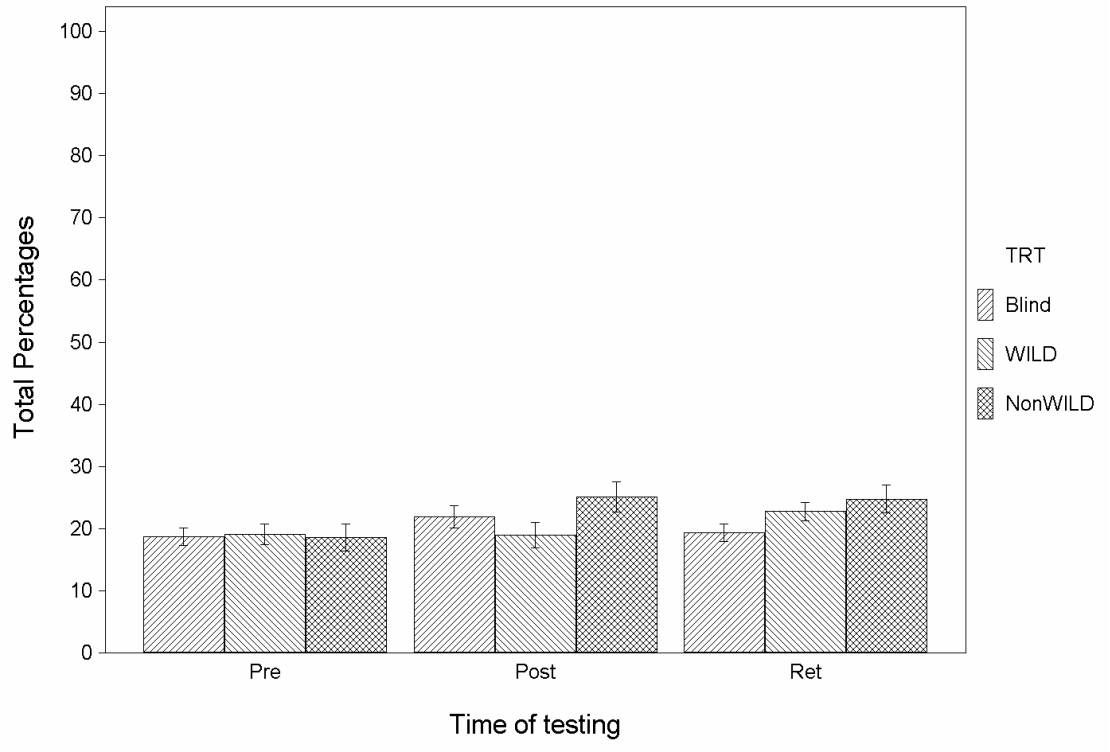

Figure 2. Overall total percentages for Blind, WILD, and Non-WILD classroom groups for pre-instruction (given at beginning of school year), post-instruction (immediately following presentation of ecosystem function unit – early autumn of school year), and retention (end of school year – six or more months later) testing.

Table 9. Total mean, minimum, and maximum scores for treatment and time.

Total Scores: Treatment/Time	n=	Mean x/54*	Minimum	Maximum
Blind Pre-test	11	10.07	6.80	14.25
Blind post-test	11	11.82	7.15	16.25
Blind retention test	11	10.43	6.20	13.55
WILD pre-test	8	10.03	5.75	15.55
WILD post-test	8	10.24	8.58	18.74
WILD retention test	8	12.28	9.52	14.94
Non-WILD pre-test	7	10.03	5.75	15.55
Non-WILD post-test	7	13.56	8.58	18.74
Non-WILD retention test	7	13.36	9.45	19.45

*x/54 refers to the average of the total number of points scored by each treatment group during each of the three testing times, divided by the total number of possible points allowed by the scoring rubric (54) from all objectives under all seven themes. The number of objectives (18 total) varied from theme to theme, but the scoring range of zero to three remained consistent throughout the rubric.

Theme One

Scores for theme one, *Observation and Expression*, could range from 0 to 6. The scores for this theme were the lowest of all themes studied (Figure 2; Tables 9-11). Ninety-three percent of student scores were zero, with no scores beyond a 20% achievement level. Given the response limitations around the theme one objectives of the dilemma statement, (limiting student ability to make actual observations during the assessment process), these low scores were to be expected. Students were required to document the use of observation in addressing questions such as those presented by the dilemma statement. They were to note the importance of the process of observation in scientifically answering questions while enabling individuals to address problems more holistically. These middle school students were not present at an actual site related to the dilemma presented them. In addition, given that the dilemma statement did not prompt them to approach the problem with a hypothetically observational approach, nearly all the middle school students skipped this aspect of problem solving in their written responses. While it was initially seen as the optimum approach to include objectives under each of the structural themes of Project WILD curricula, the area of observation and expression was one that did not receive just measurement with the testing instrument. No significant differences in student scores were observed among treatment groups (ANOVA, $p = 0.99$) or times (ANOVA, $p = 0.60$).

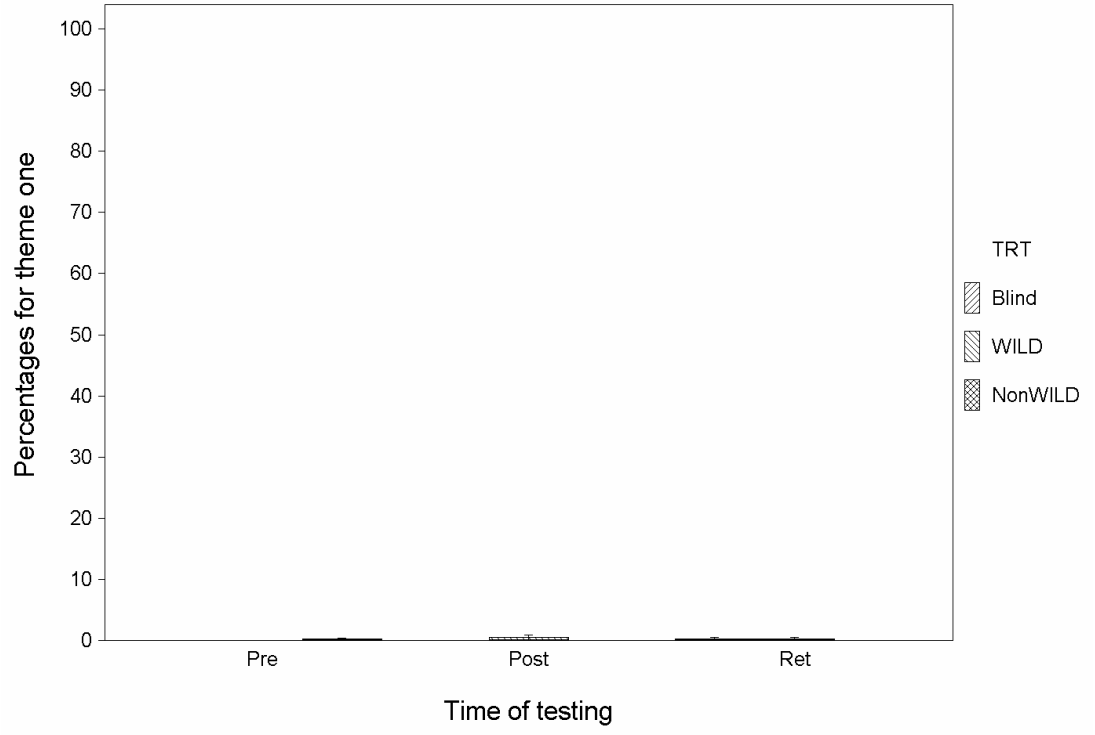

Figure 3. Theme one (Observation and Expression) total percentages for Blind, WILD, and Non-WILD groups for pre-instruction (given at beginning of school year), post-instruction (immediately following presentation of ecosystem function unit – early autumn of school year), and retention (end of school year – six or more months later) testing.

Table 10. Theme 1 total scores: mean, minimum, and maximum values for treatment and time.

Theme one totals: Treatment/Time	n=	Mean: x/6*	Minimum	Maximum
Blind Pre-test	11	0.00	0.00	0.00
Blind post-test	11	0.00	0.00	0.00
Blind retention test	11	0.01	0.00	0.15
WILD pre-test	8	0.00	0.00	0.00
WILD post-test	8	0.03	0.00	0.15
WILD retention test	8	0.01	0.00	0.10
Non-WILD pre-test	7	0.01	0.00	0.05
Non-WILD post-test	7	0.00	0.00	0.00
Non-WILD retention test	7	0.00	0.00	0.00

*x/6 refers to the total number of points possible for theme one divided by the number of points scored for the various treatments and times.

Table 11. Theme 1, objective 1 scores: mean, minimum, and maximum values for treatment and time.

Theme 1 / Objective 1 Treatment/Time	n=	Mean: x/3*	Minimum	Maximum
Blind Pre-test	11	0.00	0.00	0.00
Blind post-test	11	0.00	0.00	0.00
Blind retention test	11	0.01	0.00	0.15
WILD pre-test	8	0.00	0.00	0.00
WILD post-test	8	0.02	0.00	0.15
WILD retention test	8	0.007	0.00	0.05
Non-WILD pre-test	7	0.01	0.00	0.05
Non-WILD post-test	7	0.00	0.00	0.00
Non-WILD retention test	7	0.00	0.00	0.00

*x/3 refers to the total number of points possible for theme one, objective one divided by the number of points scored for the various treatments and times.

Table 12. Theme 1, objective 2 scores: mean, minimum, and maximum values for treatment and time.

Theme 1 / Objective 2 Treatment/Time	n=	Mean: x/3*	Minimum	Maximum
Blind Pre-test	11	0.00	0.00	0.00
Blind post-test	11	0.00	0.00	0.00
Blind retention test	11	0.00	0.00	0.00
WILD pre-test	8	0.00	0.00	0.00
WILD post-test	8	0.007	0.00	0.05
WILD retention test	8	0.007	0.00	0.05
Non-WILD pre-test	7	0.00	0.00	0.00
Non-WILD post-test	7	0.00	0.00	0.00
Non-WILD retention test	7	0.00	0.00	0.00

*x/3 refers to the total number of points possible for theme one, objective two divided by the number of points scored for the various treatments and times.

Theme Two

Theme two, *Awareness and Appreciation*, had a potential total score of 6 (Figure 3; Tables 12-14). Scores for this theme were relatively high. Treatment groups scored an average of 44% (Blind), 41% (WILD), and 43% (non-WILD), on the pretest. Post-test scores were 53% (Blind), 42% (WILD) and 54% (non-WILD). On the retention test,

Blind scores averaged 47%, WILD scores averaged 53%, and non-WILD averaged 57% (Figure 3). The Blind and non-WILD groups showed significantly higher post-testing scores than the WILD group, higher retention scores than the Blind and WILD group, and significant difference in retention scoring compared to the Blind group. Otherwise, no significant differences in student scores were observed among treatment groups (ANOVA, $p = 0.18$) or times (ANOVA, $p = 0.54$).

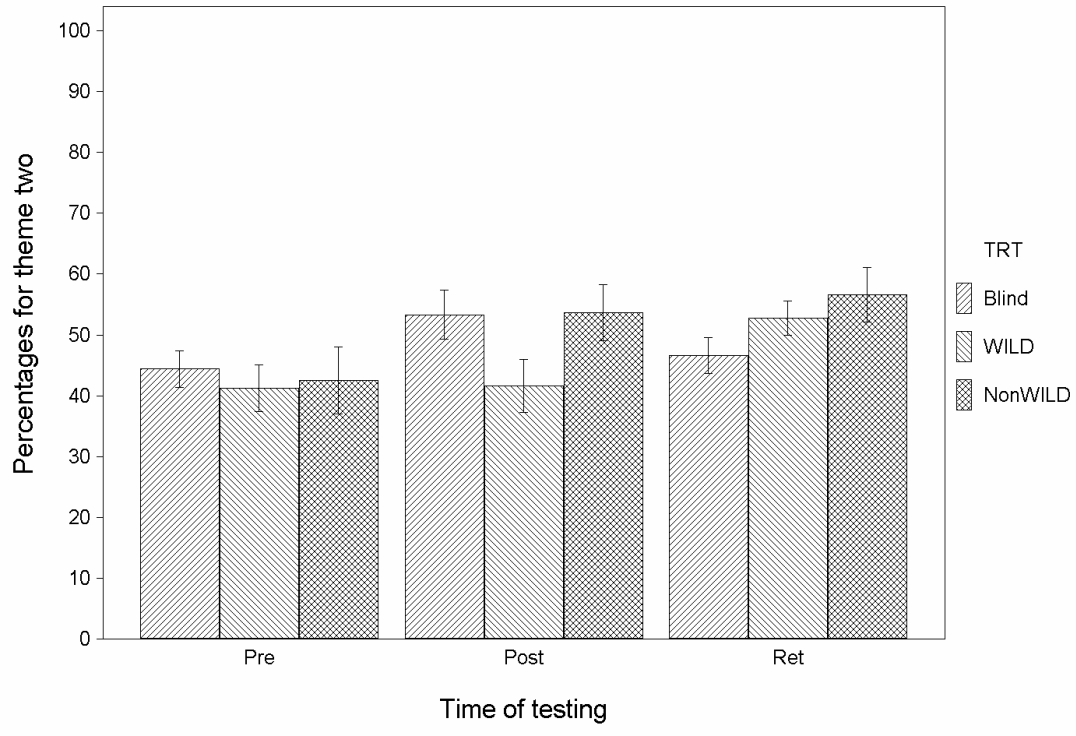

Figure 4. Theme two (Awareness and Appreciation) total percentages for Blind, WILD, and Non-WILD groups for pre-instruction (given at beginning of school year), post-instruction (immediately following presentation of ecosystem function unit – early autumn of school year), and retention (end of school year – six or more months later) testing.

Table 13. Theme 2 total scores: mean, minimum, and maximum values for treatment and time.

Theme 2 totals Treatment/Time	n=	Mean: x/6*	Minimum	Maximum
Blind Pre-test	11	2.66	1.90	3.40
Blind post-test	11	3.20	2.10	4.20
Blind retention test	11	2.80	1.75	3.70
WILD pre-test	8	2.47	1.67	3.50
WILD post-test	8	2.50	1.57	3.50
WILD retention test	8	3.16	2.38	3.89
Non-WILD pre-test	7	2.55	1.42	4.10
Non-WILD post-test	7	3.22	2.00	4.15
Non-WILD retention test	7	3.40	2.40	4.70

*x/6 refers to the total number of points possible for theme two total scores, divided by the number of points scored for the various treatments and times.

Table 14. Theme 2, objective 1 scores: mean, minimum, and maximum values for treatment and time.

Theme 2 / Objective 1 Treatment/Time	n=	Mean: x/3*	Minimum	Maximum
Blind Pre-test	11	1.68	1.11	2.10
Blind post-test	11	1.98	1.35	2.55
Blind retention test	11	1.69	0.95	2.30
WILD pre-test	8	1.52	1.00	2.00
WILD post-test	8	1.62	1.14	2.00
WILD retention test	8	1.96	1.67	2.33
Non-WILD pre-test	7	1.68	0.83	2.65
Non-WILD post-test	7	2.15	1.50	2.63
Non-WILD retention test	7	2.13	1.70	2.75

*x/3 refers to the total number of points possible for theme two, objective one divided by the number of points scored for the various treatments and times.

Table 15. Theme 2, objective 2 scores: mean, minimum, and maximum values for treatment and time.

Theme 2 / Objective 2 Treatment/Time	n=	Mean: x/3	Minimum	Maximum
Blind Pre-test	11	0.99	0.60	1.30
Blind post-test	11	1.22	0.75	1.80
Blind retention test	11	1.11	0.77	1.45
WILD pre-test	8	0.95	0.55	1.50
WILD post-test	8	0.88	0.40	1.50
WILD retention test	8	1.21	0.62	1.56
Non-WILD pre-test	7	0.87	0.53	1.15
Non-WILD post-test	7	1.07	0.50	1.55
Non-WILD retention test	7	1.27	0.70	1.95

*x/3 refers to the total number of points possible for theme two, objective two, divided by the number of points scored for the various treatments and times.

Theme Three

Scores for theme three, *Ecological Principles*, were low. On the pre-test, Blind scores averaged 18%, WILD 20%, and Non-WILD 19%. Post-test averages were 22% for Blind, 20% for WILD, and 27% for non-WILD groups. Retention averages were 19% for Blind, 24% for WILD, and 25% for non-WILD groups (Figure 3; Tables 15-19). Students consistently failed to identify basic characteristics of riparian habitats (objective 1) and to describe ecological roles played by organisms within these habitats (objective 3), students showed a greater ability to identify examples of organisms living in riparian zones (objective 2) and to identify and evaluate potential effects of changes in riparian habitat quality (objective 4). The non-WILD group post-testing total scores were significantly higher than both the Blind and WILD groups and the non-WILD total retention scores were significantly higher than the Blind scores. Other than these differences, no significant differences in student scores were observed among treatment groups (ANOVA, $p = 0.20$) or times (ANOVA, $p = 0.24$).

