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ABSTRACT

This report relates the story of the schools, teachers, and students involved in implementing the framework known as the Environment as an Integrating Context (EIC). The results of a nationwide study, a description of the major concepts and assumptions underlying EIC, an exploration of the range of successful EIC programs across the United States, and an analysis of the implications of EIC-based education for student learning and instruction are presented. Observed benefits include better performance on standardized measures of academic achievement in reading, writing, mathematics, and social studies; reduced discipline and classroom management problems; and increased engagement and enthusiasm for learning. (Contains 25 references and 17 tables.) (DDR)

RESULTS OF A NATIONWIDE STUDY

CLOSING THE ACHIEVEMENT GAP

Using the Environment as an Integrating Context for Learning

Gerald A. Lieberman, Ph.D.

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STATE EDUCATION AND ENVIRONMENT ROUNDTABLE

Several years ago, representatives of the state education agencies that comprise the State Education and Environment Roundtable became interested in the potential of environment-based education programs to improve student learning, change long-standing pedagogical paradigms, and influence the way young people learn to live successfully in the world that surrounds them. In the face of limited research on the efficacy of environment-based education programs, Roundtable members designed a study to identify some of the most innovative and successful programs, describe their effectiveness, and analyze their commonalities and differences. They also sought to identify the factors that contributed to the success of these programs and any challenges they encountered during implementation.

This report is the result of that study. It focuses on a specific area of environmental education: using the Environment as an Integrating Context for learning (EIC).

State Education and Environment Roundtable

The Roundtable is a cooperative endeavor of education agencies from 12 states working to improve student learning by integrating the environment into K-12 curricula and school reform efforts. The Roundtable provides opportunities for them to exchange skills, experience, and resources that will help them enhance their respective programs. It also collects and disseminates information on existing school improvement programs to enable state agencies to build from a foundation of practical experience.

The following agencies are members of the Roundtable:

California Department of Education
Colorado Department of Education
Florida Office of Environmental Education
Iowa Department of Education
Kentucky Environmental Education Council
Maryland State Department of Education
Minnesota Department of Families, Children, and Learning
Minnesota GreenPrint Council
New Jersey Department of Education
Ohio Department of Education
Pennsylvania Department of Education
Texas Education Agency
Washington Office of the Superintendent of Public Instruction

The Pew Charitable Trusts sponsor the Roundtable. The Council of Chief State School Officers administers project funding.

To Get More Information About EIC

The State Education and Environment Roundtable maintains a site on the Internet devoted to information on EIC-based learning: **http://www.seer.org**

The site contains a variety of links to participating state agencies, reports, reference materials, and other educational resources. The site also contains the Roundtable's Technical Assistance Register: a listing of educators at the study schools who have agreed to guide others in initiating EIC programs.

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OVERVIEW

Using the Environment as an Integrating Context for learning (EIC), defines a framework for education: a framework for interdisciplinary, collaborative, student-centered, hands-on, and engaged learning. EIC, a term coined by the State Education and Environment Roundtable, encompasses the educational practices that the group believes should form the foundation of environment-based education in America's schools. This framework has begun to transform curricula in a growing number of schools across the United States and may have the potential to significantly improve K-12 education in America.

This report, prepared by the State Education and Environment Roundtable, is the story of the schools, teachers, and students who are involved in implementing EIC. It presents the results of a nationwide study; describes the major concepts and assumptions underlying EIC; explores a range of successful EIC programs across the United States; identifies the major characteristics of successful EIC programs; and, analyzes the implications of EIC-based education for student learning and instruction.

EIC-based learning is not primarily focused on learning about the environment, nor is it limited to developing environmental awareness. It is about using a school's surroundings and community as a framework within which students can construct their own learning, guided by teachers and administrators using proven educational practices. EIC-based programs typically employ the environment as a comprehensive focus and framework for learning in all areas: general and disciplinary knowledge; thinking and problem-solving skills; and, basic life skills, such as cooperation and interpersonal communications.

Evidence gathered from the 40 study schools indicates that students learn more effectively within an environment-based context than within a traditional educational framework. This evidence comes from site visits, interviews, survey results, and gains on both standardized test scores and GPAs.

The observed benefits of EIC-based programs are both broad-ranging and encouraging. They include:

- better performance on standardized measures of academic achievement in reading, writing, math, science, and social studies;
- reduced discipline and classroom management problems;
- increased engagement and enthusiasm for learning; and,
- greater pride and ownership in accomplishments.

By providing a comprehensive educational framework, instead of traditional compartmentalized approaches, EIC significantly improves student performance throughout the curriculum and, appears to enrich the overall school experience.

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INTRODUCTION

INTRODUCTION

Prepared by the State Education and Environment Roundtable, this report is the first systematic attempt to understand the scope, implications, and potential of EIC-based learning. It presents the results of a nationwide study of schools, teachers, and students involved in significant EIC efforts. Its purpose is to:

- describe the major concepts and assumptions underlying EIC;
- describe a range of successful EIC programs across the United States;
- identify the major characteristics of and strategies employed by successful EIC programs; and,
- to analyze the implications of EIC-based education for student learning and instruction.

This report is based on a study of the efforts and experiences of 40 schools across the United States that have adopted the concepts and frameworks of EIC and, in the course of doing so, transformed the educational experience of students and teachers. The concepts discussed and the findings reported here are informed by comments and experiences gathered through interviews of more than 400 students, and more than 250 teachers and principals with an average tenure of over 16 years in education. The schools, and the voices of principals, teachers, and students presented here, represent a geographical and socio-economic cross-section of America: from urban Los Angeles to Maryland's Eastern Shore; from Iowa's Corn Belt to the hillsides of central Pennsylvania; from Kentucky's Appalachian Mountains to Florida's panhandle.

BACKGROUND OF THE STUDY

Many educators, including specialists in education reform, have long insisted on the value of the problem-solving, hands-on approaches espoused by environmental educators (Lieberman, 1994). Most of this perceived value was, however, based on personal observations and anecdotal information rather than rigorous research. Therefore, educators could not make a strong case for the pedagogical significance of environment-based education to student learning. As a result, the mainstream education community has never fully embraced environment-based education as an integral part of the formal education system, relegating study of the environment to a long list of possible supplements to the traditional school curriculum.

At the Roundtable's first seminar in December 1995, participants discussed the potential of environment-based education for helping students become self-initiating and self-reliant learners who are prepared to participate in an ever-changing society. In the wake of that discussion, the Roundtable's project team conducted an extensive review of

research studies in the areas of both general and environment-based education.

This literature search revealed that general education research held little evidence relevant to determining the educational efficacy of environment-based education. Furthermore, although the amount of research on traditional environmental education (EE) is substantial (Hoody, 1995), it is primarily concerned with assessing the development of environmental skills, knowledge, and behavior. It provides little insight into effects on the overall educational experience of students.

Design of the Study

Lacking sufficient data in the research literature, Roundtable members designed the present study to focus on one specific topic: the effects on learning and instruction of using the environment as an integrating context in K-12 schools. They asked the research team to identify the most innovative and successful programs based on the comprehensive educational practices that define EIC. The section entitled "What is EIC" describes the major attributes of these practices.

The research team had four major objectives in studying these programs:

- to describe their common features;
- to identify the "best practices" that characterize their pedagogies;
- to examine the factors that led to their success or challenged them; and,
- to compile data on the effects on students and achievement in reading, writing, math, science, and social studies, and on teachers and instruction.

Roundtable representatives and other educators from the 12 member states identified potential schools for the study. The principal criteria for inclusion were: degree of integration of the environment across the curriculum; student involvement in projects and problem-solving; extent of team teaching; and, program longevity. The research team also considered such demographic and socio-economic factors as school setting (urban or rural), population of the area, and income levels in the community.

The researchers conducted preliminary telephone interviews, 45-90 minutes in length, to ascertain if the schools met the study criteria. The team then selected 40 of these schools for the study. Table 1 summarizes the number of schools visited and the numbers of educators and students interviewed in this study.

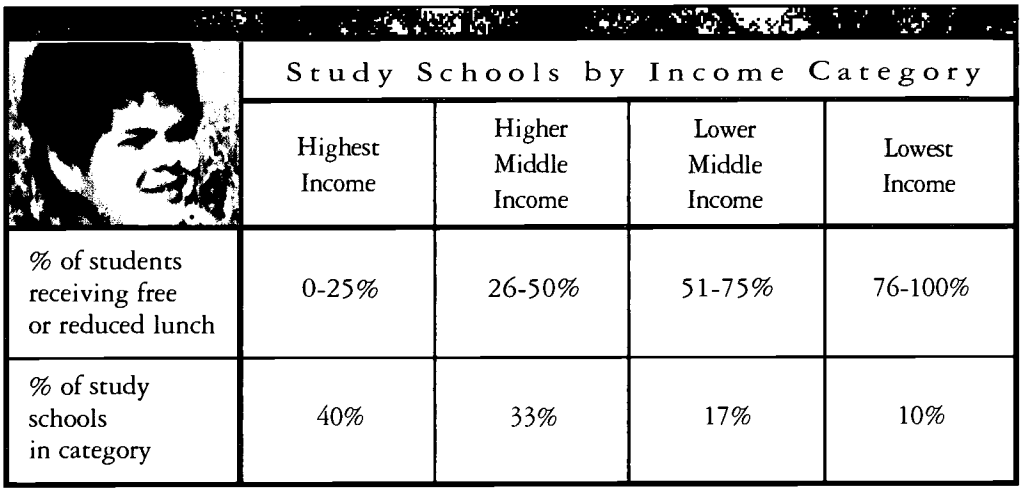
Table 1. Summary of Numbers of Study Schools, and Educator and Student Interviews.

Total Schools in Study	40
Elementary schools	15
Middle schools	13
High schools	12
Total Number of Interviews	655
Teachers and administrators	252
Students	403

Appendix A includes address, telephone, and fax information for the 40 study schools.

The schools included in this study represented a wide range of economic levels. The research team used percentage of school population receiving "free or reduced lunch" to estimate the economic status of the schools' populations. Table 2 summarizes the distribution of study schools by income level categories based on "free or reduced lunch" data.

TABLE 2. Summary of Free or Reduced Lunch Data for Study Schools.



	Study Schools by Income Category			
	Highest Income	Higher Middle Income	Lower Middle Income	Lowest Income
% of students receiving free or reduced lunch	0-25%	26-50%	51-75%	76-100%
% of study schools in category	40%	33%	17%	10%

Following the selection process, one member of the research team visited each study school for a full day. During these visits, the researcher: observed classes; interviewed teachers, administrators, students, and, in some cases, parents and alumni; and, gathered samples of curricular materials, student work and, where possible, the results of any comparative analyses of academic achievement that the school had completed.

To buttress interview data and avoid the possibility of misinterpreting comments, the research team asked the interviewees to complete four instruments concerning the effects of EIC:

- General Site Survey: regarding student and teacher participation, program history, and school characteristics (18 survey items);
- Learning Survey: assessing students and learning (32 survey items);
- Teaching Survey: concerning teachers and instruction (25 survey items); and,
- Domains Survey: charting effects on students' knowledge, skills, retention, and attitudes toward learning resulting from implementing an EIC program (25 survey items).

The research team made several follow-up telephone calls and, in some cases, supplementary visits, after the initial school visits. These contacts represented an average three and one-half hours of additional interaction with each study school.

Appendix B describes the design of the study more fully.

VALIDITY OF THE DATA

The present study is mainly qualitative rather than quantitative. It is based on: the views and experiences of participating educators as reflected in the interviews and surveys; interviews with students, alumni, and parents; the observations of the researchers; and, the research team's interpretation and analysis of these opinions and observations. Although this study was not intended to be quantitative, the research team collected as much quantitative data as possible to provide additional insight into the experiences of the study schools.

Importantly, since each school in the study developed its own unique curriculum, the participating schools represent 40 distinct program designs. The uniqueness of the programs and the wide variety of student assessment methods they employed limit the possibilities for conclusive comparative, quantitative analysis.

Although this study is not a quantitative assessment of the effects of EIC programs on students or teachers it is, nevertheless, the most comprehensive and systematic effort to date to describe existing K-12 programs that use the environment as an integrating context. In the near future, the Roundtable plans to initiate a quantitative study of the effects of EIC programs on learning, to supplement the qualitative evidence provided in this report.

Even though evidence from 40 schools can not be considered conclusive, this study brings together a major body of knowledge gained from experienced educators and successful programs. The average tenure of the educators who contributed to this study is over 16 years. Equally important, the EIC programs at these schools were not new but, rather, had an operating history with average longevity of over seven years.

Notes: The names of some students associated with quotes have been changed to ensure their privacy and anonymity. Not all educators responded to all survey items or instruments. Therefore, the number of respondents to each query is noted in the summaries of survey results cited throughout this report.

DESIGN OF THE REPORT

The remainder of this report falls into three major sections:

- **WHAT IS EIC** introduces the major concepts and assumptions that underlie using the environment as an integrating context for learning;
- **RESULTS** presents the learning improvements observed by the educators and research team in key areas: the core curriculum (language arts, math, science,and social studies); general educational benefits (disciplinary issues, enthusiasm, and engagement in learning); advances in development of critical thinking and problem-solving skills; gains in students' interpersonal relationship skills; and, effects on teachers and their instructional practices; while,
- **STORIES OF SUCCESS** contains detailed accounts of particularly successful EIC programs at six schools. It also includes personal profiles of six of the teachers and administrators who were instrumental in creating and guiding these programs.

WHAT IS EIC

WHAT IS EIC:
BASIC CONCEPTS

Environment as the Integrating Context for learning (EIC) designates pedagogy that employs natural and socio-cultural environments as the context for learning while taking into account the "best practices" of successful educators. It combines these approaches in a way that:

- breaks down traditional boundaries between disciplines;
- provides hands-on learning experiences, often through problem-solving and project-based activities;
- relies on team-teaching;
- adapts to individual students, and their unique skills and abilities; and,
- develops knowledge, understanding, and appreciation for the environment—community and natural surroundings.

EIC-based learning is not primarily focused on learning about the environment nor is it limited to developing environmental awareness. It is about using a school's surroundings and community as a framework within which students can construct their own learning, guided by teachers and administrators using proven educational practices. EIC programs typically employ the environment as a comprehensive focus and framework for learning in all areas: general and disciplinary knowledge; thinking and problem-solving skills; basic life skills, such as cooperation and interpersonal communications; and, last but not least, understanding of and appreciation for the environment.

Education based on EIC approaches can be implemented across all geographic and socio-economic settings. Since the ecosystems surrounding schools and their communities vary as dramatically as the nation's landscape, the term "environment" may mean different things at every school; it may be a river, a forest, a city park, or a garden carved out of an asphalt playground. In creating an EIC curriculum, educators have the opportunity to define the local environment broadly, to encompass natural ecosystems and socio-cultural systems in their community. Each school, by necessity, therefore designs its own program independently to take into account their specific locale, resources, and student needs.

Even though EIC programs are located in diverse natural and community settings and differ in how they are designed, they all have one thing in common: they attempt to provide students with the opportunity to connect and integrate what they are learning to their surroundings.

For example, the students' studies may be located in and focus on:

A creek running behind the playground: its relation to the region's watershed, local farming operations, and economic health of the community;

A vacant lot across from the school and the significance of abandoned property in terms of: public health, housing needs, and employment opportunities in an inner-city setting;

A wooded tract down the street: its interdependence on forests bordering town, significance to paper product companies, and costs and benefits of recycling;

A farmer's untilled land: its relationship to native prairie, historical growth of the county, and farm equipment manufacturing;

A garden built into their playground's asphalt: its dependence on healthy soil systems, on local and global weather patterns, and relationship to site-management decisions made by the school board; or,

A wastewater treatment plant outside of town: its importance to water quality and supply, to human health, and its relationship to population density and housing costs.

In each case, even though the students' studies are focused on a specific locale, they span a range of issues and activities that can involve: cross-disciplinary instruction, thinking and problem-solving, hands-on experiences, community-based learning, and integration of diverse viewpoints, perspectives, and approaches.

The remainder of this section describes how the study schools connect their EIC programs with "best practices" in education.

THE ENVIRONMENT AS A CONTEXT FOR LEARNING: A RANGE OF OPPORTUNITIES

EIC programs frequently begin in a classroom or other school setting but can rapidly grow to encompass areas outside of the building and off the campus. Educators may conduct their EIC programs within just a few blocks of school or they might extend their students' activities across a diverse geographical region.

The range of environmental settings encompassed by an EIC program can span across:

- classroom settings or other in-house facilities, such as laboratories;
- developed areas of school campuses, including playgrounds;
- undeveloped school property, such as fields or woodlands;
- off-site study areas, both natural habitats and community settings; or,
- multiple study sites located throughout a geographical region.

Generally, teachers appear to focus their EIC programs and most related learning activities within one of these categories. Many schools, however, choose to incorporate two or more of these settings into their program over the course of the school year.

EIC programs frequently begin in a classroom setting but rapidly grow to encompass areas outside of the building and off the campus.

USING CLASSROOM SETTINGS: THE WALDO MIDDLE SCHOOL ENDANGERED SPECIES PROGRAM

The *Endangered Species Program* at Waldo Middle School in Oregon is a good example of an EIC curriculum based primarily in a classroom setting, yet reaching to the larger outside context to explore opportunities for learning. Science, math, language arts, geography, and computer literacy teachers work together at Waldo to facilitate an environment-

centered curriculum. The seventh grade curriculum, for example, gives students an opportunity to choose an endangered species as the focus of a semester-long research, writing, and science project.