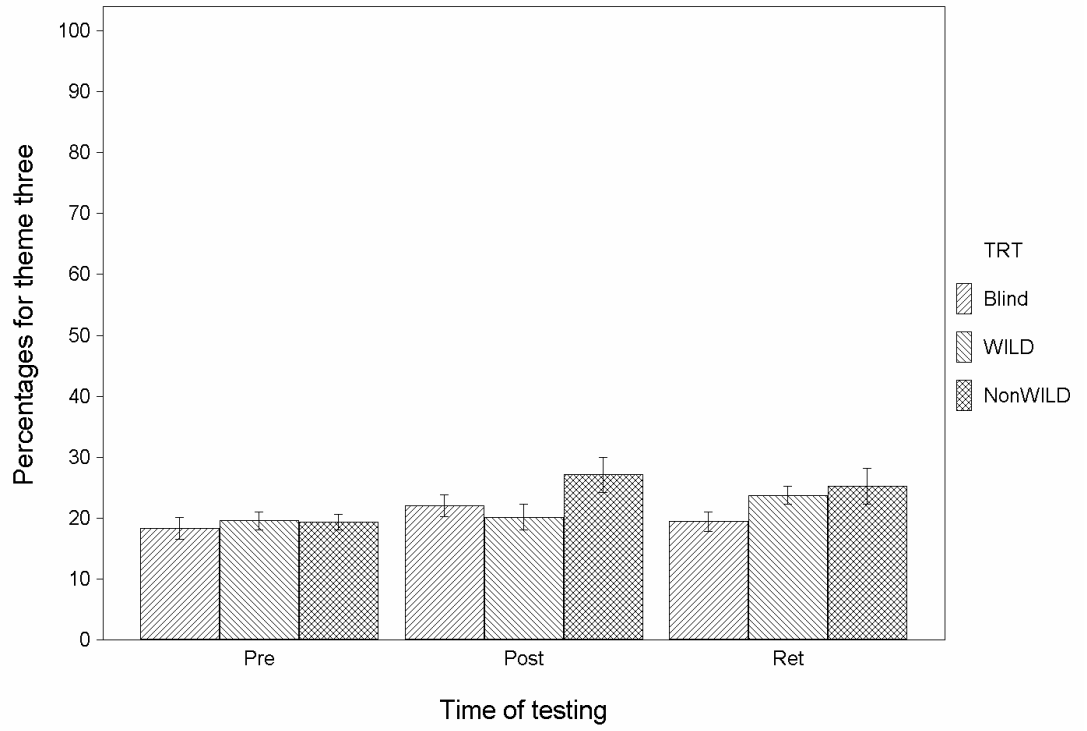

Figure 5. Theme three (Ecological Principles) total percentages for Blind, WILD, and Non-WILD groups for pre-instruction (given at beginning of school year), post-instruction (immediately following presentation of ecosystem function unit – early autumn of school year), and retention (end of school year – six or more months later) testing.

Table 16. Theme 3 total scores: mean, minimum, and maximum values for treatment and time.

Theme 3 totals Treatment/Time	n=	Mean = x/12*	Minimum	Maximum
Blind Pre-test	11	2.20	1.30	3.05
Blind post-test	11	2.64	1.60	3.54
Blind retention test	11	2.33	1.30	3.20
WILD pre-test	8	2.35	1.85	3.25
WILD post-test	8	2.15	1.76	3.75
WILD retention test	8	2.85	2.24	3.39
Non-WILD pre-test	7	2.32	1.83	2.95
Non-WILD post-test	7	3.25	2.00	4.74
Non-WILD retention test	7	3.03	1.95	4.65

*x/12 refers to the total number of points possible for theme three divided by the number of points scored for the various treatments and times.

Table 17. Theme 3, objective 1 scores: mean, minimum, and maximum values for treatment and time.

Theme 3 / Objective 1 Treatment/Time	n=	Mean x/3*	Minimum	Maximum
Blind Pre-test	11	0.03	0.00	0.20
Blind post-test	11	0.06	0.00	0.31
Blind retention test	11	0.03	0.00	0.15
WILD pre-test	8	0.01	0.00	0.10
WILD post-test	8	0.08	0.00	0.38
WILD retention test	8	0.02	0.00	0.06
Non-WILD pre-test	7	0.05	0.00	0.17
Non-WILD post-test	7	0.04	0.00	0.15
Non-WILD retention test	7	0.12	0.00	0.40

*x/3 refers to the total number of points possible for theme three, objective one divided by the number of points scored for the various treatments and times.

Table 18. Theme 3, objective 2 scores: mean, minimum, and maximum values for treatment and time.

Theme 3 / Objective 2 Treatment/Time	n=	Mean : x/3*	Minimum	Maximum
Blind Pre-test	11	0.64	0.20	1.00
Blind post-test	11	0.91	0.47	1.40
Blind retention test	11	0.83	0.25	1.50
WILD pre-test	8	0.89	0.65	1.05
WILD post-test	8	0.89	0.62	1.63
WILD retention test	8	1.07	0.67	1.44
Non-WILD pre-test	7	0.76	0.50	1.05
Non-WILD post-test	7	1.27	0.50	2.05
Non-WILD retention test	7	1.13	0.57	1.85

*x/3 refers to the total number of points possible for theme three, objective two divided by the number of points scored for the various treatments and times.

Table 19. Theme 3, objective 3 scores: mean, minimum, and maximum values for treatment and time.

Theme 3 / Objective 3 Treatment/Time	n=	Mean: x/3*	Minimum	Maximum
Blind Pre-test	11	0.12	0.00	0.30
Blind post-test	11	0.14	0.00	0.45
Blind retention test	11	0.10	0.00	0.20
WILD pre-test	8	0.17	0.00	0.50
WILD post-test	8	0.15	0.05	0.33
WILD retention test	8	0.18	0.00	0.38
Non-WILD pre-test	7	0.11	0.05	0.19
Non-WILD post-test	7	0.21	0.00	0.68
Non-WILD retention test	7	0.17	0.05	0.37

*x/3 refers to the total number of points possible for theme three, objective three divided by the number of points scored for the various treatments and times.

Table 20. Theme 3, objective 4 scores: mean, minimum, and maximum values for treatment and time.

Theme 3 / Objective 4 Treatment/Time	n=	Mean: x/3*	Minimum	Maximum
Blind Pre-test	11	1.42	1.05	1.80
Blind post-test	11	1.55	0.95	1.90
Blind retention test	11	1.37	1.00	1.85
WILD pre-test	8	1.28	0.67	1.75
WILD post-test	8	1.32	1.10	1.55
WILD retention test	8	1.58	1.33	1.75
Non-WILD pre-test	7	1.40	1.08	1.80
Non-WILD post-test	7	1.74	1.38	2.00
Non-WILD retention test	7	1.61	1.30	2.05

*x/3 refers to the total number of points possible for theme three, objective four divided by the number of points scored for the various treatments and times.

Theme Four

Theme Four, *Management and Conservation*, had very low scores. No group averaged higher than 4% during any of the testing periods and 1% was the lowest average (Figure 5; Tables 20-23). Students were, again, somewhat limited by the structuring of the dilemma statement. Some students were able to show an understanding of the concept of native versus wild species, as required for a score value of "1" on objective 1, although they rarely proceeded to go to the extent of the categorization of specific species as native or exotic, a requirement for a score of "2" or "3." A number of students could describe potential effects of the introduction of exotic species (objective 3, 1 point value), but no students mentioned the origin of any local plant or animal species and potential management solutions (objective 3, 2 or 3 point value). So, while the introduction of exotics was mentioned in the dilemma statement, it was not a focus of many students when addressing the problem. It seems either the prompt provided little invitation to

students to actually trace origins of local plants and animals – the focus was upon exotics, or students were not making the necessary connections. No significant differences in student scores were observed among treatment groups (ANOVA, $p = 0.98$) or times (ANOVA, $p = 0.89$).

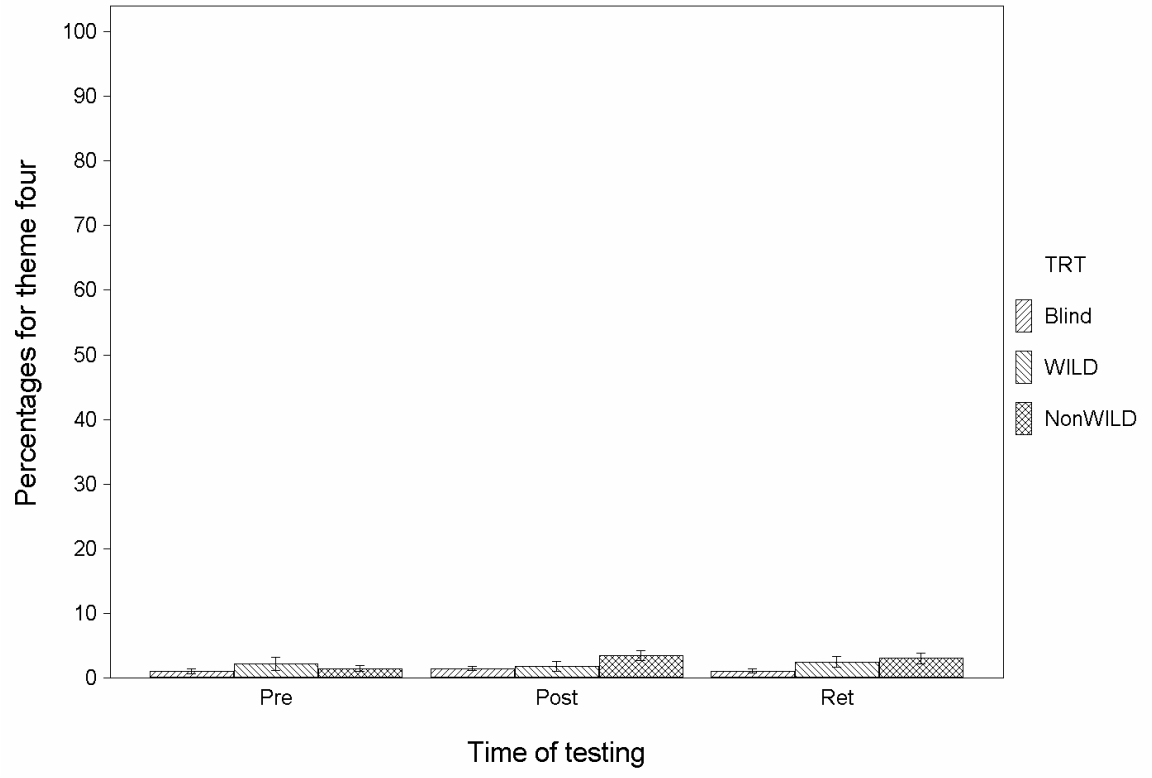

Figure 6. Theme four (Management and Conservation) total percentages for Blind, WILD, and Non-WILD groups for pre-instruction (given at beginning of school year), post-instruction (immediately following presentation of ecosystem function unit – early autumn of school year), and retention (end of school year – six or more months later) testing.

Table 21. Theme 4 total scores: mean, minimum, and maximum values for treatment and time.

Theme four totals: Treatment/Time	n=	Mean: x/9*	Minimum	Maximum
Blind Pre-test	11	0.09	0.00	0.40
Blind post-test	11	0.13	0.00	0.30
Blind retention test	11	0.10	0.00	0.25
WILD pre-test	8	0.19	0.00	0.67
WILD post-test	8	0.16	0.00	0.50
WILD retention test	8	0.22	0.00	0.40
Non-WILD pre-test	7	0.13	0.00	0.30
Non-WILD post-test	7	0.31	0.00	0.58
Non-WILD retention test	7	0.27	0.00	0.52

*x/9 refers to the total number of points possible for theme four divided by the number of points scored for the various treatments and times.

Table 22. Theme 4, objective 1 scores: mean, minimum, and maximum values for treatment and time.

Theme 4 / Objective 1: Treatment/Time	n=	Mean: x/3*	Minimum	Maximum
Blind Pre-test	11	0.05	0.00	0.20
Blind post-test	11	0.09	0.00	0.20
Blind retention test	11	0.06	0.00	0.20
WILD pre-test	8	0.09	0.00	0.33
WILD post-test	8	0.10	0.00	0.25
WILD retention test	8	0.13	0.00	0.28
Non-WILD pre-test	7	0.07	0.00	0.15
Non-WILD post-test	7	0.04	0.00	0.15
Non-WILD retention test	7	0.16	0.00	0.29

*x/3 refers to the total number of points possible for theme four, objective one divided by the number of points scored for the various treatments and times.

Table 23. Theme 4, objective 2 scores: mean, minimum, and maximum values for treatment and time.

Theme 4 / Objective 2: Treatment/Time	n=	Mean: x/3*	Minimum	Maximum
Blind Pre-test	11	0.00	0.00	0.00
Blind post-test	11	0.00	0.00	0.00
Blind retention test	11	0.00	0.00	0.00
WILD pre-test	8	0.00	0.00	0.00
WILD post-test	8	0.00	0.00	0.00
WILD retention test	8	0.00	0.00	0.00
Non-WILD pre-test	7	0.007	0.00	0.05
Non-WILD post-test	7	0.00	0.00	0.00
Non-WILD retention test	7	0.00	0.00	0.00

*x/3 refers to the total number of points possible for theme four, objective two divided by the number of points scored for the various treatments and times.

Table 24. Theme 4, objective 3 scores: mean, minimum, and maximum values for treatment and time.

Theme 4 / Objective 3: Treatment/Time	n=	Mean: x/3*	Minimum	Maximum
Blind Pre-test	11	0.04	0.00	0.20
Blind post-test	11	0.05	0.00	0.15
Blind retention test	11	0.04	0.00	0.11
WILD pre-test	8	0.04	0.00	0.20
WILD post-test	8	0.05	0.00	0.25
WILD retention test	8	0.10	0.00	0.25
Non-WILD pre-test	7	0.05	0.00	0.10
Non-WILD post-test	7	0.21	0.00	0.68
Non-WILD retention test	7	0.11	0.00	0.25

*x/3 refers to the total number of points possible for theme four, objective three divided by the number of points scored for the various treatments and times.

Theme Five

Pre-test score averages for theme five, *Plants and Animals in Our Culture*, were 13% (Blind) and 16% for both WILD and non-WILD groups. Post-test averages were 16% (Blind), 14% (WILD), and 17% (non-WILD). And retention-test scores averaged 14% (Blind) and 16% for both WILD and non-WILD groups. None of the student

responses identified the uses of wildlife or other natural images in this culture or others. Objective 2, measuring the ability to recognize the importance of plants and animals in human culture had higher responses, although still extremely low, with no maximum group score averaging over 1.15 out of a possible 3 points (Figure 4; Tables 24-26). No significant differences in student scores were observed among treatment groups (ANOVA, $p = 0.94$) or times (ANOVA, $p = 0.92$).

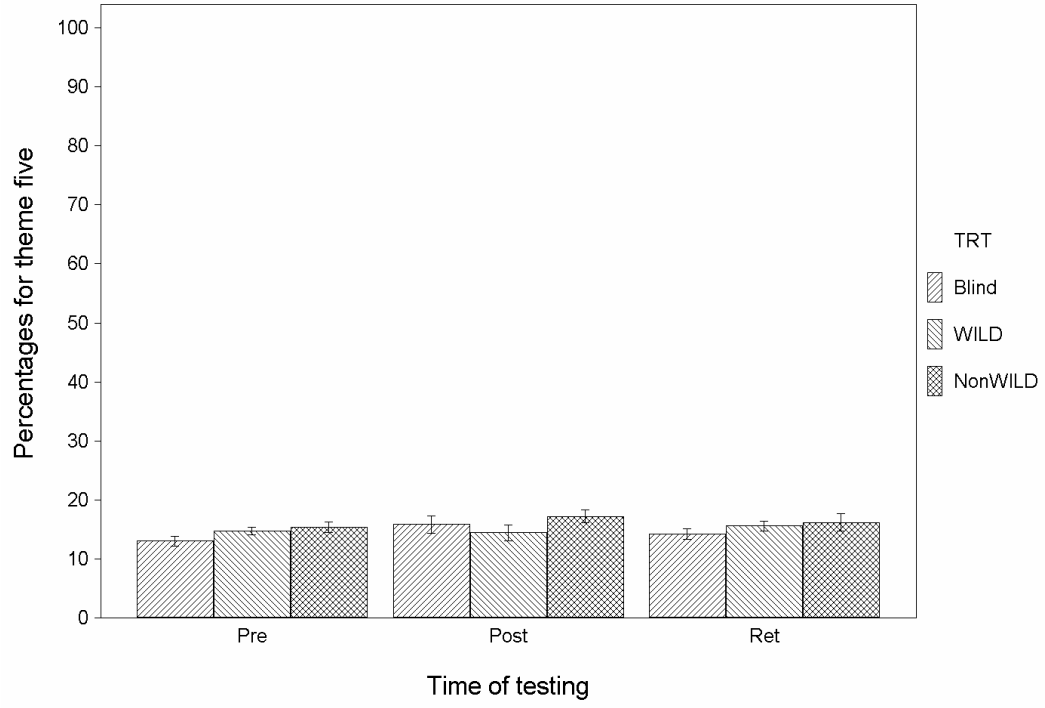

Figure 7. Theme five (Plants and Animals in Our Culture) total percentages for Blind, WILD, and Non-WILD groups for pre-instruction (given at beginning of school year), post-instruction (immediately following presentation of ecosystem function unit – early autumn of school year), and retention (end of school year – six or more months later) testing.

Table 25. Theme 5 total scores: mean, minimum, and maximum values for treatment and time.

Theme five totals: Treatment/Time	n=	Mean : x/6*	Minimum	Maximum
Blind Pre-test	11	0.78	0.55	1.10
Blind post-test	11	0.95	0.60	1.40
Blind retention test	11	0.85	0.65	1.25
WILD pre-test	8	0.88	0.67	1.00
WILD post-test	8	0.87	0.60	1.25
WILD retention test	8	0.94	0.67	1.06
Non-WILD pre-test	7	0.92	0.75	1.15
Non-WILD post-test	7	1.03	0.75	1.26
Non-WILD retention test	7	0.97	0.75	1.45

*x/6 refers to the total number of points possible for theme five divided by the number of points scored for the various treatments and times.

Table 26. Theme 5, objective 1 scores: mean, minimum, and maximum values for treatment and time.

Theme 5 / Objective 1: Treatment/Time	n=	Mean:x/3*	Minimum	Maximum
Blind Pre-test	11	0.01	0.00	0.05
Blind post-test	11	0.00	0.00	0.00
Blind retention test	11	0.00	0.00	0.00
WILD pre-test	8	0.00	0.00	0.00
WILD post-test	8	0.00	0.00	0.00
WILD retention test	8	0.00	0.00	0.00
Non-WILD pre-test	7	0.00	0.00	0.00
Non-WILD post-test	7	0.00	0.00	0.00
Non-WILD retention test	7	0.00	0.00	0.00

*x/3 refers to the total number of points possible for theme five, objective one, divided by the number of points scored for the various treatments and times.

Table 27. Theme 5, objective 2 scores: mean, minimum, and maximum values for treatment and time.

Theme5 / Objective 2: Treatment/Time	n=	Mean:x/3*	Minimum	Maximum
Blind Pre-test	11	0.78	0.50	1.10
Blind post-test	11	0.95	0.60	1.40
Blind retention test	11	0.85	0.65	1.25
WILD pre-test	8	0.88	0.67	1.00
WILD post-test	8	0.87	0.60	1.25
WILD retention test	8	0.94	0.67	1.06
Non-WILD pre-test	7	0.92	0.75	1.15
Non-WILD post-test	7	0.00	0.00	0.00
Non-WILD retention test	7	0.97	0.75	1.45

*x/3 refers to the total number of points possible for theme five, objective two divided by the number of points scored for the various treatments and times.

Theme Six

Theme six, *Evaluating and Solving Environmental Issues*, had relatively higher scores. Pre-test averages were 30% for both Blind and WILD groups and 28% for non-WILD groups. Post-test averages were 34% (Blind), 29% (WILD), and 38% (non-WILD) (Figure 5; Tables 27-30). The non-WILD group scored higher than both the Blind and Wild groups at the post and retention stages of testing. The non-WILD post-test scores were significantly higher than those of the WILD group. This trend is one seen in many of the seven themes.

Students more frequently were able to identify the value of natural resources, their availability for human use, and the connection between our natural resources and a functioning natural environment. They also performed well in identifying at least one viewpoint in a multiple-use management issue and were occasionally able to evaluate costs and benefits of human activities.

However, while these scores appear high, given those of other themes, there is a real concern that the generous framing of the dilemma statement loaded the students with ready information regarding the varying viewpoints involved in the dilemma – the dilemma listed them clearly in order to present the situation clearly enough for such young students. It would be easy for a student to score either one or two points on objective two simply by mentioning a couple of viewpoints listed in the dilemma. But in their evaluation of the costs and benefits, students showed thoughtful, concerned approaches. Within this objective (3) the true voices of the students were heard. It was also remarkable how many of the better scorers excelled in meeting the highest standard for objective 1. On those few occasions, the mastery these students showed through their appropriate use of scientific language and concepts was both impressive and promising. It was also apparent that these students were those with exceptional literacy skills. No significant differences in student scores were observed among treatment groups (ANOVA, $p = 0.28$) or times (ANOVA, $p = 0.57$).

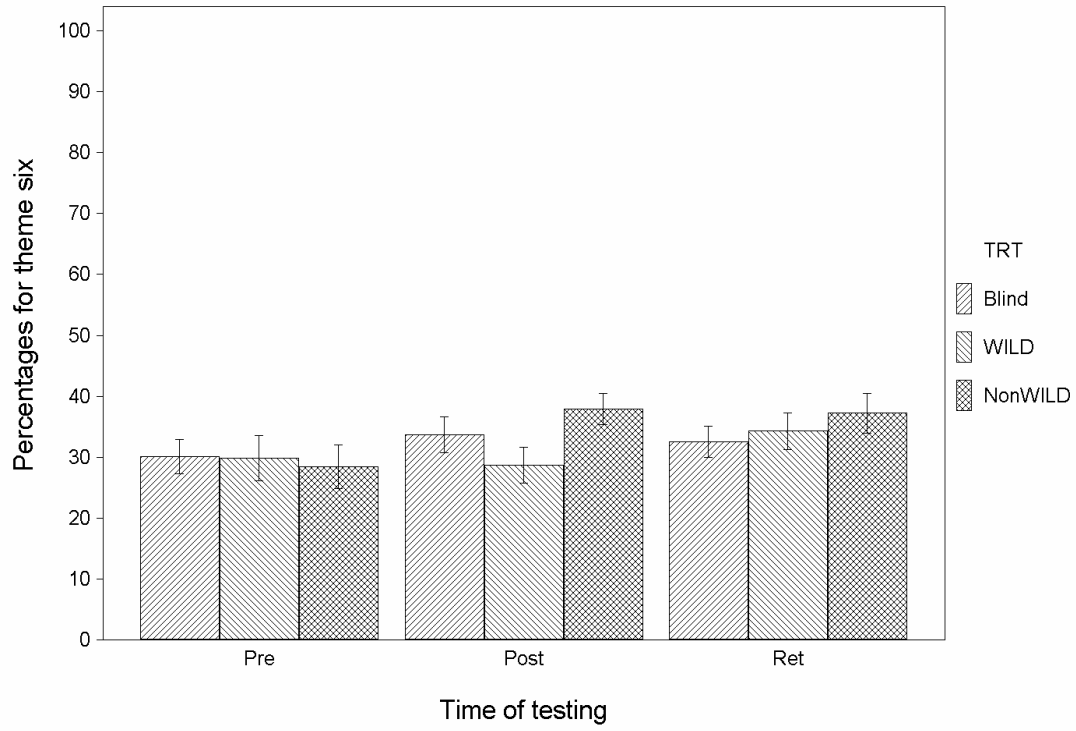

Figure 8. Theme six (Evaluating and Solving Environmental Issues) total percentages for Blind, WILD, and Non-WILD groups for pre-instruction (given at beginning of school year), post-instruction (immediately following presentation of ecosystem function unit – early autumn of school year), and retention (end of school year – six or more months later) testing.

Table 28. Theme 6 total scores: mean, minimum, and maximum values for treatment and time.

Theme six totals: Treatment/Time	n=	Mean: x/9*	Minimum	Maximum
Blind Pre-test	11	2.71	1.75	4.35
Blind post-test	11	3.03	1.85	4.20
Blind retention test	11	2.93	1.85	4.40
WILD pre-test	8	2.68	1.33	4.25
WILD post-test	8	2.58	1.67	3.63
WILD retention test	8	3.08	2.00	4.00
Non-WILD pre-test	7	2.56	1.50	4.00
Non-WILD post-test	7	3.41	2.67	4.47
Non-WILD retention test	7	3.35	2.50	4.60

*x/9 refers to the total number of points possible for theme six divided by the number of points scored for the various treatments and times.

Table 29. Theme 6, objective 1 scores: mean, minimum, and maximum values for treatment and time.

Theme 6 / Objective 1: Treatment/Time	n=	Mean:x/3*	Minimum	Maximum
Blind Pre-test	11	1.01	0.55	1.50
Blind post-test	11	1.20	0.75	1.62
Blind retention test	11	1.16	0.75	1.60
WILD pre-test	8	0.99	0.67	1.25
WILD post-test	8	1.09	0.48	1.50
WILD retention test	8	1.19	0.71	1.61
Non-WILD pre-test	7	1.09	0.67	1.65
Non-WILD post-test	7	1.45	1.08	1.95
Non-WILD retention test	7	1.33	1.05	1.80

*x/3 refers to the total number of points possible for theme six, objective one, divided by the number of points scored for the various treatments and times.

Table 30. Theme 6, objective 2 scores: mean, minimum, and maximum values for treatment and time.

Theme 6 / Objective 2: Treatment/Time	n=	Mean:x/3*	Minimum	Maximum
Blind Pre-test	11	1.40	1.00	1.85
Blind post-test	11	1.52	1.05	1.90
Blind retention test	11	1.44	1.10	1.95
WILD pre-test	8	1.38	0.67	2.13
WILD post-test	8	1.29	0.91	1.88
WILD retention test	8	1.52	1.00	2.00
Non-WILD pre-test	7	1.27	0.75	1.85
Non-WILD post-test	7	1.60	1.25	2.05
Non-WILD retention test	7	1.55	1.08	2.00

*x/3 refers to the total number of points possible for theme six, objective two divided by the number of points scored for the various treatments and times.

Table 31. Theme 6, objective 3 scores: mean, minimum, and maximum values for treatment and time.

Theme 6 / Objective 3: Treatment/Time	n=	Mean:x/3*	Minimum	Maximum
Blind Pre-test	11	0.31	0.00	1.00
Blind post-test	11	0.30	0.00	0.85
Blind retention test	11	0.34	0.00	0.85
WILD pre-test	8	0.31	0.00	1.00
WILD post-test	8	0.21	0.00	0.30
WILD retention test	8	0.38	0.00	0.75
Non-WILD pre-test	7	0.20	0.05	0.50
Non-WILD post-test	7	0.37	0.12	0.60
Non-WILD retention test	7	0.47	0.12	0.80

*x/3 refers to the total number of points possible for theme six, objective three divided by the number of points scored for the various treatments and times.

Theme Seven

The final theme, *Responsible Human Action*, while scores were still low, did have some of the higher averages. On the pre-test, averages were 28% (Blind), 29% (WILD), 26% (non-WILD). Post-test averages were 32% (Blind), 28% (WILD), and 39% (non-WILD), and retention averages were 24% (Blind), 34% (WILD) and 39% (non-WILD)

(Figure 6; Tables 31-33). Again, the non-WILD group scored higher than both Blind and WILD groups at post and retention testing. The non-WILD group's retention scores were significantly higher than those of the Blind group. Other than this, no significant differences in student scores were observed among treatment groups (ANOVA, $p = 0.51$) or times (ANOVA, $p = 0.37$).

Averages reflect even performance on the two objectives of theme seven. Students scored well in identifying and defining types of pollution in general while identifying examples of aquatic pollution and the potential cause and effect relationships involving aquatic-related pollution. Their scores showed an equal ability to properly evaluate the problem in order to make a well-informed decision regarding the pollution.

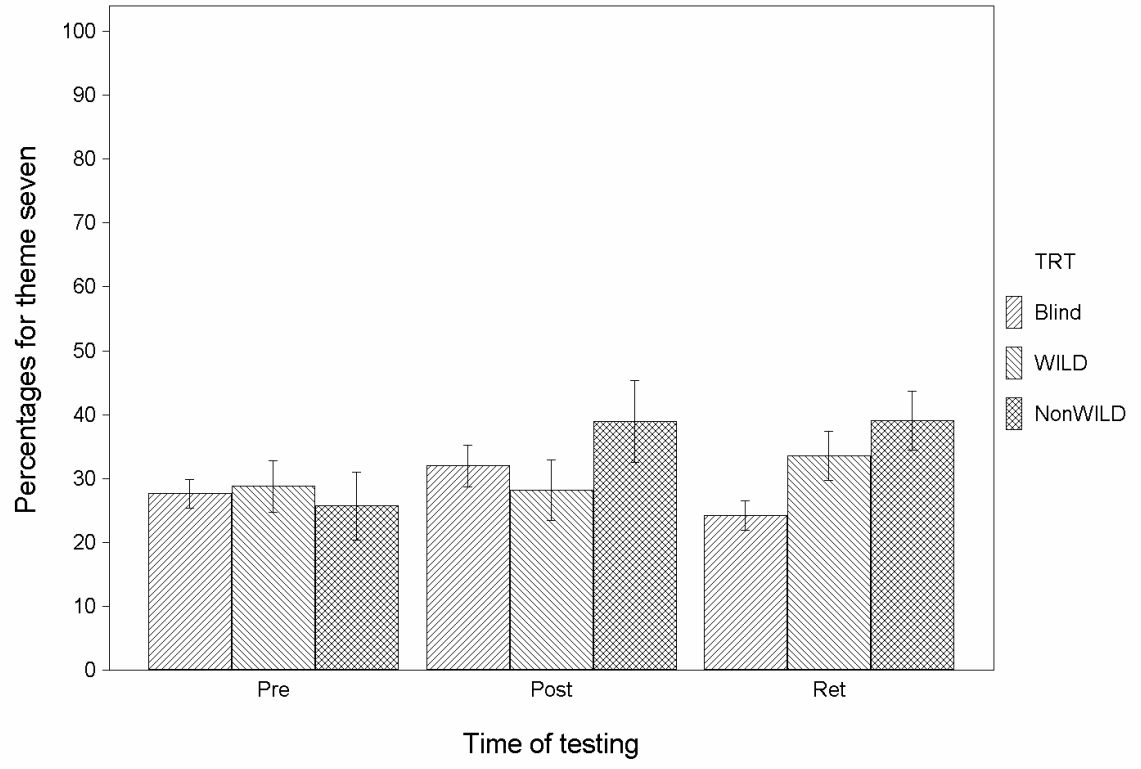

Figure 9. Theme seven (Responsible Human Actions) total percentages for Blind, WILD, and Non-WILD groups for pre-instruction (given at beginning of school year), post-instruction (immediately following presentation of ecosystem function unit – early autumn of school year), and retention (end of school year – six or more months later) testing.

Table 32. Theme 7 total scores: mean, minimum, and maximum values for treatment and time.

Theme seven totals: Treatment/Time	n=	Mean: x/6*	Minimum	Maximum
Blind Pre-test	11	1.66	1.05	2.50
Blind post-test	11	1.92	0.75	2.80
Blind retention test	11	1.45	0.55	2.10
WILD pre-test	8	1.66	1.05	2.50
WILD post-test	8	1.69	0.65	3.00
WILD retention test	8	2.01	1.30	3.00
Non-WILD pre-test	7	1.54	0.25	3.05
Non-WILD post-test	7	2.33	1.00	3.74
Non-WILD retention test	7	2.34	1.45	3.55

*x/6 refers to the total number of points possible for theme seven divided by the number of points scored for the various treatments and times.

Table 33. Theme 7, objective 1 scores: mean, minimum, and maximum values for treatment and time.

Theme 7 / Objective 1: Treatment/Time	n=	Mean	Minimum	Maximum
Blind Pre-test	11	0.86	0.50	1.20
Blind post-test	11	0.98	0.40	1.45
Blind retention test	11	0.78	0.30	1.15
WILD pre-test	8	0.88	0.55	1.50
WILD post-test	8	0.89	0.30	1.75
WILD retention test	8	1.08	0.76	1.88
Non-WILD pre-test	7	0.81	0.08	1.60
Non-WILD post-test	7	1.23	0.52	2.00
Non-WILD retention test	7	1.23	0.75	1.85

*x/3 refers to the total number of points possible for theme seven, objective one divided by the number of points scored for the various treatments and times.

Table 34. Theme 7, objective 2 scores: mean, minimum, and maximum values for treatment and time.