Working in teams, Waldo students collect literature from the library, conduct research on the Internet, call specialists at zoos, and write to experts at conservation organizations around the country. They jointly analyze their data to create species recovery plans and then develop in-school presentations that they deliver to panels of outside professionals from local natural resources agencies and zoos.

During the first few years of Waldo's program, the students worked only in a classroom and library setting. However, Waldo's program continues to evolve. Recently, Waldo's teachers extended their effort beyond the walls of the building to provide students with a variety of field opportunities that expanded the students' potential for learning and integrating new areas of knowledge.

Using the Campus: Kimbark Elementary

California's Kimbark Elementary School provides an example of using a school campus to help students connect their studies to their surroundings. Teachers at Kimbark have developed a variety of learning stations allowing students to venture past traditional classroom instruction into practical, hands-on experiences. At Kimbark, rather than read about the water cycle in a textbook or encyclopedia, students collect and interpret data on their campus.

At the edge of the playground, Kimbark students grow, study, and maintain their own plants in the school's vegetable garden. Nearby, a greenhouse and native plant arboretum help the students expand their botanical knowledge. A small pond, encircled by a cyclone fence, provides a place where they can investigate microscopic organisms and observe aquatic insects. Kimbark's campus resources broaden students' horizons and give them the chance to learn in a setting that approximates the natural world.

Using Undeveloped Areas on or off the Campus: Clay County High School

Schools that enjoy access to parks, fields, woods, ponds, and streams located on or adjacent to school property can provide students the chance to learn about the functions of natural ecosystems and how they relate to their community. That is how Kentucky's Clay County High School utilizes 80 acres of district-owned woodlands surrounding the campus. Over the past several years, Clay County teachers and students have developed nature trails, agricultural areas, aquaculture facilities, and a replica of an Indian village.

Using Off-site Locations: Taylor County High School

Where feasible, EIC educators move beyond school property to capitalize on the opportunities for learning offered by natural environments and community settings. In Florida, Taylor County High School students study the nearby Econfina River. Taylor County's teaching team incorporates math, science, and language arts into their studies of the river environment. Their program provides numerous opportunities to visit a particular study site so students can gain an in-depth understanding of the location: its ecology, biology, chemistry, human influences, and relation to the economy of Taylor County.

Using Multiple Locations: Central Middle School

At the middle and high school levels it may be possible for educators to provide students with the opportunity to visit a variety of areas in their region. This offers students the chance to put what they are learning into a larger context than if they were confined to their school grounds or limited to visiting one study site. Teachers at

Minnesota's Central Middle School, for instance, designed the *Red River Valley of the North (RRVN)* program to encompass multiple sites throughout northwestern Minnesota, eastern North Dakota, and Canada. This comprehensive program provides students with opportunities to study the region's rivers, wetlands, prairies, and the local farming industry and manufacturing businesses on which their economy depends.

Central's teachers chose to begin the *RRVN* program in early fall specifically so that students could share a common starting point and maintain a year-long context for learning. Working in teams, they organized the program to maximize educational benefits, through a developmentally appropriate sequence of learning opportunities. Sixth graders study present conditions in the *RRVN*, while seventh graders go on to explore the region's history. Eighth-grade students build on their growing knowledge and skills by pondering the future of northwestern Minnesota.

Common Features of Successful EIC Programs

In spite of their different designs, goals, and locations, the 40 successful programs examined in this study had several fundamental commonalities that characterize exemplary EIC-based instruction:

- interdisciplinary integration of subject matter;
- collaborative instruction;
- emphasis on problem solving and projects;
- combinations of independent and cooperative learning; and,
- learner-centered and constructivist approaches.

Interdisciplinary Integration of Subject Matter: Weaving it Together

One of the predominate characteristics of the study schools is that they use EIC to successfully integrate knowledge from diverse disciplines: students and teachers working across disciplinary boundaries to achieve their educational goals. Instead of compartmentalizing education, members of EIC teaching teams weave their individual learning objectives into a single instructional tapestry.

Contributing their own individual areas of expertise, EIC educators each address a specific facet of the same endeavor, helping their students develop comprehensive understanding and simultaneously creating for one another a synergistic support system. Math teachers no longer assign only end-of-the-chapter problems; language arts teachers do not require "what I did during my summer vacation" essays; science teachers do not ask students to roll toy trucks down a wooden ramp; and, social studies teachers do not drone on about how a bill becomes law.

EIC teaching teams weave their individual learning objectives into a single instructional tapestry.

Some schools vary their methods of subject matter integration at different times during the school year. In these instances, faculty might teach disciplines independently to provide students with subject matter not yet integrated into their EIC program. At other times, schools may fully integrate all of the traditional core disciplines into their EIC programs.

Students who learn within the resulting comprehensive framework begin to recognize how seemingly disconnected elements fit together to explain the world around them: societal systems, structures, and functions, as well as natural systems and ecological relationships.

Huntingdon Area Middle School's *STREAMS* program offers a good example of an integrated-interdisciplinary approach to learning. Huntingdon's curriculum comprises numerous EIC activities that cut across discipline-based boundaries. Students have "field" experiences that provide a springboard for classroom explorations.

Sixth graders acquire math skills by collecting data at a nearby stream, then work with their data as the basis for developing their math skills. Huntingdon math teacher Mike Simpson, for example, uses data collected by the students in the field to teach fractions, percentages, and statistics, as well as interpreting charts and graphs. "I don't have to worry about coming up with themes for application problems anymore," Simpson said. "The students make their own."

At the same time, Huntingdon's language arts specialist, Rose Taylor, connects to the *STREAMS* program by asking her students to comment on their projects in opinion pieces for school and community newspapers or letters to elected officials and government agencies. "We do letter writing to real, live people that students perhaps will meet on the street when they go downtown," she said. "I only remember writing to fictitious people in my school days."

Taylor also helps students develop their public speaking skills and encourages them to express their opinions as they venture out into the community. "Students have done public speaking in front of county commissioners," she noted.

Huntingdon science teacher, Tim Julian, easily adapts his students' *STREAMS* studies to achieve his core curriculum goals, helping them understand the properties of water and its various forms—groundwater, lakes, even glaciers—as well as the physical features streams can create—flood plains, meanders, and levees. Julian uses the students' field experiences as a springboard to classroom explorations of stream organisms or alternate wastewater treatment methods. At the same time, he helps them apply sound scientific methods to research projects for their other classes.

Social studies teacher, Fred Wilson, who coordinates *STREAMS*, sees the integrated-interdisciplinary approach as a means of helping students "learn how the system works." He encourages them to share the knowledge and skills gained from their EIC projects with other classes and local groups, believing that civic involvement helps students understand their roles within society and their responsibility to "give back" to the community. Along the way, Wilson said, "students begin to see how their budding math, science, language arts, and citizenship skills work together to equip them to be active, contributing citizens."

Students recognize and appreciate the differences between the integrated nature of EIC programs and their traditional classes. "The way the teachers incorporated *STREAMS* with the science program," said Sarah, a former Huntingdon student, "you weren't just doing it for science; you were doing it for multiple classes. You could combine and understand different things. It was great."

Using the environment as a context for integrated-interdisciplinary instruction requires teachers to break down the boundaries to learning that traditionally separate the subject matter disciplines. Removing these impediments enables students to bind together their growing disciplinary knowledge so that they can create their own complete and coherent understanding of the world around them—devoid of artificial barriers.

Collaborative Instruction: Seeing Through the Eyes of Others

Another fundamental component of EIC-based learning is collaborative instruction. Collaborative instructional teams typically include teachers from several core disciplines: language arts, math, science, and social studies. These teams often also involve subject area specialists from creative arts, computer literacy, speech, or physical education.

EIC educators also frequently supplement their teaching teams by involving parents and specialists from the community, local businesses, government agencies, nature

centers, zoos, and universities. This approach helps them decrease the student/teacher ratio and fill gaps in their own technical expertise about the local environment, government, and business community.

Educators use these collaborative instructional processes so that students can simultaneously work on related aspects of the same project in several classes. Collaborative instruction also offers students the opportunity to expand their understanding in two important ways:

- gaining insights on any given topic, project, or problem from the perspective of a variety of teachers and discipline-specific viewpoints; and,
- discovering the varied outlooks, on what they are studying, among the people who represent a cross-section of their community.

The structure of EIC teaching teams varies, depending on grade level and the commitment of teachers from the different disciplines. Elementary teams usually include several teachers, each focusing on a different discipline, most commonly representing only a single grade level. In a few cases, however, these teams also combine teachers from different grades, either temporarily or permanently.

At the middle and high school levels, where the currently prevalent pedagogy is separate study of the disciplines, EIC teams connect teachers from different subject areas. In most cases, these upper-level teams work at one grade level. Middle and high school teaching teams, much more frequently than elementary schools, work across traditional disciplinary boundaries and, at the same time, combine students and teachers from different grade levels.

Educators use collaborative instructional processes so that students can simultaneously work on related aspects of the same project in several classes.

EIC teaching teams meet on a regular basis to jointly design their curriculum and develop instructional strategies. Initially, team members discuss alternative teaching themes and eventually choose those most appropriate to their local setting. As their programs mature, these educators use team meetings to discuss the logistics of their cooperative programs: from arranging field trips to creating plans for block schedules, from developing student assessment methods to discussing behavioral problems and solutions.

Perhaps the most important component of these collaborative planning sessions is that they offer a venue for ongoing discussions about how to most effectively integrate learning across disciplines and grade levels. These interchanges allow each teacher to contribute to the team's plans and further refine their individual teaching objectives to best meet the needs of the students and other team members.

Regular meetings are an important means of communicating about progress and challenges as they relate to individual students and the program as a whole. They also allow teams to adapt their plans and take advantage of rapidly changing conditions such as a forest fire, flood, or other natural or societal occurrences related to their community.

Educators place a high value on cooperative planning time. It provides them opportunities to improve their educational effectiveness and, at the same time, to get both professional and personal support from their colleagues.

EIC teachers consider their team meetings so important that they often make professional or personal concessions so that they can accommodate regular team planning meetings. At Minnesota's Central Middle School, for instance, teachers accept slightly

larger class sizes to accommodate their daily team-planning period within the school schedule. While at Taylor County High, the team members use their daily "prep time" for group planning meetings and do their routine preparation on personal time.

EIC schools typically incorporate community members, parents, specialists, and even students into their teaching teams at various times throughout the school year. These "outside" team members serve as sources of technical and professional expertise, to expose students to a variety of viewpoints and, in some cases, to provide students with opportunities to work and learn in authentic settings such as water districts, city offices, and fish hatcheries. Some schools assign these additional team members as mentors for classroom and field projects, while others invite them to share their insights as guest speakers.

Collaborative instructional approaches help students learn that there are diverse perspectives about the environment and their community as well as many different ways of looking at the world around them. These methods also help students understand that the knowledge and skills they gain as they study language arts, science, social studies, math, and other subjects provide them the tools for understanding the complex interplay among socio-cultural and natural systems.

Emphasis on Problem Solving and Projects: Hands-on, Minds-on Learning

EIC educators emphasize project- and problem-based instructional approaches that appeal to a variety of sensory processes and learning styles. These approaches combine hands-on, minds-on methods to take advantage of students' cognitive, kinesthetic, affective, and sensory abilities. Such teaching more effectively engages students, who have a broad range of learning modalities, than traditional pedagogies.

EIC-based instruction is especially amenable to reducing the dependence of students and teachers on textbooks, worksheets, and lectures. Teachers in successful EIC programs generally downplay these traditional approaches because they only offer students opportunities for "implied learning," rather than the rich practical learning experiences available from project- and problem-based instruction. "They're actually out there doing these things in real life... It's better for the kids. You can't tell me that I should show them pictures in a book," remarked Jill Thompson, a science teacher at Minnesota's Central Middle School. "That isn't what we're trying to do in education."

Most EIC educators have difficulty imagining that they ever told their students to open their books to study characteristics of a healthy stream, or learn how that stream relates to their local forests and the economy of their community. There are abundant hands-on and minds-on learning opportunities in the local environment. "You're nuts as a teacher not to want this for your students," Thompson concluded.

EIC programs take the hands-on approach a step further by letting their students tackle more complex projects, with the intent of resolving authentic problems. Such learning activities give students the chance to dig in, not only with their hands, but also with their minds to discover creative solutions for complex problems. Some educators label this instructional approach "minds-on" learning.

Freed from traditional book-and-blackboard methods, EIC teachers, quickly add diverse hands-on activities and minds-on projects to their repertoire of instructional strategies. The variety of activities they and their students invent seems limitless.

The sequence of events in an EIC program might, for example, first have students collect water from a local river and then test it for dissolved oxygen, pH, and bacteria levels. This is the point at which many hands-on programs typically stop, but many EIC educators take the process several steps further and make the endeavor a "minds-on" process. Once students have completed their initial analysis of the water, they could begin to compare it with data from other locations. If they discover an unusual bacterial count,

The project-based nature of EIC studies offers opportunities to develop a broad array of knowledge and skills.

they may then expand their research to identify possible sources of the "problem." As a next step, students might then get assistance from specialists at a local college, write a report about their discovery, disseminate their findings to the appropriate government agency, make a presentation to the community, or help to raise funds to resolve the problem.

These examples are typical of the project- and problem-based activities successful EIC programs use to fully engage students in learning and to foster high-level cognitive skills, specifically creative-thinking and problem-solving abilities. "What I think is really different about what we do is that the kids have an authentic experience," said Manette Anderson, a teacher at Colorado's Glenwood Springs High. "Our students decide what they want to study and what they want to go after and tackle," Anderson explained. "It's not a simulation; it's not contrived; it's not an exercise. They brainstorm all kinds of solutions."

The project-based nature of EIC studies offers students real-world opportunities to develop a broad array of knowledge and skills. Collecting and analyzing data, learning about the responsibilities of government agencies, and making presentations to their community, for example, give students the chance to use and expand their knowledge of the subject matter disciplines.

The educational benefits of minds-on instructional approaches extend far beyond simple gains in comprehension of content and skills. Students have the chance to combine their knowledge and skills in new and challenging ways as they work through authentic problems in the context of their local environment. They begin to put together the pieces of the puzzle rather than just looking at the individual parts through the separate lenses provided by science, social studies, math, or language arts. In EIC programs, the topics of study are concrete and thus, the interconnections among the traditional disciplines become less abstract.

Hands-on, minds-on methods help students learn through many of the abilities suggested by Gardner's theory of "multiple intelligences." "They can use their brains, their feelings, their smell, and their touch. That's a lot better than just sitting in a classroom reading out of a book," explained Jerry Wenzel, Thompson's colleague at Central.

A further benefit of the authentic experiences inherent in project- and problem-based learning is that it helps convince students their studies are meaningful and important. "They need to be involved in something that's bigger than they are," Glenwood Spring's Anderson continued. It counteracts "a lot of discouragement and a negative sort of dismay about our world."

EIC educators have found that the environment provides a valuable context for these active approaches to learning. "It's just a real natural way to get these skills to the kids," explained Terry Duty, principal at Washington State's Tahoma High School, "something that they're interested in, something that's hands-on, so that they can solve problems along the way and work it through."

Students echo educators' comments. Books and lectures are "passive learning," said Scott, a sophomore in the *Integrated Program* at Tahoma. "If you don't get involved; it's not as interesting. You can read in a textbook about testing water, but if you actually go out and test the water, it's so obvious that you'll remember it easier."

Project- and problem-based learning holds great appeal for students and offers important educational benefits because it connects to their innate interests and abilities.

Hands-on, minds-on approaches help students make connections between what they are learning and the world outside the school building. This encourages students to dig deeper into their work and helps them develop their higher-level thinking skills.

Combinations of Independent and Cooperative Learning: Working Together, Learning Independently

The diversity of knowledge and skills that students need to succeed when working in the context of the environment often requires the use of cooperative and group learning. The project-based approaches that are part of EIC focus student teams on a common goal, answering the questions and solving the problems connected to their interdisciplinary studies of natural and socio-cultural systems.

Student teams can take a variety of forms including different classes, ages, and schools. In some cases, the teams may include only two or three students; in others, they might bring together twenty or more students from several classes and grades to focus on one major project.

The variety of components in their EIC studies make it possible for students to contribute to the team effort at the same time as they are developing their individual skills and abilities. Different members of EIC student teams also support the effort of the entire group by sharing the workload.

In a cooperative educational setting, students have the opportunity to benefit from the knowledge and experiences of their teammates. Simultaneously, they each have the chance to demonstrate their own skills and particular areas of expertise and knowledge. For example, after jointly defining the project, one student may help the others work through the statistical aspect of the research, another may take the lead in the design of the project display, and yet another may write an article for the local newspaper, while a fourth organizes the oral presentation to the board of the local water district.

Cooperative learning approaches give students the chance to learn from and gain respect for other people's perspectives. At Tahoma High School, for instance, students work together in small groups as they study and discuss their projects at the Cedar River. As a result, according to Dane, an eleventh grader, "You just see it from a different angle and you might see something from a point of view that you've never seen before. And then, you learn from that too. I think in group work you learn a lot more discussing it with somebody than having the teacher lecture to you," Dane continued, "because there's not much thinking going on if you're just copying something down. But, if you have to think about it and talk about it and hear what your other group members have to say, then it's a lot better."