Theme 7 / Objective 2: Treatment/Time	n=	Mean	Minimum	Maximum
Blind Pre-test	11	0.80	0.50	1.30
Blind post-test	11	0.94	0.35	1.45
Blind retention test	11	0.67	0.25	1.00
WILD pre-test	8	0.85	0.65	1.63
WILD post-test	8	0.80	0.35	1.25
WILD retention test	8	0.94	0.50	1.28
Non-WILD pre-test	7	0.73	0.17	1.45
Non-WILD post-test	7	1.10	0.48	1.74
Non-WILD retention test	7	1.12	0.70	1.70

*x/3 refers to the total number of points possible for theme seven, objective two, divided by the number of points scored for the various treatments and times.

Discussion

An initial observation regarding the results from this study was the presence of overall low scores for student performance. The range for total percentage scores for the three treatment groups over the pre, post, and retention testing periods ranged between 18.6% and 25.1%. Scores were consistently low among the treatment groups, showing no statistically significant differences. A number of possibilities might explain these low scores.

First of all, the choice of an assessment method requiring student-written responses from middle school students, while aiming to provide a more sensitive, accurate measurement of student concept mastery, also introduced potentially confounding factors into the study. An open-ended dilemma statement allowed students to respond freely, in their own words. A readability program was used to assist in ensuring that the statement was written at a sixth grade reading level. As our students were sixth, seventh, and eighth graders, this appeared a reasonable adjustment that still

allowed us to maintain the integrity of the material communicated via the dilemma statement. However, it is not uncommon, in South Dakota middle schools, to find reading abilities within any of these grades (6^{th} – 8^{th}) that range from first grade through post high school levels. So, even delivered at a sixth grade reading level, this assessment may have inadvertently been a measure of students' reading abilities rather than of their content-related knowledge (Moskal & Leydens, 2000).

Between 2000 and 2003, South Dakota Governor William Janklow instated a comprehensive primary teacher training program, "Advanced Reading Enhancement Approach," or AREA, embracing a comprehensive literacy framework (South Dakota Department of Education, 2002). The approach includes an emphasis upon "phonemic awareness, phonics instruction, fluency, vocabulary development, and comprehension strategies" (South Dakota Department of Education, 2002). The program will cost the state over six million dollars (South Dakota Department of Education, 2002).

In the Rapid City Area School District, the second largest district in South Dakota and a location of a number of our study groups, a heavy emphasis, particularly in grades K-2, is now placed on literacy skills (Peel, 2002). Cuts were made in the district budget to allow for a number of changes supporting early literacy learning, ie.- reading, writing, and oral skills (Peel, 2002). Rapid City Area School's literacy program is the AREA model now being implemented across the state of South Dakota (Peel, 2002). The adoption of such a state-wide program indicates that there has been a serious problem in the area of literacy with many South Dakota students.

Along with these varying reading abilities are different levels of written communication skills. In scoring student responses, these discrepancies in written communication skill levels were apparent. One possible explanation for the overall pattern of low scoring might be due to the inability of some students to effectively communicate their knowledge in written form. Consistent effort was made to guarantee that individual scores reflected only the presence or absence of statements related to the stated objective criteria. The actual mechanics – grammar, sentence structure, spelling, and to some extent legibility – did not impact the achieved score (Chicago Public Schools, 2001). In a few, isolated cases, legibility of handwriting did contribute to possible loss of score due to the impossibility of accurately interpreting the marks students had made.

Another contributing factor could have been the structuring of the criteria for the seven theme objectives. While the objectives used to frame these criteria were adopted, for each activity used, from the Project WILD manuals, the specific criteria meant to display increasingly sophisticated levels of student understanding oftentimes reflected two important things for consideration. First, as the possible score increased from "0" to "3," higher order thinking skills were called upon. A score of "1" was occasionally available to a student merely through restating some of the revealing information given in the dilemma statement. But a higher score would demand that a student rely solely upon their memory while also calling upon an ability to analyze and apply what they knew, and ultimately to extend their knowledge to the problem before them. These criteria were designed to be sensitive to these varied levels of mastery. Thus, a problem may have

existed in anticipating a stronger showing of high-level responses from students who, in general, were not yet to the requisite stage of cognitive development.

> *Piaget believed that formal operational thought comes into play between the ages of 11 and 15. Formal operational thought is more abstract than a child's thinking. Adolescents are no longer limited to actual concrete experience as the anchor of thought. Instead, they may conjure up make-believe situations, hypothetical possibilities, or purely abstract propositions and reason about them….At the same time as adolescents think more abstractly and idealistically, they also think more logically. Adolescents begin to think more like a scientist, devising plans to solve problems and systematically testing solutions. Hypothetical-deductive reasoning is Piaget's formal operational concept that adolescents have the cognitive ability to develop hypotheses, or best guesses, about ways to solve problems...Only about one in three young adolescents is a formal operational thinker. Many American adults never become formal operational thinkers, and neither do many adults in other cultures* (Santrock, 1997).

A select, small, segment of students was better able to conceptualize abstractly about the problem, apply many facets of their understanding to the problem; and communicate very effectively about their knowledge, thought processes, and opinions. Far more students showed an elementary ability to address the task. Few students were unable to respond in any meaningful way whatsoever. While the assessment criteria were not extraneous to the content covered, some of the processing skills may have been beyond many students' cognitive abilities at the time of testing.

Then, there is the potential problem created by the underlying structures of the educational system itself (Hoody, 1995; Hungerford & Volk, 1990). Regardless of the age group, attempting to assess students using an alternative assessment method when they and their learning are primarily products of a traditional methodology puts them at a disadvantage. There are pros and cons to this possibility. The con side necessitates that studies like this stick to more traditional testing, i.e., multiple choice questioning. But

traditional testing can limit higher order learning. Environmental education focuses, ultimately, on the attainment of the ability to not only recite facts, but to make sound evaluations based on accurate, scientifically founded information, in order to determine appropriate action (or non-action). This requires higher order learning. Such cognitive skills require repeated learning opportunities, delivered in age-appropriate and sequentially logical manner (Phye, 1986), such that students advance to their own highest cognitive potential. Approaching middle school students who have, likely, experienced limited exposure to such a spiraling approach to real life problem solving, and challenging them with objectives intensive in this area, might potentially result in such low overall performance.

A possible pro side is one that many in the field of EE are attempting to address through encouraging the integration of EE curricula into the regular school curricula – the potentially powerful impact of an environmental science component integrated consistently and effectively into a K-16 education toward achieving mature, well-informed individuals able to apply information to current problems in search of the best solution. Interestingly, there is debate regarding the effectiveness of even this infusion approach. For example, Doug Knapp, writing in response to the Thessaloniki declaration of 1997, suggests that anything short of in-depth pre-service and/or in-service training of teachers who would then be capable of presenting the necessary strong, sequential learning process for our students, will miss the mark by a long shot (Knapp, 2000). He also voices serious reservations about what he called the “activity-guide mentality” in EE, warning that these guides, full of piece-meal activities, do not lend themselves

readily enough, at least alone, to attaining the desired learning outcomes, but dangerously provide the illusion that they are sufficient (Knapp, 200).

In retrospect, delivery of a multiple-choice assessment alongside each of the alternative assessments might have been valuable (McMillan, 2000). Perhaps, this would have helped to clarify some of the uncertainties around such markedly low scores, while allowing greater variance between treatment group performances to be revealed. Requiring that teachers grade student responses might also have been helpful. As it was, there was no stipulation regarding whether or not teachers evaluated student responses for their own use. This practice may have varied and influenced results. Lack of this reinforcement may have influenced student motivation in answering the dilemma prompt to the best of their ability.

Also, it became apparent, following the development of the scoring rubric and the final drafting of the dilemma statement, that certain objectives would not receive a fair showing. Due to the limitations of the dilemma statement in equally addressing all eighteen objectives, some objectives were not as readily addressed by students' responses. The assessment instrument proved inadequate in measuring certain knowledge and processing skills specified by the objectives, and thus, the rubric criteria. For example, all scores for Theme One: Observation and Expression were close to zero. The inability of students to make actual observations, rather needing to imagine the scenario as stated in the dilemma, seems to have prevented the majority of students from framing their response around the important role of observations in preparing them to address a problem. When students did respond with auxiliary drawings these often

seemed more an element prompted by the instructor's direction rather than a natural inclusion to their response to the prompt. Use of a pilot group for evaluating the validity of the assessment tool would have been helpful.

Varied levels of experience in teaching science, degrees of comfort with using varied teaching methodologies, the consistency of practice between teachers within the same treatment groups, while being controlled to the best of the study's capability, contribute to possible unknown factors in the study (Gribbons & Herman, 1997). Teachers' potentially varied emphases upon the seven themes, their activities, and objectives may have confounded results.

Again, regarding the randomization of participating teachers, we were unable to randomly select instructors for participation in the study. We found it difficult to recruit volunteers, even while being fortunate enough to be able to provide a graduate credit incentive for our participants – both WILD and non-WILD instructors. Also, after an unexpectedly high level of recidivism in our first year teacher participants, the need for an additional summer training session became apparent. Again, the generosity of the State of South Dakota Game , Fish, and Parks Department allowed us the financial room to increase our subject base at that time. So, while to some extent our samples reflected the voluntary nature of our recruitment restrictions, the study went well beyond single classroom measurements, providing sampling in numerous classrooms across the state of South Dakota.

As previously mentioned, one observation of possible note is the trend of slight increases seen consistently in WILD performance on retention test scores for the majority

of the objectives tested; a trend not consistently present in either of the other two groups. And, although the WILD scores were not necessarily the highest scores, they were the scores showing more noticeable gains across testing periods. Given the findings of Schwaab (1982-3) citing the increased learning potential inherent in educational activities that invite strong student participation, such as those found in the Project WILD curricula, such a trend might be expected. Also, the expectation that students, who are taught concepts in a constructivist manner, would show long-term retention of the activities and their lessons, seems foreshadowed in the findings, mentioned earlier, that Project WILD teacher workshop participants display such behavior (Pitman, 1996). Future studies might investigate the possibility of enhanced learning retention in WILD students, through a design repeating the pre, post, and retention testing procedure.

Designing assessment methodologies that are able to accurately evaluate both product and process gains remains the goal of many in the EE community as well as other groups of educators (Moskal & Leyden, 2000). In that regard, this study was one attempt to investigate the quality of student learning through examining not only simple right or wrong answers, but also the level of proficiency in applying gained knowledge to new situations and attempting to assess this ability in a more sensitive manner. Application of reformed assessment methods to accurately evaluate reformed curriculum needs to be an additional goal of EE researchers (Hoody, 1995). As we found, there are definite challenges for students in being assessed in this manner and there are equal challenges to be met by the researchers in designing and delivering these newer assessments.

This study's inherent flaws stem from its fledgling attempt to move environmental education curricular evaluation into the realm of alternative assessment. Ironically, these flaws, once identified, may represent potential strengths for future studies.

In addition to the cautionary lessons present in this study, recently published guidelines for "conducting and reporting environmental education research," both qualitative and quantitative methods of inquiry, offer a step-by-step framework for maximizing research efforts and minimizing oversight and error (Smith-Sebasto, 2000; Smith-Sebasto, 2001). While these guidelines may contain limitations and biases regarding the qualitative research guidelines requiring additional review and revision (Marcinkowski, 2000), still, many in the field must be applauding these contributions that will surely help to address the ongoing concerns around the quality of research designs used in EE studies, as documented by Gerald Lewis (1982), Frank Leeming et al (1983), Dierking et al (1998), as well as many others. Strong, valid assessment in this field means stronger, more effective EE programs in the long-term. Few would argue with the current need for the most effective EE curricula possible.

We no longer doubt the seriousness of our environmental problems (Wilson, 2002). Now, it is determining the manner by which we balance human needs with those of the rest of the natural world that is contested (Wilson, 2002). A sustainable approach to human life on Earth is essential (Orr, 1992). Science continues to clarify for us how this world of ours works. Social scientists, neuroscientists, economists, and others' investigations are enhancing our ability to understand the many facets at play in our

current environmental and humanistic dilemmas (Wilson, 2002). Education will play a key role in dispensing the growing findings. With the necessary environmental and ethical underpinnings, hopefully, human beings will manage to comprehend their interconnectedness with the natural world, and the damaging impacts of undermining the ecosystems they are dependent upon, in time to avoid greater environmental and societal disaster. An environmental, ethical foundation will need to be incorporated into our educational programs (Sitarz, 1993). We need environmental education to have a prominent place in both our formal and informal education systems (Sitarz, 1993). Strengthened EE curricula - guided by informed professionals in the field, developed with an eye on the ever-growing understanding of all that contributes to our many environmental challenges and potential solutions, evaluated regularly for ultimate effectiveness, and placed in a prominent place in our education system - is indispensable in attaining the ultimate goal of sustainability. Research, capable of determining the ability of various EE curricula to effectively educate about and for the environment is important to this process and needs to be regarded as such.

In conclusion, I add some of Dietrich Bonhoeffer's thoughts cited in the epilogue of David Orr's book, *Ecological Literacy*. In discussing an underlying need for virtue in human thought and action, Orr cites Dietrich Bonhoeffer's statement that "cheap grace is the deadly enemy of our church," adding that in its place he, Bonheoffer, would promote "costly grace" (Orr, 1992). I cannot help but think that it is this latter form of grace, of right thought mixed with right action, which is called for here, also. Even at the level of research, our efforts, in order to be valid, need to reflect a great deal of forethought,

carefully building upon lessons from the past, forging better ground for future efforts, providing guidelines for curriculum development and implementation at many levels (Smith-Sebasto, 1998). Much of great value rests upon our responding to our rather calamitous situation – a human-dominated world seeming about to run amok – with swift, informed wisdom. Environmental educators, along with all educators, have a lot of work to do.

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Attachment A

Project WILD Research Assessment Rubric

(Prepared by Dr. Nels Troelstrup, Maria Kearns, and Year I Workshop Participants)

The following assessment tool will allow student dilemma responses to be scored based upon the criteria listed below. We are utilizing a three-point scale, with a zero for "no demonstration." Scores will be tabulated for each objective, each theme, and finally as a total score.

Theme 1: Observation and Expression

WILD Activity: Wild Words (Basic p. 66)

Objective 1. Students will learn the importance of the role of observation in the scientific method [or] Students will demonstrate awareness of using observation in the solving/answering of problems/questions.

0…no demonstration
1…student documents an example of the use of observation in addressing question
2…student documents the use of observation along with its importance in answering a question scientifically
3…student documents the use of observation, its importance in answering a question, and how this enables individuals to address a problem holistically

Objective 2. Students will be able to describe in writing and drawing their observations.

0…student fails to use any sensory information in writing and/or drawing their observations
1…student uses one of the five senses in writing and/or drawing their observations
2…student uses two of the five senses in writing and/or drawing their observations
3…student uses three or more of the five senses in writing and/or drawing their observations

(visual, auditory, olfactory, gustatory, tactile)

Theme 2: Awareness and Appreciation

WILD Activity: We're In This Together (Basic p. 60)

Objective 1: Students will become familiar with common environmental problems.

0…student does not include the mention of a common environmental problem
1…student mentions one common environmental problem
2…student mentions two common environmental problems
3…student mentions three or more common environmental problems and demonstrates an understanding of their connections with human actions along with their impact upon human, wild, and domesticated populations

Objective 2: Students will recognize that wild plants and animals, domesticated plants and animals, and humans share many needs and concerns.

0…student shows no response
1…student demonstrates an awareness that all living organisms have needs
2…student demonstrates an awareness that wild and domesticated plants and animals have common needs and concerns
3…student demonstrates an awareness that humans' impact on the planet affect their own needs, as well as those of all other living things while creating many mutual concerns

Theme 3: Ecological Principles

WILD Activity: Blue Ribbon Niche (Aquatic p. 72)

Objective 1: Students will be able to describe the basic characteristics of riparian habitats.

0…student shows no response
1…student describes one of the basic characteristics of riparian habitats
2…student describes two of the basic characteristics of riparian habitats
3…student describes two or more of the basic characteristics of riparian habitats while acknowledging their interconnectedness

List of acceptable characteristics (not exclusive):
- different and more abundant vegetation than surrounding areas
- higher percentage of shade
- higher humidity
- more diversity in plants and animals
- width depends upon the amount of available water, soil types, minerals, water table, geologic structure etc.

Some specific to aquatic portion of habitat:
- conditions of bank vegetation
- type of bank vegetation
- type of stream substrate
- types of aquatic organisms present
- evidence of use by terrestrial animals

(additional characteristics can be considered)

Objective 2: Students will be able to identify examples of organisms living in riparian habitats.

0…student shows no response
1…student lists one example of an organisms commonly found in a riparian habitat
2…student lists two examples of organisms commonly found in a riparian habitat
3…student lists two or more examples of organisms commonly found in a riparian habitat while also demonstrating an understanding of their dependence upon other habitat factors

Objective 3: Students will be able to describe ecological roles played by organisms within riparian habitats.

0…student shows no response
1…student describes one ecological role played by organisms within riparian habitats
2…student describes two ecological roles played by organisms within riparian habitats
3…student describes two ecological roles played by organisms within riparian habitats while also displaying an understanding of the integration of such roles at ecosystem-level functioning

Objective 4: Students will demonstrate an ability to evaluate potential positive and negative effects of changes in riparian habitat quality.

0…student shows no response
1…student describes one positive or one negative effect of changes on riparian habitat quality
2…student describes one positive and one negative effect of change on riparian habitat quality
3…student describes one positive and one negative effect of change upon riparian habitat quality and is able to explain reasons for such impact while recognizing potential management solutions to address such effects

Theme 4: Management and Conservation

WILD Activity: Aquatic Roots (Aquatic p. 100)

Objective 1: Students will be able to categorize plants and animals into native and exotic species.

0… student shows no response
1…student categorizes either a plant or an animal species as native or exotic
2…student categorizes two plant or animal species as native or exotic
3…student categorizes three plant or animal species as native or exotic

Objective 2: Students will be able to trace the origins of several species of local plants and animals.

0…student shows no response
1…student traces the origin of one species of local plant or animal species
2…student traces the origins of two species of local plant or animal species
3…student traces the origins of three or more species of plant or animal species

Objective 3: Students will be able to describe the potential effects of exotic species.

0…student shows no response
1…student describes one potential effect (trade-off) of exotic species
2…student describes two potential effects (trade-offs) of exotic species
3…student describes two or more potential effects (trade-offs) of exotic species while also demonstrating an understanding of the potential for accumulative, chain-reaction effects of their introduction

Theme 5: Plants and Animals in Our Culture

WILD Activity: Does Wildlife Sell Cigarettes? (Basic p. 232)

Objective 1: Students will be able to recognize the importance of plants and animals in human culture.

0…student shows no response
1…student mentions that either plants or animals are important in peoples' lives
2…student identifies specific ways that either plants or animals are important in peoples' lives
3…student identifies specific ways that both plants and animals are important in peoples' lives

Objective 2: Students will be able to recognize the importance of plants and animals in human culture.

0…student shows no response
1…student shows concern for an impact upon wildlife or domestic populations (plant/animal)
2…student shows concern for an impact upon wildlife or domestic populations (plant/animal) while providing specific reasons for such concern
3…student shows concern for an impact upon wildlife or domestic or domestic populations (plant/animal), providing specific reasons for such concern, while also mentioning the cultural significance of a plant or animal population

(Note: students may allude to this point)

Theme 6: Evaluating and Solving Environmental Issues

WILD Activity: Planning for People and Wildlife (Basic p. 284)

Objective 1: Students will learn the definition of a natural resource.

(1) is a portion of the environment
(2) has value
(3) is available for use to humankind

0…student shows no response
1…student lists or discusses one part of the definition of a natural resource
2…student lists or discusses two parts of the definition of a natural resource
3…student lists or discusses all three parts of the definition of a natural resource

Objective 2: Students will demonstrate an ability to address different human perspectives and conflicting issues in multiple-use management.

0…student shows no response
1…student demonstrates the ability to address one viewpoint in multiple-use management issue
2…student demonstrates the ability to address two viewpoints in multiple-use management issue
3…student demonstrates the ability to address three or more viewpoints in multiple-use management issue

Objective 3: Students will gain an appreciation of evaluating costs and benefits associated with an activity and learn to evaluate the off-site long-term impacts associated with an activity.

0…no response
1…student identifies a multiple-use land management practice
2…student identifies the proposed action of a multiple-use land management decision
3…student identifies the losses and gains of the action

Theme 7: Responsible Human Actions

WILD Activity: Something's Fishy Here (Aquatic p. 176)

Objective 1: Students will be able to define and identify different types of pollution.

0…student shows no response
1…student lists without defining one type of pollution
2…student lists and defines one type of pollution
3…student lists and defines two or more types of pollution

Objective 2: Students will be able to identify potential cause and effect relationships involving aquatic-related pollution and can generate and evaluate alternative solutions to problems caused by these pollutants

0…student shows no response
1…student mentions the presence of a cause and effect relationship involving aquatic-related pollution
2…student mentions both cause and effect relationships involving aquatic-related pollution while offering a potential solution to problems caused by these pollutants
3…student mentions the presence of a cause and effect relationship involving aquatic-related pollution while outlining a plan to initiate environmental action to reduce the negative consequences of such pollution

Attachment B

PROJECT WILD
Dilemma Issue

You own a home downstream from a proposed golf course development. The current landowner upstream from you has been encouraged to sell his land. An outside developer wants to build a golf course on your neighbor's land.

This land is native prairie. It is an area of one square mile. A medium stream runs through the property. This stream provides excellent fishing for warm water game fish (like northern pike, smallmouth bass, and bluegill). Willow and cottonwood trees line the stream valley. These trees provide cover for turkey, deer, and other wildlife. The Northern Red Belly Snake, a state threatened species, has also been found on this property.

Many local residents are against the golf course. They are concerned about bad things happening to the quality of the water. They are also worried about impacts to fish and wildlife on the property.

Several farmers use the stream for irrigation and water for livestock. They are concerned about pesticides and fertilizers. They worry that these will run off from the golf course and into the stream.

Fisheries managers are concerned that construction activities will remove trees in the riparian zone around the stream. They worry that this might cause erosion on the stream banks.

Wildlife managers are concerned that native grasses and trees will be replaced by exotic species. They worry that exotic grasses and ornamental bushes could cause a change in local wildlife.

Local school children are afraid that they will lose their swimming hole. Many swim in the creek just downstream from the proposed golf course. They worry that the stream will get polluted.

Other people within the community like the idea of the golf course. People here aren't wealthy. There aren't many jobs for teens. The golf course would attract tourists and golfers from nearby. These people would spend money at local stores. There would be more jobs for local teens and adults.

The developer claims that the golf course would boost people's incomes. Jobs created by the golf course would help the local economy.

The whole issue is up in the air. Several town meetings will be held. They will discuss possible good and bad results of building a golf course. People here want facts. They want to know how the golf course will change the area. They want to know what they'll lose. They want to know what they'll gain.

What do you think will happen if the golf course is built? Can you help people in your community with their dilemma?

Attachment C

April 17, 1999

Dear Project Applicant:

Thank you for your interest in the Project WILD research project workshop. We are happy to inform you that you are guaranteed a spot in our research project! The objectives of our Project WILD assessment are to (1) assess the Project WILD program in South Dakota, (2) provide training to deliver an ecosystem science unit in the middle school classroom and (3) evaluate student classroom performance following instruction using traditional and WILD activities.

Our Project WILD project is a combination instruction and research effort supported by the South Dakota Department of Game, Fish and Parks. Enrolled teachers receive instruction and materials during a three day summer workshop. Teachers are split into two groups (traditional and WILD). One group will provide instruction on ecosystems using traditional teaching methods while the other will present a similar unit using WILD activities. Student performance is evaluated using an alternative assessment tool designed during our pilot-year workshop (1998). Performance assessment is conducted three times during the following school year (immediately before and immediately after the ecosystem unit instruction as well as in the late spring of the same school year). Student performance data are submitted for analysis to examine (1) changes in performance as a result of using WILD activities and (2) retention of knowledge and performance. This information will be used by the SD GF&P to support continued growth and commitment toward education in wildlife conservation.

Teachers come out great on this deal! You'll receive two graduate credits for participating in our workshop and effort during the following school year. Your tuition, fees, and travel expenses are covered through our grant. You'll receive a load of useful activities and resource materials for use in your classroom. There is a catch. You must commit to the entire effort (workshop and follow-up) now. We have many applicants but we are only able to work with a limited number of teachers. Thus, your commitment is necessary to ensure a spot.

To confirm your spot in our Project WILD effort (1) send us a letter confirming your total commitment to the workshop and follow-up, (2) include your name, summer and school address, phone numbers(s) and social security number (for registration purposes). Once we receive your letter, we'll take care of the registration.

You'll receive confirmation of your registration along with any further updates prior to June 1st. Remember, our workshop is scheduled for June 28-30. If for any reason you are not able to commit totally to this project, please let us know within the next two weeks so that we may open your spot to another applicant.

Please feel free to contact us with any questions or concerns (Nels Troelstrup – 605-688-5503; Maria Kearns – 605-341-3567). See you the end of June!

Best regards,

Nels H. Troelstrup, Jr.
Director – Oak Lake Field Station

Maria Swain Kearns
23061 Hisega Road
Rapid City, SD 57702

encl.

Research Participants:

To assist you in preparing for the workshop we'd like to outline basic arrival and departure times as well as other needs, requirements and suggestions.

As you can see from the enclosed itinerary, all participants are expected at the field station prior to our 6:30pm start-up time on Monday, June 28th. Arrival between 4:00pm and 6:00pm is recommended to allow for settling in before dinner.

Departure is scheduled for after 5:00pm on June 30th.

When packing for your stay please be sure to bring the following:

- Bedding (pillow along with either sheets or a blanket/comforter or sleeping bag)
- Toiletries (soap, shampoo, towels, along with sunscreen, insect repellent, etc.)
- Field clothing (boots, old shoes, long pants, warm clothes, jackets – think practicality as this is a field experience)
- Writing materials such as notebooks, pens, pencils
- Snacks and beverages if desired (beyond normal meal offerings; refrigerator available)
- Approximately $40.00 to cover the cost of meals and lodging for duration of workshop (your only expense)

Keep in mind the crazy South Dakota weather we might see. Clothing needs may be more diverse than normal for the month of June. Be prepared for cold, hot, dry, or wet conditions. Time allowing, we will spend time canoeing, hiking, and exploring the area so come prepared to have a great time no matter what weather we are handed.

Enclosed is a map that should provide adequate directions for finding the field station. If you have any additional questions about directions or anything not included in this mailing, please contact one of us.

We look forward to working with you!

Nels H. Troelstrup, Jr.
Maria Swain Kearns

Project WILD Research
Itinerary

DAY	TIME	ACTIVITY
Sunday, June 28	4:00pm – 6:00pm	Arrive at field station, check-in and get settled
	6:30pm	Dinner
	7:30pm	Orientation Meeting
	8:30 – 10:00pm	Free time and open discussion
Monday, June 29	8:00pm – 9:00am	Breakfast
	9:00am – 10:30am	Ecosystem unit exercises (introduction and breakout)
	10:30am – 10:45am	Break
	10:45am – 12:00pm	Ecosystem unit exercises (introduction and breakout)
	12:00pm – 1:00pm	Lunch
	1:00pm – 2:30pm	Ecosystem unit exercises (introduction and breakout)
	2:30pm – 2:45pm	Break
	2:45pm – 5:00pm	Ecosystem unit exercises (introduction and breakout)
	5:00pm – 6:30pm	Free Time
	6:30pm – 7:30pm	Dinner
	7:30pm – 9:00pm	Presentation on Assessment/Project rubric
	9:00pm	Free time and open discussion
Tuesday, June 30	8:00am – 9:00am	Breakfast
	9:00am – 10:30am	Ecosystem unit exercises (introduction and breakout)
	10:30am – 10:45am	Break
	10:45am – 12:00pm	Brainstorming/Online session -“traditional” teachers Planning/Discussion session for “WILDs”
	12:00pm – 1:00pm	Lunch
	1:00pm – 2:30pm	Project Guidelines, Deadlines, and Expectations
	2:30pm – 2:45pm	Break
	2:45pm – 5:00pm	Workshop overview, evaluation and closure

Attachment D

30 June 1998

Dear WILD Friends (I know you're all WILD at heart even if some must pretend to be "traditional"):

Summer finally made it to the western part of the state. The fact that most days are still too cool to hit the beach doesn't really matter since I have no time to play anyway!

This is a brief note to say, again, how pleased I am that you're going to be working with me on this project. Your involvement has already been extremely helpful. Our rubric has been typed up and both Nels and I will be going over it for an initial revision. You'll be receiving a copy before too long. Please look it over and make any suggestions at that time.

If you have any questions in mind, don't hesitate to give me a call or email me. I will be gone for much of the remainder of the summer, but I'll be checking my email from afar.

Have a wonderful July…put some play time in for me!

WILDly yours,
Maria Swain Kearns
23061 Hisega Rd.
Rapid City, SD 57702
341-3567
mkearns@rapidnet.com

Attachment E

30 July 1998

Greetings to all our WILD research participants!

Who can believe that August is upon us? Soon we'll be returning to our classrooms with our creative juices rejuvenated, our minds loaded with new ideas. Hopefully, the ecosystem unit has inspired some reflection over the past month and you're all preparing to have fun learning more about how the world works with your students.

We have prepared an intermediary draft of the ecosystem unit assessment rubric. You will find a copy enclosed with this mailing for your revision. If you have suggestions for its improvement please mark the copy and mail it to Maria at the address given below. Prior to September 1st, you will be mailed a final copy for your reference in approaching the delivery of your unit.

A few simple reminders before the school year begins:

1) You are an important part of this research project and your efforts are very appreciated!
2) You will be mailed a **pre-test** late-summer for deliver to your students prior to teaching the unit.
3) "WILD" teachers will deliver the unit with the Project WILD activities as centerpieces of their delivery.
4) "Non-WILD" teachers will deliver the unit via more traditional methods making a point of avoiding both Project WILD and similar curriculum in their instruction.
5) Your students will journal throughout these units.
6) You will test your students again **(test #2)** directly following the completion of the unit.
7) You will deliver the final test **(test #3)** prior to March 15, 1999.
8) Testing results should be mailed upon each completion. The journals and final testing results will be mailed in later in the school year.
9) Any and all questions are welcome. Please contact us for clarification of any sort.

We hope the remaining weeks of summer are lovely, relaxing ones and that this finds all of you well.

Sincerely,

Maria Kearns
Nels Troelstrup

Maria Swain Kearns
23061 Hisega Rd.
Rapid City, SD 57702
341-3567 (h)
mkearns@rapidnet.com

Nels Troelstrup
SDSU office 688-5503
Troelstn@mg.sdstate.edu

Attachment F

30 August 1998

Greetings to all our "blind" WILD research participants:

Who can believe that a new school year is upon us? Soon we'll be on a first name basis with our students. Hopefully, the summer has rejuvenated all of us and we'll be prepared to enjoy our very energetic students.

As members of our blind control group of teachers, you play a very important role in our Project WILD research project. In attempting to achieve a high degree of reliability in our study it is essential that we provide as large a baseline as possible. This is the role of our "blind" participants.

Here are a number of guidelines to direct you as you participate in the project:

1. You are an important part of this research and **your efforts are very appreciated!**
2. We've enclosed materials for pre-instructional journaling (a dilemma statement which your students will read on their own and respond to on paper). Please deliver this to your students between September 15th and 30th to guarantee continuity in the study.
3. You will test your students again (**assessment #2**) with the **same dilemma statement some time between October and December.**
4. You will deliver the final test (**assessment #3**) between **May 15th and 30th**.
5. Testing results should be mailed upon each completion. The final testing results need to be mailed in **by June 1st.**
6. Students should be allowed **30 minutes** of time in which to respond to the dilemma statement during each of the three assessments.
7. Teachers **should NOT provide students with any feedback** about their dilemma responses. It would be best to avoid looking over the students' papers other than to prepare them for mailing.
8. PLEASE NOTE: **TEACHERS ARE NOT TO READ THROUGH THE DILEMMA STATEMENT.** THIS GUIDELINE WILL PROTECT YOU FROM UNINTENTIONALLY CONTAMINATING ANY OF THE RESULTS.
9. Any and all questions are welcome. Please contact either of us for clarification of any sort.

Because you will not intentionally be teaching to the specific objectives as our other groups of teachers will, your assessment periods may not actually take the 30 minutes that others will need for their students to respond to the dilemma statement. While students should be encouraged to take as much of the time allotted (30 minutes) for answering the prompt, it's possible that many will complete their response in a shorter period of time.

We must stress that your participation in this study, one that will evaluate the effectiveness of Project WILD in South Dakota middle school classrooms, is very important. We are here to support your efforts in any way possible, so please contact us with any needs or concerns.

Sincerely,

Maria Kearns
Nels Troelstrup

Maria Kearns
23061 Hisega Rd.
Rapid City, SD 57702
341-3567 (H)
mkearns@rapidnet.com

Important Reminders

1. **Student names** must be on all papers submitted!

2. You are NOT to read the dilemma statement.

3. Students are to be given **30 minutes** to respond to the dilemma statement during each testing.

4. Any questions are welcome:
   Maria Swain Kearns
   23061 Hisega Rd.
   Rapid City, SD 57702
   (605) 341-3567
   mkearns@rapidnet.com

5. **You are an important part of this research project** and your efforts are extremely valuable to us and highly appreciated

Attachment G

Maria Swain Kearns
23061 Hisega Rd.
Rapid City, SD 57702
mkearns@rapidnet.com
(605) 341 – 3567

15 November 1999

Dear Project WILD Research Project Teachers:

The school year is racing past! Our weather in Rapid City has been too good to believe. While it's impossible to think we could have a Floridian winter, it's reassuring to know that as we've hit the mid-November mark there's less time left for winter's chills. Regardless, I do plan to enjoy snow-laden hills and snowflakes falling quietly from a white sky…up to a point.