Another way EIC students learn about cooperative work and group dynamics is by observing the collaborative efforts among their teachers, parents, and school administrators. These educators further enrich their students' collaborative learning experiences as they work with each other and form partnerships with parents and community members. When students observe this type of collegial, respectful behavior they are more likely to emulate it than if they just hear their teachers talking about cooperation.

At California's Open Charter Elementary, for instance, teacher teaming demonstrates collaboration. "There are examples of what we want the kids to be like in the structure of the school, from the teamwork of the teachers to the collaboration of the parents," explained Grace Arnold, principal. "They see us doing it."

Cooperative learning groups also give students the chance to develop important interpersonal skills. As they discuss issues and make decisions in cooperative teams, EIC students practice the collaboration and communication skills they will use as adults.

Learner-centered and Constructivist Approaches

The roles of teachers change when they begin to make the transition from lectures, textbooks, and worksheets toward hands-on, minds-on, environment-based projects and problems. As a result of this change, a student's course of study becomes more individualized than what is typical in a traditional curriculum. As they pursue their own topics of interest, answers to questions they identified, and solutions to problems they encountered, each student or group of students needs a different type of support and guidance.

This approach leads students and teachers on unforeseen adventures and discoveries.

Therefore, teachers in EIC programs tend to employ learner-centered, constructivist teaching styles. They facilitate their students' learning in many different ways: by guiding students in choosing projects or topics for study; by advising students in developing methods of study; by overseeing the implementation of projects; by discussing approaches to analyzing information; and, by advising students on the means of communicating what they have learned.

The learner-centered approach gives students primary responsibility for choosing both content and methods of study from within various comprehensive frameworks, such as "prairies of the Great Plains" or "built environments." Consequently, the teacher's role within this paradigm shifts toward helping students achieve their chosen learning objectives by arranging opportunities to allow students to make discoveries in the world around them.

Students notice the difference from traditional classes where teachers just hand out assignment packets and give them lectures. "You have freedom to make your own choices," commented Nisa, a fifth-grade student at Open Charter Elementary. "We get to choose what projects we want to do instead of having them assigned, and we get independent time where we can do whatever would be useful toward our project."

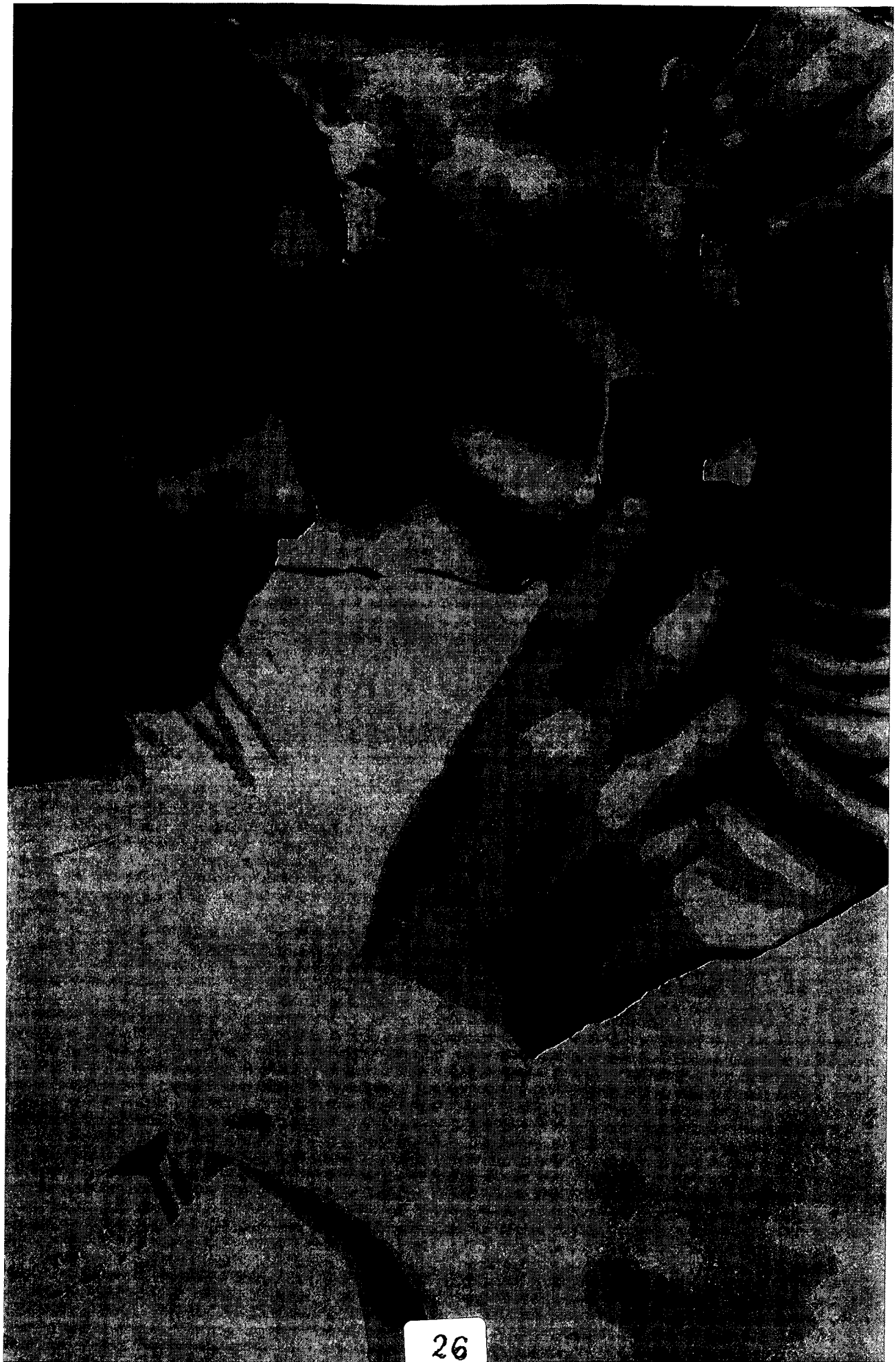
This approach leads students and teachers on unforeseen adventures and discoveries. Once, for example, when Open Charter students realized that their school was built over an ancient marsh, they speculated that there might be a prehistoric connection between the site and the fossil beds at Los Angeles' famous La Brea Tar Pits, some five miles distant. Their interest and curiosity convinced Barbara Moreno and Judy Utvich, Nisa's teachers, to add a previously unanticipated field trip to their class schedule.

Teachers who use learner-centered and teacher-facilitated instruction pay closer attention to individual student's academic abilities, learning needs, and interests. When it comes to their teaching, Moreno and Utvich "are always asking, 'So what? Why do they need to know this? What difference does it make?'"

The learner-centered approach requires a major shift in teachers' mind-sets. "We don't always lay it out. We really want the children to decide what it is they need to do," Moreno explained, a departure from constant expectations for educators to know all the answers, or all the questions. "We don't know all the answers and the kids don't know, but between us maybe we'll be able to get some answers," she explained.

Students who have the opportunity to pursue their own interests and chart their own courses of study become active participants in their learning. "They're engaged. They know they're learning... It's meaningful to them," said Elizabeth Adams, a third-grade teacher at Texas' Hotchkiss Elementary. Learner-centered methods make it more "their learning," Adams said. "They start to want to learn, it's not just because I'm telling them to study something."

Learner-centered pedagogy fosters innovative projects and imaginative activities that frequently require teachers and administrators to loosen the limitations imposed by traditional curricula and schedules. They need to work constantly to achieve the delicate balance between teacher supervision and facilitating the needs of students on a variety of paths to discovery.



RESULTS

RESULTS:
EDUCATIONAL BENEFITS OF EIC-BASED LEARNING

This section describes the study's findings in eight key areas:

- GENERAL EDUCATIONAL BENEFITS
- LANGUAGE ARTS
- MATH
- SCIENCE
- SOCIAL STUDIES
- THINKING SKILLS
- INTERPERSONAL ABILITIES
- REVITALIZED TEACHING

General Educational Benefits: Using Environment-based Education to Engage Young Minds

Summary

At all 40 case study schools, EIC programs generated enthusiastic and engaged learners—children who act more independently and responsibly than students in traditional educational settings.

EIC students possess a strong sense of pride and ownership in their accomplishments. Often, the realization that each of them can make a difference results in active participation in service-learning projects in their community, a secondary benefit of many EIC programs.

Evidence also strongly suggests that within an environment-based context, student enthusiasm and engagement, as well as a sense of pride and ownership, work together to improve self-control and decrease discipline and classroom management problems.

Furthermore, schools that analyzed standardized tests and grade point averages (GPAs) found that EIC students consistently perform better in terms of academic achievement than their traditionally instructed peers.

Fourteen of the study schools conducted comparative analyses of data for both EIC and traditional students. They each collected different types and combinations of data. Data types included: standardized tests, grade point averages, student attitude measures, disciplinary referrals, and attendance. (Appendix C provides descriptions of the standardized tests referenced in this report.)

Based on analysis of both comprehensive and discipline-specific, standardized tests, all 14 study schools found that quantitative measures of achievement affirm the academic benefits of EIC-based learning. Their data indicate that most students in EIC programs scored better on standardized tests, earned higher GPAs, and had better behavior—results the school administrators attributed to their EIC programs.

Most of the schools compared test results from individual subject matter areas, these results are presented in the language arts, math, science, and social studies subsections of this report. Table 3 only summarizes data from study schools that conducted comparative analyses of comprehensive standardized tests and GPAs.

All 14 schools found that quantitative measures of achievement affirm the academic benefits of EIC-based learning.

TABLE 3. Summary of Comparative Analyses of Comprehensive Standardized Test Scores and GPAs.

School Name	Effect of EIC	After Implementing EIC
HOLLYWOOD ELEMENTARY	1997 MSPAP Assessment	*1997 composite scores for students in 4th grade were 27% higher than at other schools in their county on MSPAP (Maryland State Performance Assessment Program) and 43% higher than Maryland as a whole.*
	1996 MSPAP Assessment	*1996 composite scores for students in 4th grade were 16% higher than at other schools in their county on MSPAP and 30% higher than Maryland as a whole.*
OPEN CHARTER ELEMENTARY	STANFORD NINE Assessment	*Scores of students in 4th/5th grade "Purple Cluster" (EIC) achieved an average growth of one full stanine (achievement increment) from their previous testing. Tracked 1996-97.*
JACKSON COUNTY MIDDLE	KIRIS Assessment	*Students in 7th and 8th grades registered a 10% average increase over their previous KIRIS (Kentucky Instructional Results Information System) scores. This moved the school to within 0.1 point of being a "Reward School." Tracked 1992-96.*
LITTLE FALLS HIGH	9th Grade GPAs	*9th graders in the EIC program averaged a 2.95 GPA compared to a 2.42 GPA for other 9th graders at Little Falls. Tracked 1995-96.*
TAHOMA HIGH	9th Grade GPAs	*9th graders in the EIC program averaged a 3.2 GPA compared to a 2.6 GPA for other 9th graders at Tahoma. Tracked 1995-96.*
	10th Grade GPAs	*10th graders in the EIC program averaged a 3.0 GPA compared to a 2.8 GPA for other 10th graders at Tahoma. Tracked 1995-96.*
VALLEY HIGH	KIRIS Assessment	*Students in 11th and 12th grades "performed measurably better than their peers [at Valley] on both KIRIS and SATs," Terry Shinkle, principal. Tracked 1994-96.*
	SAT Scores	

NOTES: Appendix C presents descriptions of the assessments. Appendix D provides notes on program history and participating populations.

Evidence from the study schools indicates that students' increased engagement in learning, fostered by EIC-based instruction, translates directly into positive changes in behavior, attendance, and student attitudes about school. Table 4 summarizes data from study schools that conducted comparative analyses of disciplinary actions, attendance, and student attitudes.

Table 5 summarizes data obtained from the Learning Survey on the effects of EIC on several key indicators of academic success, and students' attitudes and engagement in their education.

TABLE 4. Summary of Comparative Analyses of Disciplinary Actions, Attendance, and Student Attitudes.

School Name	Effect of EIC	After Implementing EIC
HOTCHKISS ELEMENTARY		*Student behavior improved as evidenced by disciplinary referrals to the office decreasing by 91%, for all grades, during the first three years of implementing EIC. First year totaled 560 incidents; 2nd year decreased to 160 incidents; and, 3rd year only 50 incidents. Tracked 1994-97.*
HUNTINGDON AREA MIDDLE		*Student behavior improved as evidenced by EIC students having 97% fewer incidents than other 6th graders. 6th graders in the EIC program represented only 1% of disciplinary incidents although they comprised 33% of the entire 6th grade population. Tracked 1996-97.*
LITTLE FALLS HIGH		*Student behavior improved as evidenced by EIC students having 40% fewer problems than other 9th graders. 9th graders in the EIC program represented only 28% of disciplinary incidents although they comprised 46% of the entire 9th grade population. Tracked 1995-96.*
		*Student behavior improved as evidenced by EIC students having 54% fewer suspensions than other 9th graders. 9th graders in the EIC program represented only 21% of suspensions although they comprised 46% of the entire 9th grade population. Tracked 1995-96.*
		*9th graders in the EIC program had a 2.4% higher rate of attendance than other Little Falls 9th graders. Tracked 1995-96.*
TAHOMA HIGH		*9th graders in the EIC program had a 1.5% higher rate of attendance than other Tahoma 9th graders. Tracked 1995-96.*
		*10th graders in the EIC program had a 1% higher rate of attendance than other Tahoma 10th graders. Tracked 1995-96.*
		*EIC students had a 9.5% better attitude than other 9th and 10th graders, as assessed with S.A.M. (School Attitude Measure). Tracked 1995-96.*
VALLEY HIGH		*EIC students had an 11% higher rate of attendance than other Valley students. Tracked 1994-96.*

NOTES: Appendix C presents descriptions of the assessments. Appendix D provides notes on program history and participating populations.

From developing personal responsibility to achieving better grades, students demonstrate positive affects in overall learning when they have the opportunity to participate in integrated, environment-based programs that capture their interest and motivate them to succeed.

TABLE 5. Summary of Learning Survey on General Educational Parameters.

Learning Survey Items	% of Educators Reporting Student Improvement	# of Educators Responding to this Survey Item
Standardized test scores	77%	60
Grade point averages	73%	101
Improved behavior	70%	162
Student engagement and enthusiasm	98%	173
Ability and willingness to stay on task	89%	171
Adaptability to various learning styles	94%	161
Practicing civility toward others	93%	157

FINDINGS

Evidence gathered from the 40 EIC study schools indicates that students learn to read, write, and do math more effectively within an environment-based context than within a traditional educational framework. These results are supported by field observations including interviews, survey results, and gains on both standardized test scores and GPAs. These data indicate that students find learning more personally meaningful when the environment serves as a context for their studies. When learning is more personally meaningful, students appear to value it more and begin to feel enthusiastic about going to school, learning, and making new discoveries.

The learning effects of EIC are both broad-ranging and encouraging. They include:

- better performance on standardized measures of academic achievement in reading, writing, math, science, and social studies;
- reduced discipline and classroom management problems;
- increased engagement and enthusiasm for learning; and,
- greater pride and ownership in accomplishments.

BETTER PERFORMANCE ON STANDARDIZED TESTS

Most of the schools included in this study use both authentic assessment and standardized tests to monitor student achievement. Not surprisingly, the authentic learning experiences available through EIC programs prepare students particularly well for authentic assessments of learning.

The vast majority of EIC teachers prefer authentic measures to traditional standardized tests. Although tests such as ITBS, Stanford Nine, TAAS, KIRIS, and ERB may provide useful data regarding traditional discipline-based learning, they do not adequately measure the diverse educational benefits students receive when teachers employ EIC approaches.

Important educational decisions, however, are usually made on the basis of standardized tests. In some states, these tests influence "high stakes" decisions about local control, school funding and teachers' salaries. Consequently, 14 of the 40 study schools decided to document, for their administrators, local school boards, and state education agencies, the academic effects of adopting the environment as a learning context. Using

standardized tests and, in some cases, GPAs, they conducted comparative analyses of data for both EIC and traditional students. These schools included: Bagley Elementary, Dowling Elementary, Hollywood Elementary, Hotchkiss Elementary, Open Charter Elementary, Park Forest Elementary, Central Middle, Huntingdon Area Middle, Chariton Middle, Radnor Middle, Jackson County Middle, Tahoma High, Valley High, and Little Falls High.

All of these 14 schools found that quantitative measures of achievement affirm the academic benefits of EIC-based learning. Analysis of comprehensive and discipline-specific, standardized tests, and GPAs indicates that most students in EIC programs score better and earn higher grades than their traditional peers—results school administrators attribute to EIC education.

Thirty-six of the thirty-nine academic achievement comparisons (92 percent), using both comprehensive and subject specific standardized assessments, indicate that EIC students outperform traditional students in reading, writing, math, science, and social studies. Two of the three cases where traditional students performed as well or better than EIC students related to math scores in programs where math was not integrated into the EIC program. (Some of these programs included the whole school population, others randomly selected students from the general school population, none selected participants based on academic achievement.)