I hope your school year is going well. Thank you all for the excellent work done back in September. The packets we received were in on time, met the guidelines of the study, and are currently being coded by support staff at SDSU (thank you Alethea!).

Now that it's mid-November, we're nearing the deadline for the second student assessments! Again it's extremely important that you have your students put their full names at the tops of their papers. Remember, by November 30th all student responses are due in the mail. Please mail those to:

Dr. Nels Troelstrup
Dept. of Biology and Microbiology
Box 2207B
SDSU
Brookings, SD 57707-0595

Enclosed is an extra copy of the dilemma statement. Again, allow your students up to 40 minutes to complete their individual responses to the dilemma. Students are to read the dilemma on their own, to the best of their ability.

If you are a member of the BLIND study group, remember, it is essential that your classroom instruction not be altered in any way that addresses the dilemma statement. Of course, if you normally cover issues and content related to the dilemma, then you continue doing so. It would be best for you to simply avoid reading over the statement yourself as this will make it less likely that you unintentionally teach to the dilemma.

Please contact me with any questions or concerns and thanks again for your contribution to this research!

Sincerely,

Maria Swain Kearns

Attachment H

12 March 2000

Greetings to all Project WILD Research Participants!

Are you as excited as I am that our daylight hours are on the increase and that spring is around the corner? Summer can't come too soon for me! I spent much of this fall and winter scoring student response papers from the 1998/1999 research efforts. Last year's data is ready to be analyzed just in time for your final student assessments to be completed and mailed.

I'm also celebrating what a successful contribution this year's group of teachers has made to our project. You've been FANTASTIC and so on-the-ball that it's very encouraging. Our participation this year has been double that of the previous year and will definitely enhance our findings. Thanks to each and every one of you!

So, like I mentioned, there's one last assessment to do that's coming up fairly soon. This is a friendly reminder to get your retention testing completed and in the mail before the **30th of April**. Remember, you can plan this assessment for sometime during the final two weeks of April, and if necessary can even sneak it in a few days earlier if there's a planning conflict.

If you are a member of the WILD or nonWILD groups (not BLIND) you will also need to send us your student journals at this time, if you have not already done so! Remember to mail all student work to Dr. Troelstrup at the address listed below.

Mailing Address:

Dr. Nels Troelstrup
Dept. of Biology and Microbiology
Box 2207B
SDSU
Brookings, SD 57007-0595

Thank you again for your participation in this study. We will notify you of our findings some time in the spring of 2001. Please call me with any concerns. I'd be happy to visit and clarify any points.

I have included a copy of the dilemma statement in case yours has been misplaced and also a short list of reminders.

Sincerely,

Maria Swain Kearns

Table 35. Data for Theme 1: Total Scores and Objectives 1 & 2 Scores

YEAR	CLASS ROOM	TIME	TRT	REP	Theme 1 Total Scores	Theme1 Obj. 1 Scores	Theme 1 Obj. 2 Scores
1998	5	1	1	1	0.00	0.00	0.00
1998	8	1	1	2	0.00	0.00	0.00
1999	9	1	1	3	0.00	0.00	0.00
1999	10	1	1	4	0.00	0.00	0.00
1999	11	1	1	5	0.00	0.00	0.00
1999	13	1	1	6	0.00	0.00	0.00
1999	15	1	1	7	0.00	0.00	0.00
1999	17	1	1	8	0.00	0.00	0.00
1999	20	1	1	9	0.00	0.00	0.00
1999	21	1	1	10	0.00	0.00	0.00
1999	24	1	1	11	0.00	0.00	0.00
1998	5	2	1	1	0.00	0.00	0.00
1998	8	2	1	2	0.00	0.00	0.00
1999	9	2	1	3	0.00	0.00	0.00
1999	10	2	1	4	0.00	0.00	0.00
1999	11	2	1	5	0.00	0.00	0.00
1999	13	2	1	6	0.00	0.00	0.00
1999	15	2	1	7	0.00	0.00	0.00
1999	17	2	1	8	0.00	0.00	0.00
1999	20	2	1	9	0.00	0.00	0.00
1999	21	2	1	10	0.00	0.00	0.00
1999	24	2	1	11	0.00	0.00	0.00
1998	5	3	1	1	0.15	0.15	0.00
1998	8	3	1	2	0.00	0.00	0.00
1999	9	3	1	3	0.00	0.00	0.00
1999	10	3	1	4	0.00	0.00	0.00
1999	11	3	1	5	0.00	0.00	0.00
1999	13	3	1	6	0.00	0.00	0.00
1999	15	3	1	7	0.00	0.00	0.00
1999	17	3	1	8	0.00	0.00	0.00
1999	20	3	1	9	0.00	0.00	0.00
1999	21	3	1	10	0.00	0.00	0.00
1999	24	3	1	11	0.00	0.00	0.00
1998	6	1	2	1	0.00	0.00	0.00
1998	7	1	2	2	m	m	m
1999	12	1	2	3	0.00	0.00	0.00
1999	18	1	2	4	0.00	0.00	0.00
1999	19	1	2	5	0.00	0.00	0.00
1999	23	1	2	6	0.00	0.00	0.00

1999	25	1	2	7	0.00	0.00	0.00
1999	26	1	2	8	0.00	0.00	0.00
m	m	1	2	9	m	m	m
m	m	1	2	10	m	m	m
m	m	1	2	11	m	m	m
1998	6	2	2	1	0.00	0.00	0.00
1998	7	2	2	2	m	m	m
1999	12	2	2	3	0.00	0.00	0.00
1999	18	2	2	4	0.00	0.00	0.00
1999	19	2	2	5	0.00	0.00	0.00
1999	23	2	2	6	0.00	0.00	0.00
1999	25	2	2	7	0.00	0.00	0.00
1999	26	2	2	8	0.20	0.15	0.05
m	m	2	2	9	m	m	M
m	m	2	2	10	m	m	M
m	m	2	2	11	m	m	M
1998	6	3	2	1	0.00	0.00	0.00
1998	7	3	2	2	m	m	M
1999	12	3	2	3	0.00	0.00	0.00
1999	18	3	2	4	0.00	0.00	0.00
1999	19	3	2	5	0.00	0.00	0.00
1999	23	3	2	6	0.00	0.00	0.00
1999	25	3	2	7	0.00	0.00	0.00
1999	26	3	2	8	0.10	0.05	0.05
m	m	3	2	9	m	m	m
m	m	3	2	10	m	m	m
m	m	3	2	11	m	m	m
1998	1	1	3	1	0.05	0.05	0.00
1998	2	1	3	2	0.00	0.00	0.00
1998	3	1	3	3	0.05	0.05	0.00
1998	4	1	3	4	0.00	0.00	0.00
1999	14	1	3	5	0.00	0.00	0.00
1999	16	1	3	6	0.00	0.00	0.00
1999	22	1	3	7	0.00	0.00	0.00
m	m	1	3	8	m	m	m
m	m	1	3	9	m	m	m
m	m	1	3	10	m	m	m
m	m	1	3	11	m	m	m
1998	1	2	3	1	0.00	0.00	0.00
1998	2	2	3	2	0.00	0.00	0.00
1998	3	2	3	3	0.00	0.00	0.00
1998	4	2	3	4	0.00	0.00	0.00

1999	14	2	3	5	0.00	0.00	0.00
1999	16	2	3	6	0.00	0.00	0.00
1999	22	2	3	7	0.00	0.00	0.00
m	m	2	3	8	m	m	m
m	m	2	3	9	m	m	m
m	m	2	3	10	m	m	m
m	m	2	3	11	m	m	m
1998	1	3	3	1	0.00	0.00	0.00
1998	2	3	3	2	0.00	0.00	0.00
1998	3	3	3	3	0.00	0.00	0.00
1998	4	3	3	4	0.00	0.00	0.00
1999	14	3	3	5	0.00	0.00	0.00
1999	16	3	3	6	0.00	0.00	0.00
1999	22	3	3	7	0.00	0.00	0.00
m	m	3	3	8	m	m	m
m	m	3	3	9	m	m	m
m	m	3	3	10	m	m	m
m	m	3	3	11	m	m	m

“m” – missing value
“TIME 1” – pretest
“TIME 2” – posttest
“TIME 3” – retention test
“TRT 1” – blind treatment group
“TRT 2” – WILD treatment group
“TRT 3” – non-WILD treatment group

Table 36. Data for Theme 2: Total Scores and Objectives 1 & 2 Scores

YEAR	CLASS ROOM	TIME	TRT	REP	Theme 2 Total Scores	Theme 2 Obj. 1 Scores	Theme 2 Obj. 2 Scores
1998	5	1	1	1	2.85	1.80	1.05
1998	8	1	1	2	2.69	1.85	0.85
1999	9	1	1	3	2.25	1.30	0.95
1999	10	1	1	4	3.20	2.00	1.20
1999	11	1	1	5	3.40	2.10	1.30
1999	13	1	1	6	3.40	2.10	1.30
1999	15	1	1	7	2.10	1.50	0.60
1999	17	1	1	8	1.95	1.11	0.84
1999	20	1	1	9	3.30	2.05	1.25
1999	21	1	1	10	2.25	1.40	0.85
1999	24	1	1	11	1.90	1.20	0.70
1998	5	2	1	1	4.00	2.55	1.45
1998	8	2	1	2	3.85	2.46	1.39
1999	9	2	1	3	2.50	1.70	0.80
1999	10	2	1	4	3.55	2.20	1.35
1999	11	2	1	5	2.20	1.35	0.85
1999	13	2	1	6	3.25	2.10	1.15
1999	15	2	1	7	4.15	2.35	1.80
1999	17	2	1	8	2.84	1.63	1.21
1999	20	2	1	9	4.20	2.45	1.75
1999	21	2	1	10	2.10	1.35	0.75
1999	24	2	1	11	2.55	1.65	0.90
1998	5	3	1	1	2.70	1.70	1.00
1998	8	3	1	2	2.77	2.00	0.77
1999	9	3	1	3	2.20	1.25	0.95
1999	10	3	1	4	2.55	1.50	1.05
1999	11	3	1	5	2.80	1.70	1.10
1999	13	3	1	6	3.70	2.30	1.40
1999	15	3	1	7	3.50	2.05	1.45
1999	17	3	1	8	2.63	1.47	1.16
1999	20	3	1	9	3.55	2.15	1.40
1999	21	3	1	10	2.60	1.50	1.10
1999	24	3	1	11	1.75	0.95	0.80
1998	6	1	2	1	1.80	1.25	0.55
1998	7	1	2	2	m	m	m
1999	12	1	2	3	2.43	1.71	0.71
1999	18	1	2	4	3.50	2.00	1.50
1999	19	1	2	5	2.75	1.65	1.10
1999	23	1	2	6	2.67	1.50	1.17

1999	25	1	2	7	1.67	1.00	0.67
1999	26	1	2	8	2.50	1.55	0.95
m	m	1	2	9	m	m	m
m	m	1	2	10	m	m	m
m	m	1	2	11	m	m	m
1998	6	2	2	1	1.85	1.45	0.40
1998	7	2	2	2	m	m	m
1999	12	2	2	3	1.57	1.14	0.43
1999	18	2	2	4	3.50	2.00	1.50
1999	19	2	2	5	2.40	1.55	0.85
1999	23	2	2	6	2.61	1.56	1.06
1999	25	2	2	7	2.33	1.67	0.67
1999	26	2	2	8	3.20	1.95	1.25
m	m	2	2	9	m	m	m
m	m	2	2	10	m	m	m
m	m	2	2	11	m	m	m
1998	6	3	2	1	3.15	2.05	1.10
1998	7	3	2	2	m	m	m
1999	12	3	2	3	2.38	1.76	0.62
1999	18	3	2	4	3.13	1.88	1.25
1999	19	3	2	5	3.20	1.90	1.30
1999	23	3	2	6	3.89	2.33	1.56
1999	25	3	2	7	3.00	1.67	1.33
1999	26	3	2	8	3.40	2.10	1.30
m	m	3	2	9	m	m	m
m	m	3	2	10	m	m	m
m	m	3	2	11	m	m	m
1998	1	1	3	1	2.25	1.65	0.60
1998	2	1	3	2	1.42	0.83	0.58
1998	3	1	3	3	2.60	1.85	0.75
1998	4	1	3	4	4.10	2.65	1.45
1999	14	1	3	5	2.71	1.62	1.10
1999	16	1	3	6	3.00	1.90	1.11
1999	22	1	3	7	1.77	1.24	0.53
m	m	m1	3	8	m	m	m
m	m	m1	3	9	m	m	m
m	m	m1	3	10	m	m	m
m	m	m1	3	11	m	m	m
1998	1	2	3	1	3.15	2.25	0.90
1998	2	2	3	2	2.00	1.50	0.50
1998	3	2	3	3	3.00	2.05	0.95
1998	4	2	3	4	4.15	2.60	1.55

1999	14	2	3	5	2.81	1.67	1.14
1999	16	2	3	6	3.95	2.63	1.32
1999	22	2	3	7	3.47	2.35	1.12
m	m	2	3	8	m	m	m
m	m	2	3	9	m	m	m
m	m	2	3	10	m	m	m
m	m	2	3	11	m	m	m
1998	1	3	3	1	3.35	2.25	1.10
1998	2	3	3	2	2.92	1.83	1.08
1998	3	3	3	3	2.40	1.70	0.70
1998	4	3	3	4	4.70	2.75	1.95
1999	14	3	3	5	3.19	1.86	1.33
1999	16	3	3	6	3.63	2.26	1.37
1999	22	3	3	7	3.59	2.24	1.35
m	m	3	3	8	m	m	m
m	m	3	3	9	m	m	m
m	m	3	3	10	m	m	m
m	m	3	3	11	m	m	m

“m” – missing value
“TIME 1” – pretest
“TIME 2” – posttest
“TIME 3” – retention test
“TRT 1” – blind treatment group
“TRT 2” – WILD treatment group
“TRT 3” – non-WILD treatment group

Table 37. Data for Theme 3: Total Scores and Objectives 1, 2, 3 & 4 Scores

YEAR	CLS RM	TIME	TRT	REP	Theme 3 Total Scores	Theme 3 Obj. 1 Scores	Theme 3 Obj. 2 Scores	Theme 3 Obj. 3 Scores	Theme 3 Obj. 4 Scores
1998	5	1	1	1	3.05	0.20	0.95	0.25	1.65
1998	8	1	1	2	2.31	0.00	0.69	0.08	1.54
1999	9	1	1	3	1.50	0.00	0.20	0.00	1.30
1999	10	1	1	4	2.95	0.05	1.00	0.30	1.60
1999	11	1	1	5	2.70	0.00	0.90	0.20	1.60
1999	13	1	1	6	2.70	0.00	0.85	0.05	1.80
1999	15	1	1	7	1.75	0.00	0.60	0.00	1.15
1999	17	1	1	8	1.53	0.00	0.37	0.11	1.05
1999	20	1	1	9	3.05	0.00	1.00	0.30	1.75
1999	21	1	1	10	1.40	0.00	0.25	0.00	1.15
1999	24	1	1	11	1.30	0.05	0.20	0.00	1.05
1998	5	2	1	1	3.10	0.00	1.25	0.00	1.85
1998	8	2	1	2	3.54	0.31	1.15	0.23	1.85
1999	9	2	1	3	2.25	0.00	0.80	0.10	1.35
1999	10	2	1	4	3.10	0.15	1.10	0.20	1.65
1999	11	2	1	5	2.05	0.00	0.65	0.05	1.35
1999	13	2	1	6	2.90	0.05	0.75	0.20	1.90
1999	15	2	1	7	3.50	0.00	1.40	0.45	1.65
1999	17	2	1	8	1.95	0.00	0.47	0.00	1.47
1999	20	2	1	9	3.20	0.00	1.25	0.20	1.75
1999	21	2	1	10	1.60	0.05	0.60	0.00	0.95
1999	24	2	1	11	1.90	.0.05	0.50	0.05	1.30
1998	5	3	1	1	2.95	0.15	1.00	0.05	1.75
1998	8	3	1	2	2.23	0.08	0.77	0.00	1.39
1999	9	3	1	3	2.20	0.00	0.85	0.15	1.20
1999	10	3	1	4	2.15	0.00	0.80	0.20	1.15
1999	11	3	1	5	2.45	0.05	0.80	0.20	1.40
1999	13	3	1	6	3.20	0.00	1.15	0.20	1.85
1999	15	3	1	7	3.15	0.00	1.50	0.20	1.45
1999	17	3	1	8	1.79	0.00	0.53	0.00	1.26
1999	20	3	1	9	2.75	0.05	1.10	0.00	1.60
1999	21	3	1	10	1.45	0.00	0.40	0.05	1.00
1999	24	3	1	11	1.30	0.00	0.25	0.00	1.05
1998	6	1	2	1	1.85	0.00	0.65	0.05	1.15
1998	7	1	2	2	m	m	m	m	m
1999	12	1	2	3	2.14	0.00	0.76	0.00	1.38
1999	18	1	2	4	3.25	0.00	1.00	0.50	1.75
1999	19	1	2	5	2.50	0.00	1.05	0.15	1.30
1999	23	1	2	6	2.22	0.00	0.94	0.00	1.28