Six of the 14 schools compared academic achievement on comprehensive standardized tests. All nine of these comparative studies (100 percent) indicate that EIC students outperform traditional students on comprehensive standardized tests. Table 3, at the beginning of this section, summarizes data from the six study schools that conducted comparative analyses of comprehensive standardized tests and GPAs. (The language arts, math, science, and social studies subsections of this report include results from schools that compared scores in individual subject matter areas.)

Seventy-seven percent of educators responding to the Learning Survey concurred with the schools that conducted comparative analyses, students in EIC programs score higher on standardized tests than traditional students. Additionally, 73 percent of respondents to the Learning Survey reported that students' GPAs increased after their schools implemented EIC programs.

Evidence gathered from the 40 EIC study schools indicates that students learn more effectively within an environment-based context than within a traditional educational framework.

Effects measured at Jackson County Middle School in rural Kentucky typify those found at the other nine schools reporting improvements in standardized test scores. Jackson's EIC students showed significant performance gains as measured by KIRIS, Kentucky's state-mandated test.

After implementation of the EIC program at Jackson, the school's KIRIS scores increased by 10 percentile points, placing Jackson within one-tenth of a point of becoming a Kentucky "Reward School." The gains came just in time. "If we hadn't pulled them up this year we would have been a 'School in Crisis,'" said Karen Abner, a seventh-grade teacher. "Someone from the state would have come into our school and helped us to align our curriculum and get everything going again. We did it on our own; we pulled up 10 percentile points this year."

Terry Shinkle, principal of Valley High School in Louisville, Kentucky, saw similar improvements on his

campus. Shinkle compared the standardized test scores of students in Valley's *Environmental Tech-prep Program* with those of their peers outside the program. He found that the tech-prep group performed measurably better on KIRIS and their SATs.

Kentucky's KIRIS test uses authentic measures of student achievement. Thus, it is not unexpected that students involved in authentic learning experiences, like those offered by EIC programs, show gains on KIRIS. However, educators also observed the benefits of EIC-based learning through more conventional testing.

At California's Open Charter Elementary, EIC students' test scores showed marked improvement over a two-year period. Recent analysis of "Stanford Nine" test results for students in Open Charter's "Purple Cluster" found an average growth of one full stanine (achievement increment) from previous testing. The teaching team attributes these results to switching from a more traditional instructional approach to their current integrated-interdisciplinary EIC curriculum. In particular, Open Charter teachers remarked about greater-than-average gains they had observed among their middle-range students, a group they considered among the most challenging that they had ever taught.

It is important to note that authentic learning and assessment approaches do not prepare students for traditional testing formats; therefore, it is especially significant when EIC students perform well in standardized assessments following non-traditional instruction.

"We did no preparation for this test," said Barbara Moreno, a fourth/fifth-grade teacher at Open Charter. "When we test in our classroom, it's a collaborative learning situation so, with standardized tests, the students are operating in an unfamiliar format."

Schools that monitored their students' GPAs also observed improved grades after implementing environment-based curricula. At Minnesota's Little Falls High School, for instance, assistant principal Malcolm Wax compared the GPAs of ninth-grade students in the *LINC-9* program with those of their traditionally instructed peers. Wax found the average GPA of the randomly selected EIC students was 2.95 compared to an average GPA of 2.42 for the traditional group.

Tahoma High School recorded similar results. They found that ninth graders randomly selected to participate in Tahoma's *Integrated Program* achieved an average GPA of 3.2, while students in the traditional program posted an average GPA of only 2.6.

"I was looking for other ways to convince people of the fact that we're doing a good job, we have the documentation now. We have higher GPAs," reported Barry Fountain, ninth/tenth-grade social studies teacher at Tahoma. "Our kids do better on standardized tests, because our kids like what they are doing. They like coming to school, so we have less truancy and we have fewer behavioral problems."

Standardized test data and GPAs alike indicate that EIC-based instruction offers students substantial academic benefits over traditional educational approaches. Students in EIC programs consistently achieved scores that exceeded the performance of students taught in traditional settings. This is especially significant considering the additional educational benefits EIC programs offer beyond what is available to students within traditional curricula.

Reduced Discipline and Classroom Management Problems

Evidence from the study schools indicates that students' increased engagement in learning, fostered by EIC-based instruction, translates directly into positive changes in classroom behavior. Comparative analysis of quantitative data gathered from five study schools affirms this conclusion. All nine of the comparative studies (100 percent) indicate that EIC students demonstrate better behavior, attendance, and attitudes than traditional students. Table 4, at the beginning of this section, summarizes data from study schools that conducted comparative analyses of disciplinary actions.

Reports from 70 percent of educators responding to the Learning Survey coincide with the schools that conducted comparative analyses—behavior improved and discipline problems decreased with the adoption of EIC approaches.

In Texas, for instance, in the first year of Hotchkiss Elementary's EIC program, teachers made 560 disciplinary referrals to the office. The next year, as program implementation expanded, that number dropped to 160. The following year, with the EIC curriculum fully established, Hotchkiss administrators reported only 50 disciplinary referrals. Both the principal and teachers attribute these decreases in behavioral problems to students' increased engagement in learning.

Principal Judy Zimny sees this benefit as a strong indicator of increased quality of learning. "The level of student interest and the level of student engagement generated by this type of instruction," she said, "yield very few behavior problems."

Administrators at all the case study schools, who tracked discipline problems, reported similar improvements when they compared EIC students and traditional students. Assistant principal Jeff Coppes, for example, monitored discipline incidents at Pennsylvania's Huntingdon Area Middle School over a two-year period. During that time, only five of 418 incidents reported for all three sixth-grade classes involved students in the school's *STREAMS* program. In other words, the randomly selected *STREAMS* students, although they comprised 33 percent of the entire sixth grade enrollment, were responsible for just over one percent of the disciplinary incidents at that grade level.

"They truly begin to discipline themselves," Coppes concluded. "I think if you keep it so it's centered around the kids and they're involved, and they're actively doing things, then there's less time for them to think, 'I'm bored and I want to do something else.'"

This evidence, along with evidence from other study schools, strongly supports the conclusion that students' self-discipline and behavior improve when they are involved in environment-based, hands-on, minds-on activities that engage and challenge them.

Increased Engagement and Enthusiasm for Learning

Using the environment as a context for learning gives educators the chance to offer students choices in subject matter and study methods. EIC educators' observations show that when students are active participants in defining their own educational goals, they are likely to develop a deeper interest in learning.

Students in EIC programs develop a passion for learning. In some cases, even reluctant learners began looking forward to going to school and taking part in environment-based projects. As a result, attendance may improve with participation in an EIC program. Table 4, at the beginning of this section, summarizes data from study schools that conducted comparative analyses of attendance and student attitudes.

Ninety-eight percent of educators responding to the Learning Survey reported that their experiences paralleled the results of the schools that conducted comparative analyses—student enthusiasm and engagement increased noticeably after their schools adopted EIC approaches.

"The level of student interest and engagement generated by this type of instruction, yield very few behavior problems."

As their learning crosses traditional disciplinary boundaries, helping them make connections among a variety of subject areas, students become more interested and eager class participants. Not surprisingly, increased enthusiasm results in increased attention to schoolwork. Eighty-nine percent of respondents to the Learning Survey reported that student willingness and ability to stay on task improved as a direct result of environment-based teaching and learning.

Students in EIC programs are more likely to stay focused on their studies because they are intrigued by exploring the woods behind their school, venturing along a stream, or walking through a prairie. "I've noticed a difference in the enthusiasm of the kids for the things that they're doing," said Lauvonnia Conrad, principal of Ohio's Indian Hills Elementary.

Todd, an Indian Hills fifth-grader, explained just what his principal meant. "Even though I don't like school very much," he confessed, "I look forward to coming more than I used to because of the stuff we do. It used to be just sitting there looking at a book and reading it. It's better when you do stuff that you can actually see and not just read about."

The environment offers a compelling venue for a majority of students, even those who previously have exhibited the most difficulty in focusing on their work. Frequently, students whose learning styles differ from the norm do not readily respond to traditional methods of instruction and are left behind. These individuals can be much more successful when given the chance to use their own learning styles.

Teaching with an EIC approach offers students a wide range of opportunities to explore information and experiences using their most effective, individual learning modalities. Ninety-four percent of teachers and principals responding to the Learning Survey reported that the EIC approach was more adaptable to various learning styles than traditional approaches.

"Even though I don't like school very much, I look forward to coming more than I used to because of the stuff we do."

All 40 study schools reported that students learned more effectively when their educational experiences were diverse, offering a mixture of hands-on projects, cooperative learning, and experiences outside the classroom. These schools have found that the benefits of traditional disciplinary approaches can be significantly augmented when students: graph plant species in a forest study plot rather than working on textbook word problems; monitor hillside erosion and develop a re-vegetation plan instead of watching a video on faraway volcanoes; or, meet for small-group discussions of community issues as opposed to reading about them in a newspaper.

Some of the most dramatic effects of venturing beyond the classroom can be seen when observing the attitudes of at-risk students. Within an EIC setting, many at-risk students gain a sense of control as they connect to a learning mode that holds more relevance for them than sitting at their desks filling in another worksheet. Educators at all 40 study schools reported that at-risk students work better and learn more effectively in the outdoor venues used with EIC approaches.

"If you find something the at-risk kids are interested in, they'll give you 110 percent," commented Gene Lake, principal of Kentucky's Jackson County Middle School. Functioning successfully out-of-doors is "something they can do," he continued. "It's something they can relate to. Lots of times if you keep a kid in books, if he's behind and he can't read or is missing some skills, he's just going to get further behind all the time."

By contrast, Lake said, these same students placed in an outdoor learning setting blossom. "When they get out there, they tell the teacher, 'I know what this is,'" he said. "They just get to feeling better about themselves. You're in their territory out there. They like it. They buy into it."

Ultimately, these students become more interested in the subject at hand and feel better about themselves as they tackle real-world projects. As a result, at-risk students involved in EIC programs do a better job of staying on task in all aspects of their school work, just as other EIC students do.

Like a Candy Bar for Later: Radnor Middle School

To understand how EIC-based instruction affects students, consider students' own voices. Take Emily, for instance, a seventh grader in the *Watershed* program at Radnor Middle School in Wayne, Pennsylvania. Watershed gives students the chance to explore multiple facets of an entire geographical region. When Radnor teachers Ed Silcox and Mark Springer first brought the idea of an integrated, environment-based curriculum before their school board, they won a two-year go-ahead. Eleven years later, *Watershed* is still going strong. Emily knows why:

"I signed up for *Watershed* because I thought it would be easier. But let me tell you: it is a lot harder. It's fun in a way that it's harder. I actually want to learn now... I just got awakened to the fact that I love school for the first time in seven years...

"Last year, I didn't like school. I took forever to learn. Sometimes I turned in assignments late. But now I don't, because I like the overall learning experience better...

"Before, I studied really hard for the test, did the test, probably got an A and then, after the test, I forgot everything. Now stuff is actually interesting to learn and I know that I can use it later if I get it now. It's sort of like buying a candy bar. You don't have to eat it now. You can eat it later...

"They split apart the regular classes when the whole idea is to learn. In here we mix that all together. It's much better mixed together. Those lines that they cut between classes, they don't mean to be very big. But really they're big fat walls between the classes, really mental walls...

"*Watershed* makes you want to learn because it's useful. I like the process of learning. When I finish something, I say, 'give me something else, give me something to do.' I learn so quickly because I like it."

Using the environment as an educational context helps students become engaged and enthusiastic about learning, which results in increased attention to schoolwork. These benefits are apparent in a wide range of students, representing diverse learning styles and abilities. Even those typically classified as at-risk show an increased ability to stay focused and on task in EIC programs.

Greater Pride in and Ownership of Learning

Students who participate in EIC programs appear more likely to display a sense of pride and ownership in their work than students in more traditional school settings. From restoring wetlands to creating butterfly gardens at the community landfill, the environment-based, service-learning projects common in EIC curricula generate great personal interest among students. These young people feel they can actually make a difference by improving their school or hometown. They develop a sense of personal investment in their communities that is often rewarded with public recognition and appreciation for their efforts.

Pride and ownership translate into greater respect for others as EIC students learn to value and appreciate the work of peers and other community members. Ninety-three percent of educators responding to the Learning Survey reported that students acted with more civility toward others after the adoption of EIC approaches.

At Wakeland Elementary School in Bradenton, Florida, for example, students display a growing sense of pride and ownership as they work on their school grounds and in their neighborhood. Because they are helping to build and maintain outdoor learning areas

such as nature trails and a tree nursery, these students have developed a vested interest in the appearance and upkeep of their school.

Wakeland principal Brian Flynn has watched the sense of ownership among his students grow as a result of their EIC projects. "They don't want to see anything happen to the school that they helped build," Flynn explained. "I think there's a lot of ownership and pride in the school because the kids have been involved in the environmental program."

Students grow protective of their school's campus when they have the opportunity to take an active role in developing and maintaining their outdoor learning areas. As a result, vandalism at the study schools is virtually unknown, although in some cases, neighboring schools serving analogous populations with traditional educational curricula, suffer from serious and ongoing vandalism of school buildings and landscaping.

The project-based methodologies used in EIC programs give students a chance to become involved on the local level and thus learn they can indeed make a difference. From erosion control at local creek beds to tree planting in community parks, students at Washington's Komachin Middle School are making a difference. They think that concentrating their efforts on their hometown is important. "We can't always do that much about places that are far away; we might as well help in the community around us," explained Amanda, an eighth-grader.

"We can't always do that much about places that are far away; we might as well help in the community around us."

Classmate Brianne agreed, "If we go down to the park where we planted we can say, 'Oh, I planted those trees and I put those posts there and I did that.' If you buy an acre of rainforest, you can never see that and you can never go there," she said. "We're doing projects closer to home because we can go out and really make a difference."

Students like those at Wakeland and Komachin, who see tangible proof of their efforts in their communities, develop a sense of pride that helps them become more civic-minded and productive members of society. The positive feedback students receive when they undertake an environment-based, service-learning project in their community is reinforced every time they walk by a waterway where they released salmon, or trees they planted, or a park they helped establish.

LANGUAGE ARTS:
IMPROVING READING, WRITING, AND SPEAKING WITH ENVIRONMENT-BASED EDUCATION

SUMMARY

Students learning within the context of the environment improve their language arts skills beyond those of their peers taught with traditional curricula.

As they become involved in first-hand study of the natural and socio-cultural systems that make up their world, EIC students grow more enthusiastic about developing and applying language arts skills. They voluntarily go to the library, search the Internet, or call subject matter experts to learn more. They like reading about nature and their community; they enjoy writing about issues affecting society; and, they welcome the chance to express their ideas at public meetings and in presentations. These increased opportunities facilitate the development of strong skills in reading, writing, and oral expression.

Data from both the Learning and Domains Surveys indicate that teachers and administrators have found EIC-based learning to be an effective means of helping students develop their language arts knowledge and skills. Table 6 summarizes data from the Learning and Domains Surveys on the effects of EIC on developing language arts skills.

Nine of the study schools conducted comparative analyses of language arts achievement data from both EIC and traditional students. These nine schools conducted a total of 17 comparative analyses of language arts achievement using data from several different standardized tests.

Based on analysis of these data, all nine schools found that quantitative measures of achievement affirm the academic benefits of EIC-based learning for language arts. All 17 of these comparisons (100 percent) indicate that students who have been in EIC programs outperform their peers in traditional programs. Table 7 provides a summary of the results of the comparative analyses of language arts at four elementary schools and Table 8 presents the results at five middle and high schools.

FINDINGS

Reading, writing, and speaking are the means through which we communicate with those around us. Achieving proficiency in these core skills is a vital first step to every individual's success in school and society, as well as in personal and professional pursuits.

EIC approaches appear to provide excellent opportunities to learn language arts skills. Using the environment as a context for projects and problem solving offers teachers many possibilities to foster language arts learning within and across disciplines.

TABLE 6. Summary of Learning and Domains Surveys on Developing Language Arts.

Learning Survey Items	% of Educators Reporting Student Improvement	# of Educators Responding to this Survey Item
Language arts learning	93%	150
Communicating with others	94%	167
Communicating with public and private agencies	91%	141
Domains Survey Items		
Knowledge: content, concepts, and principles	83%	110
Skills: processes and application to real situations	91%	116
Retention of knowledge and skills	85%	104
Attitudes: engagement, enthusiasm, and interest	94%	114
Opportunities: context and content for learning	94%	114
Average for Language Arts Domains Survey	89%	111

Ninety-four percent of respondents to the Domains Survey reported that, in contrast to traditional curricula, EIC approaches offered greater opportunities to provide students with both context and content for learning language arts.

When students read, write, and speak about topics that interest them, they are more likely to make an effort to strengthen these important skills. Ninety-three percent of respondents to the Learning Survey reported that students in EIC curricula more effectively developed language arts skills than their peers in traditional educational settings.

"I think that our TAAS [Texas Assessment of Academic Skills] language arts results really support what current research tells us," summarized Judy Zimny, principal of Hotchkiss Elementary in Texas. "That is, if language arts skills and concepts are taught within the context of a meaningful whole, they are learned more easily, and they are retained longer."

Evidence from the study schools indicates that the language arts skills of students in EIC programs improve in three important ways:

- reading with improved understanding;
- writing more effectively; and,
- speaking with increased skill and confidence.

"If language arts skills and concepts are taught within the context of a meaningful whole, they are learned more easily, and they are retained longer."

TABLE 7. Summary of Comparative Analyses of Standardized Data on Student Achievement in Language Arts at Elementary Schools.

School Name	Effect of EIC	After Implementing EIC
BAGLEY ELEMENTARY		*Average reading scores on ITBS (Iowa Test of Basic Skills) of students in 5th grade rose from 46 to 52. Tracked 1993-95.*
		*Average language scores on ITBS of students in 5th grade rose from 43 to 53. Tracked 1993-95.*
DOWLING ELEMENTARY		*Median reading comprehension scores on CAT (California Achievement Test) rose 19 percentile points. Tracked 1990-92.*
		*Median reading comprehension scores on CAT rose 8 percentile points for low achievers, 7 percentile points for middle achievers, and 6 percentile points for high achievers (over a two year period). Tracked 1995-97.*
		*Median reading comprehension scores on CAT placed the school in the top 5 of 68 schools in Minneapolis. Tracked 1995-97.*
HOTCHKISS ELEMENTARY		*4th-, 5th-, and 6th-grade EIC students averaged a 9% year-to-year gain on TAAS (Texas Assessment of Academic Skills) passing rates as they moved from one grade to the next. Tracked 1995-97.*
		*TAAS passing rates of 4th-grade EIC students, from the 1996-97 class, surpassed by 13 percent the rates for students in the 1995-96 class. Statewide, the average gain was only 1%. Tracked 1995-97.*
PARK FOREST ELEMENTARY		*12% more 5th-grade students scored in the top and high-middle ranks, on PSSA (Pennsylvania State System of Assessment), than similar schools designated by the Pennsylvania Department of Education. Tracked 1995.*

NOTES: Appendix C presents descriptions of the assessments. Appendix D provides notes on program history and participating populations.

READING WITH IMPROVED UNDERSTANDING

Teachers in the study schools compared the reading development of EIC and traditional students in three ways: time spent reading; effort to obtain and read materials outside the framework of specific assignments; and, ability to comprehend and digest the materials. In terms of these three measures, EIC students apparently read better and comprehend more than students in traditional programs. These conclusions are supported by observations of student behavior and analysis of standardized test data (see Tables 7 and 8).

Although quantitative measures are not a primary source for this study, at case study schools where such statistics are available, they corroborate behavioral evidence of improved reading. At Hotchkiss Elementary, for instance, Principal Zimny credited EIC approaches with significant increases in reading scores as measured by the TAAS. Zimny found an average nine percent year-to-year gain in the TAAS passing rates of EIC students in three different grade levels as they moved from one grade to the next. She discovered that most gains occurred in classrooms where teachers did the most integrated work.

TABLE 8. Summary of Comparative Analyses of Standardized Data on Student Achievement in Language Arts at Middle and High Schools.

School Name	Effect of EIC	After Implementing EIC
CENTRAL MIDDLE	WRITING 6th Grade	*72% of students scored greater than expected gains on the CMSWT (Central Middle School Writing Test). Tracked 1995-96.*
	WRITING 7th Grade	*53% of students scored greater than expected gains on the CMSWT. Tracked 1995-96.*
	WRITING 8th Grade	*83% of students scored greater than expected gains on the CMSWT. Tracked 1995-96.*
CHARITON MIDDLE	LANGUAGE	*50% of 7th-grade students scored at least one grade above and 27% scored at least three grades above national grade equivalent student populations on the ITBS (Iowa Test of Basic Skills). Tracked 1995-96.*
HUNTINGDON AREA MIDDLE	READING	*The school ranked 4th of 64 schools for students scoring in high and high-middle quartiles, on PSSA (Pennsylvania State System of Assessment), in their assessment region. Tracked 1996-97.*
RADNOR MIDDLE	WRITING	*EIC students, "Improved significantly over school's other 7th graders. They also accounted for almost all the 7th grade's improved writing scores." Tracked 1988.*
	READING	*EIC students, scored "significantly better than the control group [at Radnor] in reading." Tracked 1988.*
TAHOMA HIGH	LANGUAGE	*11th-grade students, who had been in the program in 9th and 10th-grades, averaged 4.8% higher on CFAS (Curriculum Frameworks Assessment System) in language than other Tahoma 11th graders. Tracked 1995-96.*
	WRITING	*11th-grade students, who had been in the program in 9th and 10th grades, averaged 1.7% higher on CFAS in writing than other Tahoma 11th graders. Tracked 1995-96.*

NOTES: Appendix C presents descriptions of the assessments. Appendix D provides notes on program history and participating populations.

Standardized test scores at Minnesota's Dowling Elementary School also show benefits in reading skills as a result of environment-based teaching. Principal Jeffrey Raison analyzed data from the California Achievement Test (CAT) and found that median scores in reading comprehension rose, over a two year period; eight percentile points for low achievers; seven percentile points for middle achievers; and, six percentile points for high achievers. Also, in 1996-97 the growth of reading comprehension for second graders was significantly higher than expected based on pre-testing and student demographics. Raison attributes these gains to his faculty's implementation of "best practices," team building, and creative thinking when they developed their EIC program.

Student changes in reading behavior vary from subtle to dramatic. When allowed to read about the environment and related community topics, students commonly express a

growing interest in reading, with many becoming openly enthusiastic, even pressing their teachers for more reading time. Evidently, this increased enthusiasm results from participation in EIC activities. Ninety-four percent of educators responding to the Domains Survey reported that EIC students exhibited more interest in and enthusiasm for language arts than did students in traditional curricula.

As EIC students become aware of interdisciplinary connections, they tend to read more and pursue a greater variety of reading materials, often beyond what their assignments require. In some cases, poor or reluctant readers begin seeking out and digesting written material on their own, without the usual prompting or assistance from teachers. As they become increasingly motivated, students also begin bringing in additional resources or independent language projects from home. Some educators take advantage of these extra materials to integrate additional subjects into their lesson plans. Newspaper clippings about the local forest industry, for example, may form the basis for social studies activities.

As students practice habits crucial to authentic scholarship, even at the elementary level, they learn important lessons about gathering information. Their research tools include the library, CD-ROMs, the Internet, and often newspapers and magazines from home. EIC students tend to follow up classroom activities with library or computer-based research more than do students in traditional programs. Their interest and curiosity about the subjects of their study make them more eager to ask questions and seek answers.

"Before, they'd stand there going, 'How do I find this out? Where do I go?'" said Amy Wagner, a fifth-grade teacher at Ohio's Indian Hills Elementary. "They didn't seem to know what to do." Since the introduction of an EIC curriculum, however, Wagner has seen her students' research skills soar. "When we go to do a project the students now know where to go to find information," she said. "When they're out at the library on their own they're seeing things that go with our theme and they're bringing them in. And, they're using the encyclopedia and the CD on the computer."

In the process of conducting environment-based research, students often discover whole new areas of interest and seek out even more reading materials to quench their growing curiosity. Their studies then become a means of advancing personal growth rather than merely satisfying class requirements. They learn to be more self-sufficient and less dependent on their teachers for knowledge. They learn they can obtain answers from more than one source, find more than one perspective on an issue, and analyze information from a variety of resources.

The explanation for these improvements in reading and comprehension is simple: students pursue what interests them. A tenth grader fascinated by her local river ecosystem does not need prodding to search for another book about the relationship between forest health and water quality. Students on Puget Sound do not need coaxing to read books about oceans. Students' innate affinity for nature can expand into broader curiosity as the integrated and interdisciplinary nature of EIC approaches helps them see the connections inherent in the natural world and their community.

Increased opportunities to read more diverse literature about subjects that interest them lead to greater comprehension. Improved understanding in turn helps EIC students retain what they are learning both in terms of content and skills. Eighty-five percent of respondents to the Domains Survey reported that EIC students more effectively retained language arts knowledge and skills than their traditional peers.

Students exhibit a natural progression from curiosity to comprehension when reading about the environment. Consequently, EIC approaches enable teachers to create a learning context that fosters enthusiasm for reading and provides opportunities to study topics of great personal interest to young people: birds and mammals, streams and lakes, forests and prairies—in other words, their surroundings. As students wake up to the wonders inherent in the natural world, they become more inquisitive explorers, more enthusiastic readers, and more self-sufficient scholars.

Writing More Effectively

The writing abilities of EIC students appear to benefit substantially from the opportunity to write about real-life experiences. As EIC students concentrate on subjects of interest and importance to them, they become more capable and confident writers. Ninety-one percent of respondents to the Domains Survey reported that EIC students were better able to apply language arts skills to real-world situations than their peers in traditional programs.

The writing demanded by EIC-based activities typically transcends in complexity the writing exercises assigned in traditional English classes. Thus, students have the chance to demonstrate greater depth in their written work and achieve mastery of composition that surpasses that of their traditionally educated peers.

At the study schools, the writing skills of students in EIC programs showed growth along three major dimensions:

- more variety in genres, styles, and strategies;
- more complex ideas; and,
- greater volume of higher quality work.

More Variety in Genres, Styles, and Strategies

The varied content of EIC activities fosters creativity in writing and encourages proficiency in a number of diverse literary styles, from lab reports to poetry, editorials to expository writing. Even students who did not enjoy writing before become more creative while working on EIC projects. Imaginative assignments, such as explaining the complex interactions between a hawk and its habitat, make writing more fun and intriguing. Experiences in the natural world and their community appear to inspire students to write about their discoveries.

Quantitative evidence of how EIC benefits students' writing skills comes from programs that assess writing proficiency through standardized measures. These data show that EIC students demonstrate higher performance in their written work than their traditionally educated peers (see Tables 7 and 8).

Results of pre- and post-tests provide strong evidence that the writing skills of EIC students at Pennsylvania's Radnor Middle School improved significantly beyond those of the school's other seventh-graders. Moreover, the writing skills of 37.5 percent of Radnor's EIC students improved more rapidly than expected when compared to typical seventh graders at Radnor. EIC students also accounted for almost all the seventh grade's improved writing scores, even though these randomly-selected students constituted only 20 percent of Radnor's seventh graders.

"My kids seem much more eager to write... A lot of that has to do with the children's natural curiosity and the fact that the environment is basically the world around them."

"We see better writing," commented Mark Springer, a seventh-grade teacher at Radnor. "That's one area we feel very strongly about. And the kids feel strongly about it. If you ask them, that's one of the things they will tell you right away. They're much more confident with their writing than they ever were before."

At Minnesota's Central Middle School, 1995-96 test results indicated that 83 percent of eighth graders, 53 percent of seventh graders, and 72 percent of sixth graders showed improvements in writing resulting from environment-based instruction. Central's EIC

teachers reported that these writing gains were greater than expected for comparable students taught with traditional language arts approaches.

Likewise, students at Hotchkiss Elementary showed significantly improved writing scores on the TAAS test after implementation of an integrated curriculum. The passing rates of fourth graders from the 1996-97 class, the first to learn through EIC approaches, surpassed by 13 percent those of students in the 1995-96 class. According to staff members in the Texas Education Agency's Division of Student Assessment, Hotchkiss' gains were "extremely significant" when compared to the statewide average gain of only one percent during the same period. Principal Zimny attributes these benefits to using EIC approaches to bring together language arts and the other disciplines.

Chris Czarnecki, a second grade teacher at Hotchkiss, seconded that conclusion. "My kids seem much more eager to write because they have more choices. They can write about the things they're interested in," she said. "A lot of that has to do with the children's natural curiosity and the fact that the environment is basically the world around them... its 'everydayness.'"

MORE COMPLEX IDEAS

EIC students also appear to more effectively connect and synthesize complex ideas in their writing than their traditionally educated peers. Ordered thinking seems to precede ordered writing as these students structure their thoughts into a personal framework of understanding, applicable to all facets of their education. They frequently transfer this integrative and analytical ability to other subjects. After writing about the complex relationships in a forest, for example, students seem better able to write about the connections among economics, historical events, and natural resource management.

"I see the kids connecting ideas," said Barbara Moreno, a teacher at California's Open Charter Elementary. "In their writing they're connecting one thought with another. They're connecting it in paragraphs that make sense."

Moreno's colleague Judy Utvich concurred. EIC "seems to provide a framework," she said. "I think that has a lot to do with why the writing makes more sense. They see an order in the world through systems thinking that they are then able to translate into their own understanding of the world. It helps them construct their own knowledge."

Furthermore, EIC students tend to develop a more sophisticated vocabulary, including a wider variety of terms relating to economics, science, history, politics, and the environment. Eighty-three percent of educators responding to the Domains Survey reported that EIC students' knowledge of language arts content and concepts improved more than that of their traditional peers.

GREATER VOLUME OF HIGHER QUALITY WORK

Reluctant writers, even special education students, tend to grow bolder in EIC programs, often taking more risks in their writing and pushing well beyond previously mastered skills. Students who previously wrote just enough to "get by" in traditional programs often produce more written work when writing about topics related to the environment. Their eagerness to paint more vivid word pictures and develop more intricate analyses of their arguments encourages them to write more.

"At the beginning of the year, in the journals, I was going to write a quarter of a paragraph because I'm not much of a writer," said Bill, a tenth-grader at Colorado's Glenwood Springs High School. "By the end of the program, I was probably writing two pages per journal [entry] just because the environment brings about questions. It just keeps you going."

Even in schools where EIC students did not register impressive gains on standardized tests, they kept pace with their counterparts in traditional programs by achieving equal or slightly better writing scores. These results help to ameliorate concerns, expressed by

some parents and school personnel, that standardized writing scores might suffer as a result of using integrated approaches to the curriculum (see Tables 7 and 8).

Nancy Skerritt, curriculum director of Washington State's Tahoma School District, offers evidence to this effect. In a standardized writing assessment given to eleventh graders during the 1995-96 school year, students who participated in the district's *Integrated Program* in ninth and tenth grades scored two percent higher than those in the traditional ninth- and tenth-grade program. Skerritt sees the ability of these students to hold their own in traditional measurements of academic achievement as important evidence of the value of EIC, especially considering the manifold other academic and personal benefits to Tahoma's students. Moreover, she believes the data point toward stronger preparation of EIC students through the curriculum offered in the *Integrated Program*.

Throughout the 40 study schools, students have become more competent in the role of author as they tackle journal entries, scientific reports, and creative writing assignments about the environment and their community. Students apparently like writing about intriguing, real-world experiences rather than isolated disconnected facts and theories. The instructional approaches inherent in EIC programs help them learn to write with more creativity and sophistication, and express complex concepts they can carry into other learning contexts.

Speaking with Increased Skill and Confidence

The environment's widespread appeal to students and community members creates diverse opportunities to nurture students' speaking skills. The desire to share their exciting discoveries with others often encourages EIC students to develop their oral presentation skills. Teachers find that they can capitalize on community interest in the environment to create opportunities for students to present their work to other classes, neighboring schools, civic organizations, local agencies, and governing bodies.

Students Benefiting the Community: Glenwood Springs High School

Students in the *Riverwatch* program at Glenwood Springs High School went to a community meeting to listen, but found themselves drawn into the discussion as a result of their EIC experiences. "By the end of the meeting we had three *Riverwatch* kids speaking about the need to help preserve and protect the Colorado River corridor," reported service learning teacher Guy Brikell.

Impressed panelists encouraged the Glenwood Springs students to apply for grant funds to implement their ideas. They did, and became the first team of high school students in their state to obtain a Greater Outdoor Colorado Grant. The city matched the state's funding and students ultimately received $66,000 to plan and develop a riverside "pocket park." The students have remained involved with local government officials as they work to name the park and develop signage describing the surrounding geography and wildlife habitat.

As a result of their articulate presentations and informed efforts, Glenwood Springs students won the respect of their city's adult leaders. "There's a growing sense that the students are a legitimate resource," Brikell said. "They're no longer viewed as just students; they're starting to be viewed as authentic community members who have a lot of energy and a lot of vision and idealism based upon the education they've received."

In terms of speaking ability, EIC approaches enable students to:

- increase the effectiveness of their oral communications;
- increase the ease and confidence of their speaking; and,
- create better-conceived, more sophisticated oral presentations.

Ninety-four percent of educators responding to the Learning Survey reported that EIC students were more successful in communicating with others than their peers in traditional programs. One explanation for this is that teachers operating within an environment-based context can effectively combine instructional approaches to foster speaking skills. Presented with extensive opportunities to make presentations, students gain confidence in their ability to persuasively deliver information about topics that are important to them.

Speaking engagements to other classes, schools, and civic groups foster poise and competence. For once, students become the authorities, often on subjects with which their audiences may not be familiar. Being the expert is, for most students, a new experience and one that fits precisely within EIC approaches that cast teachers as learning guides rather than lecturers. Students rise to the challenge, motivated by their own intense interest and growing knowledge about their communities and the natural world.

EIC approaches also appear to promote growth in vocabulary, as students become familiar with professional and technical terminology, typically heard only in the adult world. "When we take them to conferences they speak for half an hour," said Huntingdon Area Middle School's Fred Wilson. "They know what they're talking about. Their vocabulary definitely picks up. They're using vocabulary now that's technical, higher up the scale and they're using it correctly."

"Their vocabulary definitely picks up. They're using vocabulary now that's technical, higher up the scale and they're using it correctly."

In addition, teaching teams encourage students to use all of their creativity to make their case and bring into play a variety of media to augment their speeches. Students learn to use display boards, hand-built models, slides, brochures, videos, and sophisticated computer graphics when making presentations.