1999	25	1	2	7	2.00	0.00	1.00	0.33	0.67
1999	26	1	2	8	2.45	0.10	0.80	0.15	1.40
m	m	1	2	9	m	m	m	m	m
m	m	1	2	10	m	m	m	m	m
m	m	1	2	11	m	m	m	m	m
1998	6	2	2	1	2.15	0.10	0.85	0.05	1.15
1998	7	2	2	2	m	m	m	m	m
1999	12	2	2	3	1.76	0.00	0.62	0.05	1.10
1999	18	2	2	4	3.75	0.38	1.63	0.25	1.50
1999	19	2	2	5	1.90	0.00	0.65	0.05	1.20
1999	23	2	2	6	2.39	0.00	0.94	0.06	1.39
1999	25	2	2	7	2.33	0.00	0.67	0.33	1.33
1999	26	2	2	8	2.65	0.05	0.85	0.20	1.55
m	m	2	2	9	m	m	m	m	m
m	m	2	2	10	m	m	m	m	m
m	m	2	2	11	m	m	m	m	m
1998	6	3	2	1	2.95	0.00	1.20	0.10	1.65
1998	7	3	2	2	m	m	m	m	m
1999	12	3	2	3	2.24	0.00	0.67	0.10	1.48
1999	18	3	2	4	3.38	0.00	1.25	0.38	1.75
1999	19	3	2	5	2.60	0.00	0.85	0.20	1.55
1999	23	3	2	6	3.39	0.06	1.44	0.22	1.67
1999	25	3	2	7	2.33	0.00	1.00	0.00	1.33
1999	26	3	2	8	3.05	0.05	1.10	0.25	1.65
m	m	3	2	9	m	m	m	m	m
m	m	3	2	10	m	m	m	m	m
m	m	3	2	11	m	m	m	m	m
1998	1	1	3	1	2.25	0.10	0.75	0.05	1.35
1998	2	1	3	2	1.83	0.17	0.50	0.08	1.08
1998	3	1	3	3	2.70	0.05	0.95	0.15	1.55
1998	4	1	3	4	2.95	0.00	1.05	0.10	1.80
1999	14	1	3	5	2.33	0.00	0.86	0.19	1.29
1999	16	1	3	6	2.21	0.00	0.68	0.11	1.42
1999	22	1	3	7	1.94	0.00	0.53	0.12	1.30
m	m	1	3	8	m	m	m	m	m
m	m	1	3	9	m	m	m	m	m
m	m	1	3	10	m	m	m	m	m
m	m	1	3	11	m	m	m	m	m
1998	1	2	3	1	3.05	0.00	1.25	0.05	1.75
1998	2	2	3	2	2.00	0.00	0.50	0.00	1.50
1998	3	2	3	3	2.65	0.15	0.80	0.00	1.70
1998	4	2	3	4	4.00	0.15	1.60	0.30	1.95

1999	14	2	3	5	2.81	0.00	1.19	0.24	1.38
1999	16	2	3	6	4.74	0.00	2.05	0.68	2.00
1999	22	2	3	7	3.53	0.00	1.47	0.18	1.88
m	m	2	3	8	m	m	m	m	m
m	m	2	3	9	m	m	m	m	m
m	m	2	3	10	m	m	m	m	m
m	m	2	3	11	m	m	m	m	m
1998	1	3	3	1	2.55	0.10	1.00	0.05	1.40
1998	2	3	3	2	3.33	0.33	1.33	0.08	1.58
1998	3	3	3	3	1.95	0.00	0.60	0.05	1.30
1998	4	3	3	4	4.65	0.40	1.85	0.35	2.05
1999	14	3	3	5	2.05	0.00	0.57	0.14	1.33
1999	16	3	3	6	3.21	0.00	1.21	0.37	1.63
1999	22	3	3	7	3.47	0.00	1.35	0.18	1.94
m	m	3	3	8	m	m	m	m	m
m	m	3	3	9	m	m	m	m	m
m	m	3	3	10	m	m	m	m	m
m	m	3	3	11	m	m	m	m	m

“m” – missing value
“TIME 1” – pretest
“TIME 2” – posttest
“TIME 3” – retention test
“TRT 1” – blind treatment group
“TRT 2” – WILD treatment group
“TRT 3” – non-WILD treatment group

Table 38. Data for Theme 4: Total Scores and Objectives 1, 2, & 3 Scores

YEAR	CLASS ROOM	TIME	TRT	REP	Theme 4 Total Scores	Theme 4 Obj. 1 Scores	Theme 4 Obj. 2 Scores	Theme 4 Obj. 3 Scores
1998	5	1	1	1	0.40	0.20	0.00	0.20
1998	8	1	1	2	0.23	0.08	0.00	0.15
1999	9	1	1	3	0.00	0.00	0.00	0.00
1999	10	1	1	4	0.00	0.00	0.00	0.00
1999	11	1	1	5	0.05	0.05	0.00	0.00
1999	13	1	1	6	0.05	0.05	0.00	0.00
1999	15	1	1	7	0.05	0.05	0.00	0.00
1999	17	1	1	8	0.11	0.05	0.00	0.05
1999	20	1	1	9	0.15	0.10	0.00	0.05
1999	21	1	1	10	0.00	0.00	0.00	0.00
1999	24	1	1	11	0.00	0.00	0.00	0.00
1998	5	2	1	1	0.30	0.15	0.00	0.15
1998	8	2	1	2	0.08	0.08	0.00	0.00
1999	9	2	1	3	0.20	0.10	0.00	0.10
1999	10	2	1	4	0.25	0.20	0.00	0.05
1999	11	2	1	5	0.00	0.00	0.00	0.00
1999	13	2	1	6	0.10	0.10	0.00	0.00
1999	15	2	1	7	0.20	0.10	0.00	0.10
1999	17	2	1	8	0.05	0.05	0.00	0.00
1999	20	2	1	9	0.15	0.10	0.00	0.05
1999	21	2	1	10	0.00	0.00	0.00	0.00
1999	24	2	1	11	0.10	0.05	0.00	0.05
1998	5	3	1	1	0.10	0.10	0.00	0.00
1998	8	3	1	2	0.15	0.08	0.00	0.08
1999	9	3	1	3	0.10	0.05	0.00	0.05
1999	10	3	1	4	0.00	0.00	0.00	0.00
1999	11	3	1	5	0.00	0.00	0.00	0.00
1999	13	3	1	6	0.00	0.00	0.00	0.00
1999	15	3	1	7	0.25	0.20	0.00	0.05
1999	17	3	1	8	0.21	0.11	0.00	0.11
1999	20	3	1	9	0.25	0.15	0.00	0.10
1999	21	3	1	10	0.00	0.00	0.00	0.00
1999	24	3	1	11	0.00	0.00	0.00	0.00
1998	6	1	2	1	0.05	0.05	0.00	0.00
1998	7	1	2	2	m	m	m	m
1999	12	1	2	3	0.05	0.05	0.00	0.00
1999	18	1	2	4	0.38	0.13	0.00	0.25
1999	19	1	2	5	0.10	0.05	0.00	0.05
1999	23	1	2	6	0.00	0.00	0.00	0.00

1999	25	1	2	7	0.67	0.33	0.00	0.33
1999	26	1	2	8	0.10	0.05	0.00	0.05
m	m	1	2	9	m	m	m	m
m	m	1	2	10	m	m	m	m
m	m	1	2	11	m	m	m	m
1998	6	2	2	1	0.25	0.25	0.00	0.00
1998	7	2	2	2	m	m	m	m
1999	12	2	2	3	0.00	0.00	0.00	0.00
1999	18	2	2	4	0.25	0.13	0.00	0.13
1999	19	2	2	5	0.05	0.05	0.00	0.00
1999	23	2	2	6	0.06	0.06	0.00	0.00
1999	25	2	2	7	0.00	0.00	0.00	0.00
1999	26	2	2	8	0.50	0.25	0.00	0.25
m	m	2	2	9	m	m	m	m
m	m	2	2	10	m	m	m	m
m	m	2	2	11	m	m	m	m
1998	6	3	2	1	0.40	0.15	0.00	0.25
1998	7	3	2	2	m	m	m	m
1999	12	3	2	3	0.00	0.00	0.00	0.00
1999	18	3	2	4	0.38	0.25	0.00	0.125
1999	19	3	2	5	0.00	0.00	0.00	0.00
1999	23	3	2	6	0.39	0.28	0.00	0.11
1999	25	3	2	7	0.00	0.00	0.00	0.00
1999	26	3	2	8	0.40	0.20	0.00	0.20
m	m	3	2	9	m	m	m	m
m	m	3	2	10	m	m	m	m
m	m	3	2	11	m	m	m	m
1998	1	1	3	1	0.10	0.05	0.00	0.05
1998	2	1	3	2	0.00	0.00	0.00	0.00
1998	3	1	3	3	0.25	0.15	0.00	0.10
1998	4	1	3	4	0.30	0.15	0.05	0.10
1999	14	1	3	5	0.14	0.10	0.00	0.05
1999	16	1	3	6	0.00	0.00	0.00	0.00
1999	22	1	3	7	0.12	0.06	0.00	0.06
m	m	1	3	8	m	m	m	m
m	m	1	3	9	m	m	m	m
m	m	1	3	10	m	m	m	m
m	m	1	3	11	m	m	m	m
1998	1	2	3	1	0.25	0.20	0.00	0.05
1998	2	2	3	2	0.00	0.00	0.00	0.00
1998	3	2	3	3	0.35	0.25	0.00	0.10
1998	4	2	3	4	0.35	0.15	0.00	0.20

1999	14	2	3	5	0.24	0.10	0.00	0.14
1999	16	2	3	6	0.58	0.32	0.00	0.26
1999	22	2	3	7	0.41	0.24	0.00	0.18
m	m	2	3	8	m	m	m	m
m	m	2	3	9	m	m	m	m
m	m	2	3	10	m	m	m	m
m	m	2	3	11	m	m	m	m
1998	1	3	3	1	0.15	0.15	0.00	0.00
1998	2	3	3	2	0.00	0.00	0.00	0.00
1998	3	3	3	3	0.30	0.15	0.00	0.15
1998	4	3	3	4	0.50	0.25	0.00	0.25
1999	14	3	3	5	0.52	0.29	0.00	0.24
1999	16	3	3	6	0.37	0.21	0.00	0.16
1999	22	3	3	7	0.10	0.06	0.00	0.00
m	m	3	3	8	m	m	m	m
m	m	3	3	9	m	m	m	m
m	m	3	3	10	m	m	m	m
m	m	3	3	11	m	m	m	m

“m” – missing value
“TIME 1” – pretest
“TIME 2” – posttest
“TIME 3” – retention test
“TRT 1” – blind treatment group
“TRT 2” – WILD treatment group
“TRT 3” – non-WILD treatment group

Table 39. Data for Theme 5: Total Scores and Obj. 1 & 2 Scores

YEAR	CLASS ROOM	TIME	TRT	REP	Theme 5 Total Scores	Theme 5 Obj. 1 Scores	Theme 5 Obj. 2 Scores
1998	5	1	1	1	1.10	0.00	1.10
1998	8	1	1	2	0.85	0.00	0.85
1999	9	1	1	3	0.70	0.00	0.70
1999	10	1	1	4	0.90	0.00	0.90
1999	11	1	1	5	0.95	0.00	0.95
1999	13	1	1	6	0.85	0.00	0.85
1999	15	1	1	7	0.65	0.00	0.65
1999	17	1	1	8	0.79	0.00	0.79
1999	20	1	1	9	0.70	0.00	0.70
1999	21	1	1	10	0.55	0.00	0.55
1999	24	1	1	11	0.55	0.05	0.50
1998	5	2	1	1	1.35	0.00	1.35
1998	8	2	1	2	1.31	0.00	1.31
1999	9	2	1	3	0.85	0.00	0.85
1999	10	2	1	4	0.95	0.00	0.95
1999	11	2	1	5	0.65	0.00	0.65
1999	13	2	1	6	1.00	0.00	1.00
1999	15	2	1	7	1.40	0.00	1.40
1999	17	2	1	8	0.79	0.00	0.79
1999	20	2	1	9	0.85	0.00	0.85
1999	21	2	1	10	0.60	0.00	0.60
1999	24	2	1	11	0.70	0.00	0.70
1998	5	3	1	1	1.25	0.00	1.25
1998	8	3	1	2	0.77	0.00	0.77
1999	9	3	1	3	0.75	0.00	0.75
1999	10	3	1	4	0.80	0.00	0.80
1999	11	3	1	5	0.80	0.00	0.80
1999	13	3	1	6	0.85	0.00	0.85
1999	15	3	1	7	1.10	0.00	1.10
1999	17	3	1	8	0.68	0.00	0.68
1999	20	3	1	9	0.95	0.00	0.95
1999	21	3	1	10	0.65	0.00	0.65
1999	24	3	1	11	0.75	0.00	0.75
1998	6	1	2	1	0.85	0.00	0.85
1998	7	1	2	2	m	m	m
1999	12	1	2	3	0.91	0.00	0.91
1999	18	1	2	4	0.88	0.00	0.88
1999	19	1	2	5	0.95	0.00	0.95
1999	23	1	2	6	0.94	0.00	0.94

1999	25	1	2	7	0.67	0.00	0.67
1999	26	1	2	8	1.00	0.00	1.00
m	m	1	2	9	m	m	m
m	m	1	2	10	m	m	m
m	m	1	2	11	m	m	m
1998	6	2	2	1	0.60	0.00	0.60
1998	7	2	2	2	m	m	m
1999	12	2	2	3	0.86	0.00	0.86
1999	18	2	2	4	1.25	0.00	1.25
1999	19	2	2	5	1.00	0.00	1.00
1999	23	2	2	6	0.83	0.00	0.83
1999	25	2	2	7	0.67	0.00	0.67
1999	26	2	2	8	0.85	0.00	0.85
m	m	2	2	9	m	m	m
m	m	2	2	10	m	m	m
m	m	2	2	11	m	m	m
1998	6	3	2	1	0.95	0.00	0.95
1998	7	3	2	2	m	m	m
1999	12	3	2	3	1.00	0.00	1.00
1999	18	3	2	4	0.88	0.00	0.88
1999	19	3	2	5	0.95	0.00	0.95
1999	23	3	2	6	1.10	0.00	1.10
1999	25	3	2	7	0.67	0.00	0.67
1999	26	3	2	8	1.05	0.00	1.05
m	m	3	2	9	m	m	m
m	m	3	2	10	m	m	m
m	m	3	2	11	m	m	m
1998	1	1	3	1	0.90	0.00	0.90
1998	2	1	3	2	0.75	0.00	0.75
1998	3	1	3	3	1.05	0.00	1.05
1998	4	1	3	4	1.15	0.00	1.15
1999	14	1	3	5	1.00	0.00	1.00
1999	16	1	3	6	0.84	0.00	0.84
1999	22	1	3	7	0.77	0.00	0.77
m	m	1	3	8	m	m	m
m	m	1	3	9	m	m	m
m	m	1	3	10	m	m	m
m	m	1	3	11	m	m	m
1998	1	2	3	1	1.10	0.00	1.10
1998	2	2	3	2	0.75	0.00	0.75
1998	3	2	3	3	0.90	0.00	0.90
1998	4	2	3	4	1.20	0.00	1.20

1999	14	2	3	5	0.95	0.00	0.95
1999	16	2	3	6	1.26	0.00	1.26
1999	22	2	3	7	1.10	0.00	1.10
m	m	2	3	8	m	m	m
m	m	2	3	9	m	m	m
m	m	2	3	10	m	m	m
m	m	2	3	11	m	m	m
1998	1	3	3	1	0.75	0.00	0.75
1998	2	3	3	2	1.00	0.00	1.00
1998	3	3	3	3	0.75	0.00	0.75
1998	4	3	3	4	1.45	0.00	1.45
1999	14	3	3	5	0.90	0.00	0.900
1999	16	3	3	6	0.95	0.00	0.95
1999	22	3	3	7	1.00	0.00	1.00
m	m	3	3	8	m	m	m
m	m	3	3	9	m	m	m
m	m	3	3	10	m	m	m
m	m	3	3	11	m	m	m