Often, students' speeches become sophisticated enough to persuade community leaders. In many cases, these presentations have led directly to investigations by government agencies or informed decisions by local governing bodies. Ninety-one percent of respondents to the Learning Survey reported that EIC students demonstrated more success in communicating with public and private agencies than their peers in traditional programs.

Schools using EIC approaches help students improve their oral presentation skills, gain confidence, and become proficient in making effective presentations. Even students who in traditional programs would rather have taken a failing grade than speak before their classmates, become eager to share what they have learned about their community and natural surroundings.

Ultimately, such successes encourage students to grow more enthusiastic about sharing their knowledge, thoughts, and opinions, an important step in the process of discovering that public speaking skills will serve them throughout their lives.

MATH:
GAINING SKILLS THROUGH ENVIRONMENT-BASED LEARNING

SUMMARY

Students learning in the context of the environment begin to look at the world of math a little differently. Instead of thinking that math is only abstract concepts, these students learn that math skills are tools that they can use to quantify, analyze, and recognize connections among natural and socio-economic systems.

Learning in the context of their local environment fosters deeper understanding of math and enables students to more readily master crucial skills than they would in a traditional curriculum. They see how math connects to other disciplines and helps them interpret what they discover when studying economics, geography, science, and other subject areas.

EIC students also more readily remember what they learn. When they apply their emerging skills to problems that are relevant to them, students' attitudes toward learning math improve and they begin to understand the value of math in everyday life. In the process, they become more motivated and enthusiastic about math.

Data from both the Learning and Domains Surveys indicate that teachers and administrators have found EIC-based learning to be an effective means of helping students develop their math knowledge and skills. Table 9 summarizes data obtained from the Learning and Domains Surveys on the effects of EIC on learning math skills.

Seven of the study schools conducted comparative analyses of mathematics achievement data from both EIC and traditional students. These seven schools conducted a total of seven comparative analyses of mathematics achievement using data from several different standardized tests.

Based on analysis of these data, five of the seven schools (71 percent) found that quantitative measures of achievement affirm the academic benefits of EIC-based learning for mathematics. Math was not integrated into the EIC programs at either of the two schools where achievement scores for EIC students were equal to or lower than scores for traditional students. The equal or lower scores at the schools that did not integrate math may, in fact, be additional evidence of the value of incorporating math into EIC programs. Table 10 provides a summary of the results of the comparative analyses of mathematics at these seven schools.

TABLE 9. Summary of Learning and Domains Surveys on Mathematics.

Learning Survey Items	% of Educators Reporting Student Improvement	# of Educators Responding to this Survey Item
Learning of math	92%	137
Domains Survey Items		
Knowledge: content, concepts, and principles	73%	92
Skills: processes and application to real situations	93%	94
Retention of knowledge and skills	78%	83
Attitudes: engagement, enthusiasm, and interest	89%	94
Opportunities: context and content for learning	96%	91
Average for Math Domains Survey	86%	91

FINDINGS

Authentic, environment-based experiences provide students with a lens through which they can connect math with all other disciplines; consequently, it becomes a more relevant and valuable subject to them. Teachers at all 40 case study schools found that employing EIC approaches is a highly effective means of making math lively, engaging, and meaningful for learners of all ages. Students learn math better when they can connect it directly to their daily lives within the context of the environment. Ninety-two percent of educators responding to the Learning Survey reported that using EIC approaches improved math learning when compared with traditional methods.

As students work through the hands-on projects common in EIC curricula, they find that math becomes a tool they can use to quantify and analyze the world around them. As these students move from conceptual understanding to meaningful application, learning reaches a critical point when suddenly math begins to make sense. As their perception of math changes, students become more committed to its study.

"They can make more sense out of their answers," commented Michael Simpson, a sixth-grade math teacher at Pennsylvania's Huntingdon Area Middle School. For example, as they floated objects of various sizes down the river, Simpson's students learned the meaning of water velocity and calculated average flow rates. In this real-world context, he explained, "the numbers really start to make sense to them."

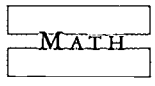
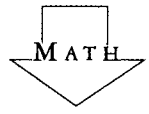
At the study schools, students' math knowledge and skills benefited in three areas:

- improved understanding of mathematical concepts;
- better mastery and retention of math skills; and,
- valuing and becoming enthusiastic about math.

IMPROVED UNDERSTANDING OF MATHEMATICAL CONCEPTS

EIC approaches offer excellent opportunities for connecting math learning to the real world. The evidence strongly suggests that, through the hands-on experiences and problem-solving activities fostered in EIC, students begin to more fully understand abstract mathematical ideas in concrete learning situations. As a direct result, students at

TABLE 10. Summary of Comparative Analyses of Standardized Data on Student Achievement in Mathematics.

School Name	Effect of EIC	After Implementing EIC
DOWLING ELEMENTARY		*Median math comprehension scores on CAT (California Achievement Test) rose 16 percentile points for low achievers, 13 percentile points for middle achievers, and 7 percentile points for high achievers (over a 2 year period). Tracked 1995-97.*
HOTCHKISS ELEMENTARY		*4th-, 5th-, and 6th-grade EIC students averaged a 15.5% year-to-year gain in TAAS (Texas Assessment of Academic Skills) passing rates as they moved from one grade to the next. Tracked 1995-97.*
PARK FOREST ELEMENTARY		*20% more 5th-grade students scored in the top and high middle ranks, on PSSA (Pennsylvania State System of Assessment), than similar schools designated by the Pennsylvania Department of Education. Tracked 1995.*
CHARITON MIDDLE		*45% of 7th-grade students scored at least one grade above and 17% scored at least three grades above national grade equivalent student populations on the ITBS (Iowa Test of Basic Skills). Tracked 1995-96.*
HUNTINGDON AREA MIDDLE		*The school ranked 1st of 66 schools for students scoring in high and high-middle quartiles, on PSSA, in their assessment region. Tracked 1996-97.*
RADNOR MIDDLE		*The students "performed on par with the control students [at Radnor] in math." Math is not integrated into this program. Tracked 1990-92.*
TAHOMA HIGH		*11th-grade students, who had been in the program in 9th and 10th grades, averaged 3.1% lower on CFAS (Curriculum Frameworks Assessment System) in math than other Tahoma 11th graders. Math is not integrated into this program. Tracked 1995-96.*

NOTES: Appendix C presents descriptions of the assessments. Appendix D provides notes on program history and participating populations.

the study schools gain deeper math knowledge than their peers in traditional classes. Seventy-three percent of respondents to the Domains Survey reported that EIC students improved their understanding of math concepts and content beyond students in traditional math classes.

Although quantitative measures are not a primary data source for this study, where such statistics were available they corroborated other evidence of improved math achievement. At Minnesota's Dowling Elementary School, for example, principal Jeffrey Raison compared the math performance of his students before and after implementation of an environment-based curriculum. Raison found that, after introduction of the EIC program, median scores in math comprehension rose, over a two year period: 16 percentile points for low achievers; 13 percentile points for middle achievers; and, 7 percentile points for high achievers.

The integrated and interdisciplinary character of EIC programs also gives students the opportunity to connect their math studies with other disciplines. They begin to see the relationships between a variety of subject areas. For example, when students combine

math studies with an analysis of a community opinion survey, they learn more than statistics; they begin to understand the socio-economic significance of the data they have gathered.

In Dallas, principal Judy Zimny conducted a comparative analysis of her Hotchkiss Elementary students and detected an average of 15.5 percent year-to-year improvement in the Texas Assessment of Academic Skills (TAAS) passing rates of EIC students at three different grade levels. She credited the integrated, interdisciplinary nature of the school's environment-based program with these considerable gains.

When students explore school grounds, natural areas, their neighborhoods and the community at large, they encounter opportunities to employ a diversity of math skills. Elementary students determining the average number of cicadas in their schoolyard study plots, seventh graders calculating the board feet of lumber in the woods behind their campus, high school students conducting a complex statistical analysis of the population dynamics of deer in their county—all these students are developing their emerging math skills in authentic settings. Ninety-six percent of educators responding to the Domains Survey reported that EIC approaches offered students greater opportunities to learn math in a real-world context than traditional curricula.

"I can see it in my other classes; I see the eyes glaze over," said Vince Vergis, who teaches math in both traditional and EIC settings at Florida's Taylor County High. "I guarantee that the comprehension, as a whole, with [the EIC] group is much better because of their hands-on experiences. In my mind there's no doubt. The [EIC] kids understand more concrete concepts. They're able to apply their understanding and take it to a higher level.

"This year we used geometry to do measurements at the Econfina River," Vergis continued. "Consequently, the students know the formulas; they've seen it and measured it and been there with it. Now, when I ask them questions either verbally or on a test they can give me answers that I'm sure none of my other classes [outside the EIC program] could have answered. I feel they've grasped the concepts better."

"I guarantee that the comprehension, as a whole, with [the EIC] group is much better because of their hands-on experiences."

Huntingdon's Simpson also attributes gains in math learning directly to the EIC program. Previously, he noted, "math was always taught in isolation." Now, because of the broader learning opportunities afforded by the EIC approach, "students are interpreting; they're writing about it, they even go back and recalculate because they are more likely to realize when they don't get the right answer," Simpson said. "I don't get nonsense answers on math tests anymore."

Better Mastery and Retention of Math Skills

EIC approaches help students master math skills and transform these abilities into tools they can use in the process of discovery. When students have the chance to apply their understanding of math to interdisciplinary, hands-on projects it helps them learn these skills more effectively. Additionally, they are more likely than students in traditional curricula to see how they can apply these math skills in other settings.

Students in EIC programs gain application skills as they use math to quantify characteristics of soil samples, analyze stream flow parameters, determine changes in employment patterns in the lumber industry, or estimate the number of cord grass plants to order for a re-vegetation project.

First-hand experiences in applying math to authentic problems helps these students understand math skills more thoroughly than their traditional peers. Ninety-two percent of educators responding to the Domains Survey reported that EIC students improved their math skills when compared to students in typical education programs.

"It was more meaningful because they did the work themselves and had ownership in the project. They retained the math concepts better."

Tenth graders at Minnesota's Little Falls High, for example, applied their knowledge of statistics to analyze their observations of the Mississippi River. Using their graphing and statistical skills, these students began to see unusual patterns in their water quality data. Further analysis uncovered a significant variation in water chemistry during the year, which in turn, triggered even deeper mathematical analysis. Ultimately, this led to the discovery of a waste-runoff problem occurring upstream from their study site.

Not only do EIC students develop stronger math skills, but they also better remember the math they learn and bring that knowledge back to the classroom. Seventy-eight percent of respondents to the Domains Survey reported that retention of math knowledge improved after implementation of environment-based instructional approaches.

While studying the life cycle of native salmon populations, Washington's Bagley Elementary students "were able to grasp the concepts of probability and measurement better than when I presented it in regular classroom instruction," said Gloria Ablé. "It was more meaningful because they did the work themselves and had ownership in the project." More importantly, she said, "they retained the math concepts better."

Many other case study schools also documented significant improvement in students' long-term retention of math skills after adopting EIC methods. At California's Open Charter School, for example, teachers compared the year-to-year achievement of students and found increased scores on annual math inventories. These results applied to students at all ability levels.

Judy Utvich, a fourth/fifth-grade teacher at Open Charter, monitored students who were taught math skills using traditional approaches and compared that to teaching math skills with EIC approaches. "When I gave the inventory at the start of this year," she said, "just looking at various math skills, every one of our students from last year scored 80 percent or above on the inventory."

Utvich discovered that eight months after teaching percentage skills in an ecosystem project, students recalled both their understanding of the concepts and the activity that provided the context for learning. In contrast, she found that most students taught with traditional methods could not, when tested six months later, remember those same skills.

Significantly, Utvich noted, these improvements happened regardless of students' ability levels or learning styles. "These are everywhere from gifted students to limited English learners," she said. "There's really quite a span in the group I monitored."

Middle and high school teachers observed effects similar to what Utvich found. At Kentucky's Jackson County Middle School, Kim Flynn, a seventh-grade math teacher reported, "When I taught the kids math skills like measuring, in the classroom, they forgot it and couldn't make use of it. When the students had a chance to use these skills on our nature trail, they not only learned better but could apply and remember their math skills longer."

As EIC students see the connections between math and their surroundings, they begin to apply mathematics in new, inventive ways, pushing beyond the benchmarks of traditional curricula to acquire and apply advanced math skills.

Valuing and Becoming Enthusiastic about Math

Learning in the context of the environment helps students recognize the practical value of math for quantifying and understanding the world around them, and perceive the importance of learning what can otherwise appear to be irrelevant mathematical material. When this occurs, their attitudes about math change from merely tolerating it to wanting to learn more. "They'll say, 'We need to know this in order to solve the problem,'" said Carol Dungen, a fourth-grade teacher at Maryland's Hollywood Elementary. "Now, when they learn something in math, they see the use in it, there's a reason why they're doing it, not just because the teacher said to do it."

Eighty-nine percent of educators responding to the Domains Survey reported that students' attitudes toward learning math improved when compared to their traditional counterparts. "They know they're going to do something besides read in a textbook and maybe learn something and then a week later not remember it," Dungen concluded.

Educators at middle and high school levels observed similar improvements in students' attitudes. At Oregon's Waldo Middle School, for example, seventh-grade math teacher Mike Reams noticed students beginning to understand why studying math is important. "When the kids see a connection between what they do in the classroom and what they might see out there in the real world, their motivation changes," Reams said. "They actually see some purpose in learning, rather than just coming in and memorizing this and memorizing that. They see some reason why it might be valuable to know math." Teaching math in the context of a project like endangered species, "just gives kids a connection to something real, something that seems to make sense to them... something other than just the book and the page and the teacher lecturing in front of them for 50 minutes," Reams explained.

"Now, when they learn something in math, they see the use in it, there's a reason why they're doing it, not just because the teacher said to do it."

Students appear to place a higher value on math when they sense that their work has potential significance beyond the classroom. "I wanted my project to have some kind of relevance to the community," said Sherri, a sophomore at California's Piner High School. "I was applying the math that I had learned, it mattered, and not just to me and my personal development. So, I wanted to be as accurate as I possibly could."

In addition, students begin to perceive the real value of the math skills they are acquiring. "These kids are learning things that are going to set them up for life," commented Clyde Cruce, principal at Florida's Taylor County High. Studying in the environment makes math "relevant and alive to them."

MATH IN REAL LIFE: CLAY COUNTY HIGH SCHOOL

Situated in the heart of Appalachia, Kentucky's Clay County High School is surrounded by 80 acres of woodlands. Within this rural setting, Clay County students are immersed in a variety of practical, hands-on projects that allow them to practice a wide variety of emerging math skills in real-world settings.

Whether laying out trails, calculating fish production, or designing and constructing outdoor learning sites, these students are finding valuable uses for their math knowledge. Planning a new building for the school's reconstructed Native American village, for example, requires taking measurements, making calculations, predicting proportions, and creating geometric designs.

Students quickly learn that in the classroom the consequences of a missed math problem may be negligible, but outside, in the context of a real project, miscalculations carry a much higher cost. "When they actually build it and it doesn't turn out the way they predicted, then they have to go through the whole process again and see where they made a mistake," explained math teacher LaDonna Marcum.

Teachers at Clay County maintain that learning math skills and concepts through hands-on EIC projects is the key to genuine comprehension. In the past, Marcum said, when she taught math within the confines of her classroom, students could not apply their newfound skills in real situations, but her EIC students can.

Clay County students also use mathematical formulas in agricultural applications. They analyze soil samples to determine percentages of clay or sand and estimate potential crop yields. They also calculate field acreage and figure the correct amounts of seed and fertilizer needed to create habitats for wildlife.

Working with Steve Mobley, their vocational agriculture teacher, in the on-campus aquaculture facility, students extrapolate fish growth based on various feeding rates and estimate market values. Mobley links these sorts of authentic experiences with a marked increase in his students' enthusiasm for their studies. "Students are more eager to do something when they can apply it to a hands-on project," he said. "Anytime it can be hands-on, it's more effective than doing something on a chalkboard."

Because of Clay County High's interdisciplinary and environment-based approach to learning, authentic mathematical applications have become possible across the school's curriculum. Some students, for example, have used statistical analysis to predict fluctuations in native deer populations. Others have combined math, anthropology, and health education with their knowledge of forests to determine if local resources could have provided once indigenous Native Americans with a diet that would meet today's USDA nutritional requirements.

All of these activities have made math relevant and meaningful to Clay County's teenagers. "Now, not all math is straight out of the book; it's more hands-on," Marcum concluded. "We're actually seeing what students can do and how they can apply it."

SCIENCE:
USING ENVIRONMENT-BASED EDUCATION TO EXPLORE THE WORLD

SUMMARY

When compared to their traditionally educated peers, EIC students more effectively master scientific knowledge and skills, and achieve a deeper understanding of scientific concepts and processes. They also perform better on standardized measures of science achievement and demonstrate greater excitement about learning science than students in traditional curricula. As a result of this enthusiasm, EIC students exhibit increased interest in their studies.

Students in EIC programs are also better able than other students to discern the connections between what they learn in science and possible applications in the real world. Consequently, they are better able to transfer their scientific knowledge to interdisciplinary tasks at school, at home, and in their communities.

Finally, EIC students demonstrate increased awareness and understanding of the world around them as a result of opportunities to participate in hands-on, problem-solving projects. They become more confident learners, assured of their ability to understand new scientific information, to draw conclusions, and to make informed decisions.

Data from both the Learning and Domains Surveys indicate that teachers and administrators have found EIC-based learning to be an effective means of helping students develop their scientific knowledge and skills. Table 11 summarizes data obtained from the Learning and Domains Surveys on the effects of EIC on learning science.

Three of the study schools conducted comparative analyses of science achievement data. These three schools conducted a total of four comparative analyses of science achievement using data from different standardized tests.

Based on analysis of these data, three of the four comparative studies (75 percent) indicate that EIC-based learning can benefit science learning. Table 12 provides a summary of the results of the comparative analyses of science at these three schools.

FINDINGS

Within the context of EIC-based learning, students—as one middle school teacher put it—are not just learning about science; they are "doing science."

EIC teachers create learning opportunities that help students explore the world around them. Instead of merely reading about a creek-side habitat, for example, EIC students may go to a river to catalog aquatic insects, run transects to determine plant populations, or research and discuss the interrelationships among wildlife, human activity, and water

TABLE 11. Summary of Learning and Domains Surveys on Science.

Learning Survey Items	% of Educators Reporting Student Improvement	# of Educators Responding to this Survey Item
Learning of science	100%	150
Problem-solving and strategic thinking	97%	167
Systems thinking	89%	142
Completion of extra activities or projects	90%	164
Domains Survey Items		
Knowledge: content, concepts, and principles	99%	125
Skills: processes and application to real situations	99%	121
Retention of knowledge and skills	97%	118
Attitudes: engagement, enthusiasm, and interest	98%	126
Opportunities: context and content for learning	98%	122
Average for Science Domains Survey	98%	123

resources. Rather than just covering a chapter about agriculture, they analyze soil samples, interview agricultural experts about crop rotation strategies, or study the chemistry of fertilizers and their effects on the ecosystem. In an urban setting, rather than just studying water chemistry in a laboratory, students might collect rain water, follow it as it enters storm drains, and conduct experiments at their local wastewater treatment plant to discover how it changes along the way.

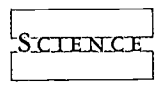
As EIC students move from studying abstract scientific concepts to participating in concrete experiences, they gain improved proficiency in learning science content and processes. One hundred percent of respondents to the Learning Survey reported that EIC approaches helped their students learn science better than teaching with traditional methods.

Specifically, students taught science through EIC-based learning demonstrate:

- increased knowledge and understanding of science content, concepts, processes, and principles;
- better ability to apply science to real-world situations;
- improved attitudes about learning science: engagement, enthusiasm, and interest; and,
- deeper and more personal understanding of the significance of science to their daily lives.

EIC educators base their programs on scientifically sound methods, not environmental advocacy, as students explore the interactions among natural and socio-cultural systems. Therefore, EIC programs can play an important role in helping students develop their knowledge of scientific methods as they apply critical thinking to authentic situations.

TABLE 12. Summary of Comparative Analyses of Standardized Data on Student Achievement in Science.

School Name	Effect of EIC	After Implementing EIC
HOLLYWOOD ELEMENTARY		*67% of students scored satisfactory or above in science on MSPAP (Maryland State Performance Assessment Program) compared to only 38% in Maryland as a whole. Tracked 1996-97.*
		*70% of students scored satisfactory or above in science on MSPAP compared to only 46% in Maryland as a whole. Tracked 1996-97.*
CHARITON MIDDLE		*50% of 7th-grade students scored at least one grade above and 28% scored at least three grades above national grade equivalent student populations on the ITBS (Iowa Test of Basic Skills). Tracked 1995-96.*
TAHOMA HIGH		*11th-grade students, who had been in the program in 9th and 10th grades, averaged equal scores on CFAS (Curriculum Frameworks Assessment System) in science with other Tahoma 11th graders. Tracked 1995-96.*

NOTES: Appendix C presents descriptions of the assessments. Appendix D provides notes on program history and participating populations.

INCREASED KNOWLEDGE AND UNDERSTANDING OF SCIENCE CONTENT, CONCEPTS, PROCESSES, AND PRINCIPLES

Using the environment as a context for learning appears to be especially effective in helping students gain knowledge of science content, concepts, and principles. Students at all ability levels demonstrate greater proficiency in science following the introduction of EIC approaches. They comprehend scientific processes better and score higher on assessments of acquired scientific knowledge and skills.

In the 40 EIC study schools, the environment provides a core theme through which teachers connect science with language arts, social studies, math, and creative arts. Teachers are also able to generate diverse learning opportunities across many science disciplines—life, physical, earth, and space.

EIC educators in the case study schools employ creative means of using the environment to help students more effectively understand the full spectrum of scientific specialties: from biology to chemistry, geology to physics, earth sciences to forestry. For example, studying stream flow characteristics provides an opportunity to teach physics. Charting plant growth introduces botany. Analyzing the water quality of a local stream involves chemistry, while exploring native grassland habitats requires knowledge of ecological principles.

As a result of such experiences, EIC students throughout the study schools demonstrated a deeper understanding of complex scientific knowledge than did their peers in traditional programs. Ninety-nine percent of educators responding to the Domains Survey reported that EIC approaches helped students achieve improved knowledge and comprehension of science content, concepts, processes, and principles.

A particular advantage of EIC is that it meets the needs of a wide range of students, regardless of learning abilities, allowing them to master scientific information more easily. At all grade levels, students soar beyond the limits of typical science curricula, making significant gains, and attaining a higher level of achievement than with traditional learning methods.

At Minnesota's Little Falls High School, for example, science teacher Wayne Pikal has observed tremendous improvement in his students' ability to grasp science concepts, regardless of their individual abilities. Pikal has documented substantial gains particularly among low achievers, students in the bottom half of the ability range. At the same time, he has witnessed higher-level students produce scientific studies he believes "surpassed the difficulty of my own master's work in biology.

"I can document very strongly that their science component is much stronger with an interdisciplinary approach," reported Pikal, who attributes the change to connecting math, chemistry, and energy studies. When the disciplines are taught in an integrated way, "There's a tremendous difference in the ability of the kids to grasp the concepts."

Students develop a deeper understanding of scientific processes and interconnections as a result of innovative field studies. At Logan School, for example, students monitored changes in salinity, animal life, water temperature, and levels of dissolved oxygen during a boat trip from the Sacramento-San Joaquin River Delta to the San Francisco Bay. Additionally, they researched the challenges facing a special government task force charged with managing this critical waterway. As a result, the students gained improved research and analytical skills, as well as a better understanding of the complex interrelationships influencing the waters of the Delta and the Bay.

EMERGING SCIENTISTS: HOLLYWOOD ELEMENTARY

In an open field behind Hollywood Elementary School, thousands of cicadas were emerging from the ground, fully matured after their 17-year pupal sleep. Over the next few days, as the cumbersome insects unfurled new wings and took flight, 300 excited students spilled out into the old farm land surrounding their southern Maryland campus to observe the rare phenomenon.

Teachers pounced on the opportunity to discuss insects: their anatomies, life cycles, and behavior patterns. In a world where life spans are measured in days, the cicada, with its inexplicable 17-year pupation period, stood out as particularly fascinating to students. They brought cicada specimens back to the classroom for closer examination. They read cicada books, told cicada stories, and drew cicada pictures. They became cicada experts.

As part of their research, students learned that cicadas mate and lay their eggs in trees. The larvae later fall to the ground where they dig in and begin their long pupation. But, there were no trees in the field behind Hollywood Elementary. As far as anyone knew, trees had not been present for a long time.

In their effort to solve this mystery, students proposed a simple hypothesis: there must have been trees in the field during the cicadas' last mating season. Aided by their teachers and parents, they mounted an enthusiastic and ultimately successful search for old maps and photographs of the area. As suspected, evidence proved that the field behind Hollywood Elementary had been wooded 17 years before.

Not only had these students solved a mystery by explaining the presence of cicadas in an open field, but they had also learned an important lesson about collecting accurate information and confirming hypotheses through research. Their hands-on approach to a scientific puzzle and their teachers' alacrity in making use of an unexpected learning opportunity, in the surrounding environment, resulted in student motivation, learning, and problem-solving.

The environment also provides an excellent context for learning the scientific meaning of systems and interrelationships. As they study the complex connections and synergies inherent in both natural and socio-cultural systems, students learn to think systematically about interconnections among economic, social, governmental, and ecological processes. Eighty-nine percent of respondents to the Learning Survey reported that EIC approaches helped students achieve higher levels of systems thinking than did traditional education.

Some educators admit that before initiating their EIC programs, they worried that these approaches might negatively affect students' acquisition and retention of traditional science content and skills. Subsequent observation and standardized test results, however, alleviated those concerns. Tahoma High science teacher Michael Melin was one such educator. "At first I was very skeptical because I didn't know if we were doing the right thing for the kids," he said. Evidence from a controlled study in Washington's Tahoma School District indicates that students have not lost content knowledge when teachers use the environment as a context for learning. On the contrary, students in Tahoma High School's *Integrated Program* scored equally well in standardized science testing as students in the district's traditional programs. "As we went through the year the kids became so excited about the simple topics that kids didn't become excited about before in traditional classes, they really convinced me that the integrated approach was worthwhile, something they could get involved with," Melin reports. "Now, science-wise... the kids remember things better and for a longer period of time."

"Now, science-wise... the kids remember things better and for a longer period of time."

In Iowa, teachers at Chariton Middle School found similar gains when they compared their EIC students' test scores from the Iowa Test of Basic Skills (ITBS) with national averages. Fifty percent of Chariton's EIC students scored above the national average in science on the ITBS—a result teachers attribute to environment-based instructional approaches.

Ninety-seven percent of respondents to the Domains Survey arrived at the same conclusion as Tahoma High's and Chariton Middle School's teachers and principals: Students not only learned science better; they also better retained their scientific knowledge when they connected it to real-life experiences in the environment.

"When we got to go outside and really do it for ourselves, it made the understanding a lot better," said Jennifer, a senior at Kentucky's Clay County High School. "I've seen a lot of students I've gone to school with all my life making better grades now because they understand it better."

As they apply fresh approaches to solving problems, rather than passively listening and taking notes, EIC students develop a clearer and deeper understanding of science. The hands-on, minds-on approaches typical of EIC enable students of all ability levels to improve their performance, gain a better understanding and appreciation for science, and remember what they have learned.

Better Ability to Apply Science to Real-World Situations

Involvement in real-world, project-based activities seems to help students refine their abilities in scientific observation, data collection, analysis, and formulating conclusions. EIC experiences open the door to investigative exploration. Rather than plugging away week after week in the lab, solving someone else's questions, EIC students venture into the real world where a variety of experiences prompt them to develop questions of their own.

"I think the kids in our program see the transferability of learning; how to look at a problem, break it down into its component parts, and then attack the parts."

As they explore diverse natural settings students realize they can apply their emerging scientific knowledge to a variety of situations. Collecting data and recording their observations from one experience to the next, they begin to see patterns and commonalities, analyze and synthesize their findings, and exercise higher-level thinking skills.

"I think the kids in our program see the transferability of learning; how to look at a problem, break it down into its component parts, and then attack the parts," said Dave Klindienst, a science teacher at Pennsylvania's State College High School. "That's really an outgrowth of the scientific method. That's a logical problem-solving skill. The kids see the value of doing that in all the disciplines."

Instead of passively waiting for new assignments, EIC students can and do begin to identify their own research questions and apply their new-found ways of thinking to solving them. Often, they formulate their own research designs, set up, and monitor their own studies, rather than depending on teachers to propose and supervise projects. Such evidence of higher-level cognitive skills is corroborated by 97 percent of educators responding to the Learning Survey. These educators reported that EIC students were more capable of solving problems and thinking strategically than their traditionally educated peers.

"What's happening now, more and more, is that I'm finding my role as the teacher is to be in the background guiding, asking questions, not giving the answers," commented Teri Hammarback, science and language arts teacher at Minnesota's Central Middle School. "It's becoming more the students' responsibility to go out and do the studying... They'll set up the experiment, go and do it, and come back with all these observations that I never could have done for them," said Hammarback.

As another indication of their growing ability to apply higher-level scientific skills, many EIC students design and produce outstanding science fair projects. Teachers reported that science projects submitted after implementation of EIC curricula showed marked improvement over earlier projects conducted within traditional learning environments. In contrast to their traditionally educated peers, EIC students produce more refined exhibits that depict more complex data and analysis regarding their chosen subjects.

At Maryland's Centreville Middle School, for example, EIC students turned in such exceptional science projects that many were invited to compete in a neighboring county's science fair. Every Centreville participant then placed among the top three in his or her category in that competition.

Many EIC students experience the rigor of actual research work by applying their scientific skills and knowledge in authentic settings. Ninety-nine percent of respondents to the Domains Survey reported that EIC students were better able to apply scientific processes to real situations than their traditionally taught peers.

Students at Kentucky's Wheatley Elementary, for example, used their scientific observation skills to study the behavior and distribution of white-tailed deer at Blackacre State Nature Reserve. A longitudinal study allowed these fifth-graders to accurately record and interpret their observations. The students first discovered that the deer population varied over time, depending on weather conditions. Through their studies, they were then able to make connections to other factors, such as types of local habitat, seasonal changes, and the distribution of deer.

When students learn about science within the context of their community and natural surroundings, they demonstrate greater proficiency in applying scientific skills to real-world situations. Participation in activities centered around authentic topics cultivates the scientific skills they need to solve many of the real-world problems they will encounter throughout their lives.

Improved Attitudes About Learning Science

Evidence from this study indicates that students participating in environment-based programs become more excited about learning science than their traditionally educated peers. As they realize the value and importance of what they are learning, EIC students frequently respond with enthusiasm and an eagerness to share their expertise and opinions with others, often in creative ways. Some organize clubs; some publish newsletters; some speak to community groups. Even students previously considered apathetic about their schoolwork have created imaginative displays, delivered exciting oral presentations, and composed inventive reports detailing their scientific discoveries.

A full 98 percent of Domains Survey respondents reported that students demonstrated increased engagement, enthusiasm, and interest in science after the implementation of EIC curricula. Results at all 40 study schools, across the nation, support this observation.

At Oregon's Waldo Middle School, for example, seventh graders present their endangered species projects before a panel of experts, and an audience of parents and students. Educators reported that even children previously considered shy are eager to share their acquired knowledge during these presentations.

In another instance, a student at Pennsylvania's Huntingdon Area Middle School became so interested that she produced filmstrips and educational pamphlets in an effort to make the public more aware of possible pollution from household chemicals. While across the country, enthusiastic students at Washington State's Rock Creek Elementary went door-to-door to educate their neighbors about water quality in the creek running right by the school and through their community.

Excitement generated by hands-on, minds-on EIC projects sometimes also triggers increased interest in science and math classes. At Kentucky's Clay County High School, for instance, students in the EIC program, not considered college bound, have doubled the number of science electives they take.

Teachers reported that EIC students, in their eagerness to find information concerning their environment-based projects, examined resource materials of every description. Media specialists sometimes found students waiting for them to unlock the library door in the morning, while technical specialists often received phone calls and e-mail from students asking sophisticated questions about their research topics.

Their innate interest in the environment encourages students to exert extra effort when they gather information or conduct special projects. Ninety percent of Learning Survey respondents reported that EIC students completed extra assignments far surpassing the accomplishments of their counterparts in traditional programs.

Enthusiasm about their community and natural surroundings builds students' interest in learning about science. This engagement translates into improved test scores and students who better understand scientific concepts and processes.

A full 98 percent of Domains Survey respondents reported that students demonstrated increased engagement, enthusiasm, and interest in science after the implementation of EIC curricula.

Better and More Personal Understanding of the Significance of Science

As they explore content, processes and principles, and apply scientific skills to their environment-based projects, EIC students make connections among diverse fields of science. They discover common threads in seemingly disparate academic areas and they learn to transfer their knowledge of scientific content and processes to authentic school and community experiences. As they see how science ties into life outside of the classroom, their commitment to learning grows.

Students in EIC programs discover the connections between science, their community, and natural surroundings through direct experience. High school students in Minnesota collect and analyze samples from the Mississippi River for their county water district. Middle school students in Florida monitor the growth and health of forest plots in partnership with local businesses. In Washington State, elementary school students teach younger children about animals, habitats, and ecological systems at a nearby park.

Throughout the study schools, EIC students are developing a strong contextual understanding of how science is applied across a wide range of academic and community settings. Ninety-eight percent of Domains Survey respondents reported that EIC offered increased opportunities to teach science in a context that students could relate directly to their lives.

"There's no better way to study science than to collect and analyze data on your own river. Being part of a community project adds a seriousness of purpose that wasn't there before."

Maryland's Centreville Middle School students, for example, help scientists monitor the nearby Chester River. The students work with data from official monitoring agencies and examine several sites along the river on their own. They quality-check the resulting data, enter it in spreadsheets, and twice a year send a copy of their findings to other site monitors across the state, who check the information for accuracy and then add it to their own databases. The students also analyze and document their research activities in an annual "Chester River Water Quality Report" distributed to Chester River Association members, interested community members, and government agencies. In addition, they operate the Chesapeake Environmental Science Network (CHESNET), a statewide, computer-based communications forum.