“m” – missing value
“TIME 1” – pretest
“TIME 2” – posttest
“TIME 3” – retention test
“TRT 1” – blind treatment group
“TRT 2” – WILD treatment group
“TRT 3” – non-WILD treatment group

Table 40. Data for Theme 6: Total and Objectives 1, 2, & 3 Scores

YEAR	CLASS ROOM	TIME	TRT	REP	Theme 6 Total Scores	Theme 6 Obj. 1 Scores	Theme 6 Obj. 2 Scores	Theme 6 Obj. 3 Scores
1998	5	1	1	1	4.35	1.50	1.85	1.00
1998	8	1	1	2	3.39	1.46	1.54	0.39
1999	9	1	1	3	1.80	0.80	1.00	0.00
1999	10	1	1	4	3.15	1.15	1.50	0.50
1999	11	1	1	5	3.10	1.20	1.50	0.40
1999	13	1	1	6	2.95	1.05	1.60	0.30
1999	15	1	1	7	2.25	0.75	1.25	0.25
1999	17	1	1	8	1.79	0.74	1.10	0.00
1999	20	1	1	9	3.30	1.20	1.75	0.35
1999	21	1	1	10	1.75	0.55	1.05	0.15
1999	24	1	1	11	2.00	0.70	1.25	0.05
1998	5	2	1	1	4.00	1.60	1.80	0.60
1998	8	2	1	2	3.69	1.62	1.69	0.39
1999	9	2	1	3	2.25	1.05	1.10	0.10
1999	10	2	1	4	3.75	1.55	1.85	0.35
1999	11	2	1	5	2.30	0.75	1.35	0.20
1999	13	2	1	6	3.45	1.35	1.70	0.40
1999	15	2	1	7	4.20	1.45	1.90	0.85
1999	17	2	1	8	2.32	0.84	1.47	0.00
1999	20	2	1	9	3.50	1.30	1.80	0.40
1999	21	2	1	10	1.85	0.75	1.05	0.05
1999	24	2	1	11	2.00	0.95	1.05	0.00
1998	5	3	1	1	4.40	1.60	1.95	0.85
1998	8	3	1	2	3.23	1.31	1.46	0.46
1999	9	3	1	3	2.50	0.95	1.35	0.20
1999	10	3	1	4	2.55	1.10	1.15	0.30
1999	11	3	1	5	2.80	1.10	1.30	0.40
1999	13	3	1	6	3.70	1.45	1.85	0.40
1999	15	3	1	7	3.55	1.40	1.60	0.55
1999	17	3	1	8	2.16	0.90	1.21	0.05
1999	20	3	1	9	3.25	1.30	1.65	0.30
1999	21	3	1	10	2.25	0.85	1.20	0.20
1999	24	3	1	11	1.85	0.75	1.10	0.00
1998	6	1	2	1	3.15	1.15	1.50	0.50
1998	7	1	2	2	m	m	m	m
1999	12	1	2	3	2.33	0.71	1.24	0.38
1999	18	1	2	4	4.25	1.25	2.125	0.88
1999	19	1	2	5	2.60	1.10	1.35	0.15
1999	23	1	2	6	2.61	1.11	1.39	0.11
1999	25	1	2	7	1.33	0.67	0.67	0.00
1999	26	1	2	8	2.50	0.95	1.40	0.15
m	m	1	2	9	m	m	m	m
m	m	1	2	10	m	m	m	m

m	m	1	2	11	m	m	m	m
1998	6	2	2	1	2.50	1.15	1.20	0.15
1998	7	2	2	2	m	m	m	m
1999	12	2	2	3	1.67	0.48	0.91	0.29
1999	18	2	2	4	3.63	1.50	1.88	0.29
1999	19	2	2	5	2.20	0.90	1.10	0.20
1999	23	2	2	6	2.78	1.28	1.28	0.22
1999	25	2	2	7	2.00	1.00	1.00	0.00
1999	26	2	2	8	3.30	1.35	1.65	0.30
m	m	2	2	9	m	m	m	m
m	m	2	2	10	m	m	m	m
m	m	2	2	11	m	m	m	m
1998	6	3	2	1	3.50	1.20	1.55	0.75
1998	7	3	2	2	m	m	m	m
1999	12	3	2	3	2.33	0.71	1.38	0.24
1999	18	3	2	4	4.00	1.38	2.00	0.63
1999	19	3	2	5	3.20	1.30	1.45	0.45
1999	23	3	2	6	3.56	1.61	1.67	0.28
1999	25	3	2	7	2.00	1.00	1.00	0.00
1999	26	3	2	8	3.00	1.10	1.60	0.30
m	m	3	2	9	m	m	m	m
m	m	3	2	10	m	m	m	m
m	m	3	2	11	m	m	m	m
1998	1	1	3	1	2.80	1.35	1.25	0.20
1998	2	1	3	2	1.50	0.67	0.75	0.08
1998	3	1	3	3	3.20	1.45	1.40	0.35
1998	4	1	3	4	4.00	1.65	1.85	0.50
1999	14	1	3	5	2.14	0.81	1.29	0.05
1999	16	1	3	6	2.37	0.95	1.32	0.11
1999	22	1	3	7	1.88	0.77	1.00	0.12
m	m	1	3	8	m	m	m	m
m	m	1	3	9	m	m	m	m
m	m	1	3	10	m	m	m	m
m	m	1	3	11	m	m	m	m
1998	1	2	3	1	3.55	1.35	1.75	0.45
1998	2	2	3	2	2.67	1.08	1.25	0.33
1998	3	2	3	3	3.25	1.40	1.50	0.35
1998	4	2	3	4	3.75	1.55	1.60	0.60
1999	14	2	3	5	2.71	1.14	1.33	0.24
1999	16	2	3	6	4.47	1.95	2.05	0.470
1999	22	2	3	7	3.47	1.65	1.71	0.12
m	m	2	3	8	m	m	m	m
m	m	2	3	9	m	m	m	m
m	m	2	3	10	m	m	m	m
m	m	2	3	11	m	m	m	m
1998	1	3	3	1	3.45	1.25	1.70	0.50

1998	2	3	3	2	2.50	1.08	1.08	0.33
1998	3	3	3	3	2.60	1.05	1.25	0.30
1998	4	3	3	4	4.60	1.80	2.00	0.80
1999	14	3	3	5	2.91	1.05	1.43	0.43
1999	16	3	3	6	4.11	1.58	1.74	0.80
1999	22	3	3	7	3.29	1.53	1.65	0.12
m	m	3	3	8	m	m	m	m
m	m	3	3	9	m	m	m	m
m	m	3	3	10	m	m	m	m
m	m	3	3	11	m	m	m	m

“m” – missing value
“TIME 1” – pretest
“TIME 2” – posttest
“TIME 3” – retention test
“TRT 1” – blind treatment group
“TRT 2” – WILD treatment group
“TRT 3” – non-WILD treatment group

Table 41. Data for Theme 7: Total and Objectives 1 & 2 Scores

YEAR	CLASS ROOM	TIME	TRT	REP	Theme 7 Total Scores	Theme 7 Obj. 1 Scores	Theme 7 Obj. 2 Scores
1998	5	1	1	1	2.50	1.20	1.30
1998	8	1	1	2	1.92	1.08	0.85
1999	9	1	1	3	1.35	0.80	0.55
1999	10	1	1	4	2.00	0.95	1.05
1999	11	1	1	5	1.15	0.50	0.65
1999	13	1	1	6	1.50	0.80	0.70
1999	15	1	1	7	1.90	1.00	0.90
1999	17	1	1	8	1.32	0.79	0.53
1999	20	1	1	9	2.05	1.05	1.00
1999	21	1	1	10	1.50	0.75	0.75
1999	24	1	1	11	1.05	0.55	0.50
1998	5	2	1	1	2.25	1.20	1.05
1998	8	2	1	2	2.15	1.00	1.15
1999	9	2	1	3	2.10	1.10	1.00
1999	10	2	1	4	2.35	1.25	1.10
1999	11	2	1	5	1.45	0.70	0.75
1999	13	2	1	6	1.80	1.05	0.75
1999	15	2	1	7	2.80	1.35	1.45
1999	17	2	1	8	1.68	0.79	0.90
1999	20	2	1	9	2.75	1.45	1.30
1999	21	2	1	10	1.00	0.50	0.50
1999	24	2	1	11	0.75	0.40	0.35
1998	5	3	1	1	1.95	1.15	0.80
1998	8	3	1	2	1.92	0.92	1.00
1999	9	3	1	3	1.20	0.65	0.55
1999	10	3	1	4	1.45	0.75	0.70
1999	11	3	1	5	1.25	0.70	0.55
1999	13	3	1	6	2.10	1.15	0.95
1999	15	3	1	7	1.60	0.85	0.75
1999	17	3	1	8	1.11	0.63	0.47
1999	20	3	1	9	1.75	0.90	0.85
1999	21	3	1	10	1.10	0.60	0.50
1999	24	3	1	11	0.55	0.30	0.25
1998	6	1	2	1	1.20	0.55	0.65
1998	7	1	2	2	m	m	m
1999	12	1	2	3	1.71	0.90	0.81
1999	18	1	2	4	3.13	1.50	1.63
1999	19	1	2	5	1.60	0.75	0.85
1999	23	1	2	6	1.33	0.67	0.67

1999	25	1	2	7	1.67	1.00	0.67
1999	26	1	2	8	1.45	0.80	0.65
m	m	1	2	9	m	m	m
m	m	1	2	10	m	m	m
m	m	1	2	11	m	m	m
1998	6	2	2	1	1.45	0.75	0.70
1998	7	2	2	2	m	m	m
1999	12	2	2	3	1.10	0.52	0.57
1999	18	2	2	4	3.00	1.75	1.25
1999	19	2	2	5	0.65	0.30	0.35
1999	23	2	2	6	1.89	1.00	0.89
1999	25	2	2	7	2.00	1.00	1.00
1999	26	2	2	8	1.75	0.90	0.85
m	m	2	2	9	m	m	m
m	m	2	2	10	m	m	m
m	m	2	2	11	m	m	m
1998	6	3	2	1	1.85	0.90	0.95
1998	7	3	2	2	m	m	m
1999	12	3	2	3	1.57	0.76	0.81
1999	18	3	2	4	3.00	1.88	1.13
1999	19	3	2	5	1.30	0.80	0.50
1999	23	3	2	6	2.67	1.39	1.28
1999	25	3	2	7	2.00	1.00	1.00
1999	26	3	2	8	1.70	0.80	0.90
m	m	3	2	9	m	m	m
m	m	3	2	10	m	m	m
m	m	3	2	11	m	m	m
1998	1	1	3	1	1.50	0.80	0.70
1998	2	1	3	2	0.25	0.08	0.17
1998	3	1	3	3	1.90	0.90	1.00
1998	4	1	3	4	3.05	1.60	1.45
1999	14	1	3	5	1.48	0.81	0.67
1999	16	1	3	6	1.32	0.79	0.53
1999	22	1	3	7	1.29	0.71	0.59
m	m	1	3	8	m	m	m
m	m	1	3	9	m	m	m
m	m	1	3	10	m	m	m
m	m	1	3	11	m	m	m
1998	1	2	3	1	2.40	1.20	1.20
1998	2	2	3	2	1.17	0.58	0.58
1998	3	2	3	3	2.15	1.10	1.05
1998	4	2	3	4	3.35	1.75	1.60

1999	14	2	3	5	1.00	0.52	0.48
1999	16	2	3	6	3.74	2.00	1.74
1999	22	2	3	7	2.53	1.47	1.06
m	m	2	3	8	m	m	m
m	m	2	3	9	m	m	m
m	m	2	3	10	m	m	m
m	m	2	3	11	m	m	m
1998	1	3	3	1	2.65	1.35	1.30
1998	2	3	3	2	1.83	0.92	0.92
1998	3	3	3	3	1.45	0.75	0.70
1998	4	3	3	4	3.55	1.85	1.7
1999	14	3	3	5	1.77	1.00	0.77
1999	16	3	3	6	2.84	1.47	1.37
1999	22	3	3	7	2.29	1.24	1.05
m	m	3	3	8	m	m	m
m	m	3	3	9	m	m	m
m	m	3	3	10	m	m	m
m	m	3	3	11	m	m	m

“m” – missing value
“TIME 1” – pretest
“TIME 2” – posttest
“TIME 3” – retention test
“TRT 1” – blind treatment group
“TRT 2” – WILD treatment group
“TRT 3” – non-WILD treatment group

Table 42. Calculations of Total Percentages & Total Scores

YEAR	CLASS ROOM	TIME	TRT	REP	TOSCR	TOPCT
1998	5	1	1	1	14.25	26.39
1998	8	1	1	2	11.39	21.08
1999	9	1	1	3	7.60	14.07
1999	10	1	1	4	12.20	22.59
1999	11	1	1	5	11.35	21.01
1999	13	1	1	6	11.00	20.37
1999	15	1	1	7	8.70	16.11
1999	17	1	1	8	7.47	13.84
1999	20	1	1	9	12.55	23.24
1999	21	1	1	10	7.45	13.80
1999	24	1	1	11	6.80	12.59
1998	5	2	1	1	15.00	27.78
1998	8	2	1	2	14.62	27.07
1999	9	2	1	3	10.15	18.80
1999	10	2	1	4	13.95	25.83
1999	11	2	1	5	8.65	16.02
1999	13	2	1	6	12.50	23.15
1999	15	2	1	7	16.25	30.09
1999	17	2	1	8	9.63	17.84
1999	20	2	1	9	14.65	27.13
1999	21	2	1	10	7.15	13.24
1999	24	2	1	11	7.50	13.89
1998	5	3	1	1	13.50	25.00
1998	8	3	1	2	11.08	20.51
1999	9	3	1	3	8.95	16.57
1999	10	3	1	4	9.10	16.85
1999	11	3	1	5	10.10	18.70
1999	13	3	1	6	13.55	25.09
1999	15	3	1	7	13.15	24.35
1999	17	3	1	8	8.58	15.89
1999	20	3	1	9	12.50	23.15
1999	21	3	1	10	8.05	14.91
1999	24	3	1	11	6.20	11.48
1998	6	1	2	1	8.90	16.48
1998	7	1	2	2	m	m
1999	12	1	2	3	9.57	17.72
1999	18	1	2	4	15.38	28.47
1999	19	1	2	5	10.50	19.44
1999	23	1	2	6	9.78	18.11
1999	25	1	2	7	8.00	14.81

1999	26	1	2	8	10.00	18.52
m	m	1	2	9	m	m
m	m	1	2	10	m	m
m	m	1	2	11	m	m
1998	6	2	2	1	8.80	16.30
1998	7	2	2	2	m	m
1999	12	2	2	3	6.95	12.88
1999	18	2	2	4	15.38	28.47
1999	19	2	2	5	8.20	15.19
1999	23	2	2	6	10.56	19.55
1999	25	2	2	7	9.33	17.28
1999	26	2	2	8	12.45	23.06
m	m	2	2	9	m	m
m	m	2	2	10	m	m
m	m	2	2	11	m	m
1998	6	3	2	1	12.80	23.70
1998	7	3	2	2	m	m
1999	12	3	2	3	9.52	17.64
1999	18	3	2	4	14.75	27.31
1999	19	3	2	5	11.25	20.83
1999	23	3	2	6	14.94	27.68
1999	25	3	2	7	10.00	18.52
1999	26	3	2	8	12.70	23.52
m	m	3	2	9	m	m
m	m	3	2	10	m	m
m	m	3	2	11	m	m
1998	1	1	3	1	9.85	18.24
1998	2	1	3	2	5.75	10.65
1998	3	1	3	3	11.75	21.76
1998	4	1	3	4	15.55	28.80
1999	14	1	3	5	9.81	18.17
1999	16	1	3	6	9.74	18.03
1999	22	1	3	7	7.77	14.38
m	m	1	3	8	m	m
m	m	1	3	9	m	m
m	m	1	3	10	m	m
m	m	1	3	11	m	m
1998	1	2	3	1	13.50	25.00
1998	2	2	3	2	8.58	15.90
1998	3	2	3	3	12.30	22.78
1998	4	2	3	4	16.80	31.11
1999	14	2	3	5	10.52	19.49

1999	16	2	3	6	18.74	34.70
1999	22	2	3	7	14.47	26.80
m	m	2	3	8	m	m
m	m	2	3	9	m	m
m	m	2	3	10	m	m
m	m	2	3	11	m	m
1998	1	3	3	1	12.90	23.89
1998	2	3	3	2	11.58	21.45
1998	3	3	3	3	9.45	17.50
1998	4	3	3	4	19.45	36.02
1999	14	3	3	5	11.33	20.99
1999	16	3	3	6	15.11	27.97
1999	22	3	3	7	13.71	25.38
m	m	3	3	8	m	m
m	m	3	3	9	m	m
m	m	3	3	10	m	m
m	m	3	3	11	m	m

“m” – missing value
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