Centreville science teacher George Radcliff is enthusiastic about this approach to teaching. "This project is so important for my students," he said. "There's no better way to study science than to collect and analyze data on your own river. Being part of a community project adds a legitimacy and a seriousness of purpose that wasn't there before. We're now part of something bigger."

EIC students blend subject matter from a variety of disciplines and multiple fields of science to accomplish academically rich and challenging tasks. Using the environment as a context provides them with an effective way to study science, to analyze and record data, and to discover firsthand the integral role that science plays in their world.

Social Studies:
Joining the Community through Environment-based Education

Summary

Learning in the context of the environment helps students better understand social studies concepts and principles. Thus, EIC students make significant academic gains and outperform their traditional counterparts on assessments of social studies performance.

Students better understand the complex interrelationships and connections among individuals, communities, and society when they have the chance to apply their social studies knowledge in real-word settings. They develop a deeper, contextual understanding of history, geography, and political systems and better retain this knowledge as a direct result of their first-hand experience with projects they can relate to their daily lives.

When EIC students apply their social studies skills to everyday situations, they begin to recognize the relevance of their decisions to their community and their environment. As a result, the EIC approach helps to produce active, involved citizens who develop a deeper understanding of their roles and responsibilities as members of a democratic society.

Data from both the Learning and Domains Surveys indicate that teachers and administrators have found EIC-based learning to be an effective means of helping students develop their social studies knowledge and skills. Table 13 summarizes data obtained from the Learning and Domains Surveys on the effects of EIC on learning social studies.

Two of the study schools conducted comparative analyses of social studies achievement using data from different standardized tests. Based on these data, both of the comparative analyses indicate that EIC-based approaches can benefit social studies learning. Table 14 provides a summary of the results of the comparative analyses of social studies at these two schools.

Findings

Students of social studies are expected to demonstrate understanding of a wide variety of information and specific skills. They must learn to recognize geographic features, analyze the significance of historical events, and understand social systems. Using the environment as a context for learning facilitates these goals by helping students explore geography, by involving them in their communities, and sometimes by allowing them to work with government agencies.

EIC teachers promote curriculum applications that translate into active participation by students in their local communities. Such applications may allow rural students to

TABLE 13. Summary of Learning and Domains Surveys on Social Studies.

Learning Survey Items	% of Educators Reporting Student Improvement	# of Educators Responding to this Survey Item
Learning of social studies	96%	139
Understanding societal relationships	96%	158
Domains Survey Items		
Knowledge: content, concepts, and principles	95%	111
Skills: processes and application to real situations	97%	112
Retention of knowledge and skills	90%	104
Attitudes: engagement, enthusiasm, and interest	99%	113
Opportunities: context and content for learning	95%	112
Average for Social Studies Domains Survey	95%	110

TABLE 14. Summary of Comparative Analyses of Standardized Data on Student Achievement in Social Studies.

School Name	Effect of EIC	After Implementing EIC
CHARITON MIDDLE	SOCIAL STUDIES	*47% of 7th grade students scored at least one grade above and 26% scored at least three grades above national grade equivalent student populations on the ITBS (Iowa Test of Basic Skills). Tracked 1995-96.*
TAHOMA HIGH	SOCIAL STUDIES	*11th grade students, who had been in the program in 9th and 10th grades, averaged 4.4% higher on CFAS (Curriculum Frameworks Assessment System) in social studies than other Tahoma 11th graders. Tracked 1995-96.*

NOTES: Appendix C presents descriptions of the assessments. Appendix D provides notes on program history and participating populations.

study local farming operations and, in the process, learn about how related government agencies work and how communities make decisions about land use. In other areas, students may monitor the water quality of a local stream, look at the surrounding geography, and study the region's history of human settlement, or even work as interns for a county water district.

In the context of their local environment, students of social studies may begin to make the connections between geography, history, politics, economics, and natural resources in their region. Making such connections can spark students' interests, engage them in their schoolwork, and help them learn the significance of social studies within a context that is personally meaningful.

EIC approaches to learning thus help students develop and improve their knowledge of social studies more effectively than do traditional educational approaches. Ninety-six percent of teachers and principals responding to the Learning Survey reported that EIC-based approaches helped their students develop and improve their knowledge of social studies.

In comparison with traditional instructional approaches, using the environment as an interdisciplinary context for teaching social studies results in improved student learning in three major areas:

- greater comprehension of socio-cultural systems and the interrelationships among civic, political, and economic processes;
- more advanced skills in applying civic processes to real-life situations; and,
- growing enthusiasm for social studies.

Greater Comprehension of Socio-cultural Systems

EIC approaches provide a large variety of both classroom and community experiences through which students can obtain first-hand knowledge and skills in social studies, while also learning how these disciplines connect with math, science, and language arts. Consequently, students have the opportunity to both understand social studies concepts and discover how this knowledge interconnects with natural systems such as forests, rivers, and wetlands.

Studying society in the context of the local environment helps students see the connections between economic, political, legal, and cultural systems. Connecting complex concepts to practical experiences in their community makes the study of the inner-workings of society more meaningful and more understandable to students.

As a direct result, students in EIC programs demonstrate better comprehension of social studies content and greater skills in analyzing complex civic issues than their peers in traditional programs. Ninety-five percent of educators responding to the Domains Survey reported that students' comprehension of social studies improved when they learned in the context of the environment.

Students in the *Integrated Program* at Tahoma High School, for example, discussed and analyzed the relationships between government agencies, businesses, and citizens. They debated who should be responsible for rectifying the economic and natural resource damage after flooding struck a nearby watershed. These students were able to consider economic, political, and humanitarian needs when evaluating who should provide relief for this natural disaster. Activities like this afford teachers an opportunity to assess how their students apply their thinking and social studies knowledge to practical situations.

Studying society in the context of the environment helps students see the connections between economic, political, legal, and cultural systems.

In addition to authentic indicators, the Tahoma School District used the Curriculum Frameworks Assessment System, a standardized test, for a comparative analysis of academic achievement in social studies. The district compared scores of eleventh-graders, who had spent ninth and tenth grades in the *Integrated Program,* with those of students who had been in a traditional ninth and tenth grade. Students from the *Integrated Program* scored 7.2 percent higher than traditional-track eleventh graders.

The district also compared EIC students' scores with those of other eleventh graders across Washington. In this case, students from the *Integrated Program* scored a significant 30.8 percent higher than their peers statewide.

Students in EIC programs become more ardent learners as they look for the connections among historical, societal, and environmental factors. In the *Watershed* program at Pennsylvania's Radnor Middle School, for example, they learn the content of the traditional disciplines in the context of studying the Brandywine Watershed where they live. These seventh graders do not just discuss the hardships faced by American troops during the Revolutionary War; they walk the same paths and discuss how the environment affected the troop's survival. Thus, Radnor's students sense more of a connection with the past than if they simply read about historical events in a textbook. They remember these events more vividly as they connect history with the farms, fields, and forests that surround their community.

EIC students retain social studies content and concepts long after their tests. They remember the experiences for a "lifetime." Educators who informally tracked students for several years after they had participated in EIC-based social studies found that students continued to recall and apply what they learned. Ninety percent of respondents to the Domains Survey reported that students were better able to recall and use their social studies knowledge than students in traditional settings.

"They're not going to remember the capital of Oregon," said Sue Fogel, a seventh grade geography teacher at Iowa's Chariton Middle School. "But these big interdisciplinary projects we do around Chariton, those are the ones they're going to remember down the line." Fogel has observed that her EIC students remember what they learn longer than students in traditional geography programs. "The fact that students could still apply what they learned earlier in the year tells me that they've learned it well. I can see that they have brought information from their fieldwork into the classroom. These are things the kids are never going to forget."

As further evidence of subject mastery and retention, EIC students are unusually willing and able to share what they learn about history, geography, social systems, and how they relate to the environment. Parents often commented on how enthusiastic their children were about the topics they were studying. They observed that they could discern differences between their children's knowledge if one had participated in an EIC curriculum and another had not had the same opportunity.

"These big interdisciplinary projects we do around Chariton, those are the ones they're going to remember."

In addition to better comprehension and retention of social studies content and concepts in an EIC setting, students seem better able to understand the complex interconnections among social and natural systems. These approaches also provide most participants in EIC programs with a better understanding of complex societal relationships.

"Using the interdisciplinary approach the kids are not just getting it one time in one class for just a few moments," commented Fred Wilson, a social studies teacher at Pennsylvania's Huntingdon Area Middle School. "They are covering these topics from different disciplines with different methodologies or approaches and they're making the interconnections, especially in social sciences," he observed.

Huntingdon's *STREAMS* program provides students with both a basic understanding of social studies and a framework for understanding the interconnections among social, cultural, and natural systems. "In terms of comprehension, in terms of the process of learning, it's evident that the students are assimilating the concepts and seeing the interrelationships," Wilson concluded.

Good Citizens, Good Scientists: Huntingdon Area Middle School

No one had even suspected it, but there was a big problem in Huntingdon, Pennsylvania. Fortunately, there was a class of determined sixth-graders at Huntingdon Area Middle School who uncovered the problem and persuaded the authorities to take appropriate action.

Studying Muddy Run is an integral part of Huntingdon's interdisciplinary *STREAMS* program. Among other things, *STREAMS* students learn about Muddy Run, watersheds, water cycles, how water flows through their region, and how people influence the water environment. This time, they also learned that they could influence their community.

In their water quality tests at Muddy Run, the students found abnormally high levels of bacteria. They immediately took their findings to scientists at a local college, who checked for themselves and confirmed the students' results. Muddy Run had become a health hazard.

Through their studies, the students learned that local sewage lines could become overloaded with groundwater and stormwater runoff, leading to leakage. Suspecting this might be the reason for Muddy Run's problems, students kept asking questions and ultimately determined that Huntingdon's sewer system was crumbling. Untreated sewage was leaking into Muddy Run.

The students knew they had to do something, but were not sure what. With the support of their EIC team teachers, the sixth-graders developed a plan to educate the community and inform government officials about the problems at Muddy Run.

They submitted articles to the local newspaper and mounted an exhaustive letter-writing campaign to state agencies. They collected signatures on petitions and sent them to the state capital. They also raised $1,000 to recreate a wetland near their school to help control stormwater runoff.

People listened. As a direct result of the students' hard work, the Borough of Huntingdon received a grant of $250,000, from the Pennsylvania Infrastructure Investment Authority, to repair its sewer system. Today, Muddy Run flows clean again and Huntingdon's young people have discovered first-hand how local democracy works.

It looks as if they will continue to play a significant role in their community. They were recently invited to address an upcoming town meeting on water quality and stormwater runoff. This is heady stuff for middle-schoolers and a big step beyond "book learning." "It makes you feel important," Corinne, a student at Huntingdon, explained, "to know that you've actually gone out and helped your community."

Observations at all 40 case study schools indicate that, like Huntingdon's students, most participants in EIC programs better comprehend complex societal relationships through interdisciplinary EIC approaches. Ninety-six percent of teachers and administrators responding to the Learning Survey reported this finding.

As EIC teachers facilitate relevant learning experiences their students better comprehend the inner workings of social and political systems. These students also better understand and retain social studies concepts, and learn how complex social systems interrelate with the natural environment.

More Advanced Skills in Applying Civic Processes to Real-Life Situations

With interdisciplinary problem-solving projects set in the local environment, students learn about how government and political systems operate and how decisions are made. These projects encourage students to become involved, participate in the democratic process, and to be active, contributing citizens and adults. EIC experiences help educators realize the objective of developing good citizens, who can become catalysts for positive change in their communities.

EIC students become involved in civic processes and service-learning projects that include activities such as: caring for public health by monitoring water quality in a local river; managing natural resources by gathering and analyzing wildlife surveys for state agencies; participating in land-use planning with city supervisors; and, partnering with the county and local businesses on habitat restoration.

Students more effectively learn how to apply social studies skills to the real world when they experience authentic lessons about how government works and communities operate in the context of the environment. Ninety-seven percent of educators responding to the Domains Survey reported that students in EIC programs could more effectively apply social studies skills to real-world situations than their traditional counterparts.

EIC students learn about land-use planning, how agency personnel evaluate and select project proposals, how citizens and city councils debate, and ultimately, how communities reach decisions.

In Colorado, for example, Glenwood Springs High School students, after having successfully planned and supervised the creation of a pocket park, were invited to take the lead in a local planning project. City planners involved them in a cooperative effort to develop a pedestrian mall and park along the Colorado River. Teams of students assessed the land, planned the project, drew designs, and submitted them to the city.

"I call what we're doing applied government... it's a real lesson about how government works and communities operate."

"I call what we're doing applied government," commented service-learning teacher Guy Brikell. "We're applying learning and giving the kids an opportunity not only to read a textbook about something, but to experience it. There's no other way we can replicate a lesson like that. It's not necessarily a pretty lesson, but it's a real lesson about how government works and communities operate. I think these kids are awfully lucky to have those kinds of opportunities."

The net effect, Brikell hypothesizes, is active, involved citizens. "I think we're developing a generation of young people in this small community who have a different attitude about politics than people at large," he said. "I really believe that the motivation level is much higher than in the traditional classroom."

The environment provides a good venue for context-based social studies learning experiences. Ninety-five percent of teachers and principals responding to the Domains Survey reported that an EIC approach, offers greater opportunities to teach social studies content in a real-world context than traditional pedagogies.

Growing Enthusiasm for Social Studies

When students participate in integrated, environment-based social studies programs they seem better able to make connections between school, work, and community. In this way, EIC approaches help them perceive that studying socio-economic systems is relevant

both to their daily life and to their future. In turn, they become increasingly engaged in the learning process.

As students become more engaged in studying their own community, they begin to discover the complexity of economic, political, and social systems. Their interest then leads them to begin to ask questions and search for answers to help them better understand the connections in their community between social studies and the natural environment.

Innate interest in the environment combines with the students' growing understanding of the connections between socio-economic and natural systems to make them more enthusiastic about learning social studies. Ninety-nine percent of educators responding to the Domains Survey reported that student enthusiasm and interest in learning social studies increased after implementing EIC.

Students' enthusiasm for community-related EIC programs generates an active, highly effective learning atmosphere. "Our program originated out of the fact that we thought the traditional curriculum was too abstract and too unconnected to the real world to engage the students," observed Huntingdon's Fred Wilson. "What I'm seeing in our *STREAMS* curriculum is that students are more engaged in activities that happen outdoors, that involve issues with an impact on their families, or in real-world, community-based problems. The students are more enthusiastic and engaged when they have a vested interest and some degree of control in the curriculum and what they are learning."

"I particularly enjoyed the field studies... It made us feel important and responsible."

Huntingdon's program has achieved what Wilson and his colleagues had hoped, more enthusiastic learners. "I particularly enjoyed the field studies," remarked Beth, a sixth-grader. "I liked them because we were participating in the county water monitoring program. To know that we were really participating in something big and important made us realize how lucky we are. It made us feel important and responsible."

THINKING SKILLS:
DEVELOPING REASONING THROUGH ENVIRONMENT-BASED LEARNING

SUMMARY

Using the environment as the context for learning fosters creative-thinking and decision-making abilities. As a result, students are better able to synthesize information and think more strategically. As one high school teacher remarked, working in the environment gives students the essential cognitive skills they need to do "problem solving for life."

The environment serves as a rich context within which students can gather, analyze, and begin to understand the many factors that affect individual, business, community, and governmental decisions. Giving students the freedom to explore their environment and develop their own questions about the functions, connections, and interrelationships they observe facilitates the development of their higher-level thinking skills.

Using hands-on approaches to gather information and collect scientific data about issues of personal significance helps students strengthen their skills in acquiring knowledge and in comprehending the world around them. As they progress through these basic cognitive domains, they become prepared for the higher levels of Bloom's "cognitive hierarchy," synthesis and evaluation. Table 15 summarizes data obtained from the Learning Survey on the effects of EIC on the development of students' thinking skills.

TABLE 15. Summary of Learning Survey on the Development of Thinking Skills.

Learning Survey Items	% of Educators Reporting Student Improvement	# of Educators Responding to this Survey Item
Critical thinking	96%	167
Higher-order thinking	94%	162
Creative thinking	98%	168
Problem-solving and strategic thinking	97%	167
Decision-making	96%	168
Systems thinking	89%	142

Findings

Using the environment as a context for interdisciplinary learning is both highly motivating for students and an effective means of helping them develop their higher-order thinking skills. Inquiry-based, interdisciplinary learning in the context of the environment allows students to exercise thinking processes through which they begin to understand interrelationships among natural and socio-cultural systems. Importantly, it helps them expand their thinking past traditional subject-matter boundaries.

Students in EIC programs begin to ask thought-provoking questions, approach their teachers with creative ideas, and explore new ways of reasoning. Ninety-six percent of Learning Survey respondents reported that students in EIC programs developed higher-level, critical-thinking skills than did their traditional peers.

The problem-solving, project-based methods inherent in EIC support the development of students' thinking skills across the continuum of Bloom's "taxonomy of the cognitive domain." Consequently, ninety-four percent of educators responding to the Learning Survey reported that students' higher-order thinking skills improved after switching to EIC.

Results at the study schools indicate that learning in the context of the environment has a variety of effects on students' higher-order thinking:

- increased ability to think creatively;
- greater proficiency in solving problems; and,
- better application of systems thinking.

Increased Ability to Think Creatively

The ever-changing character of the environment and its complex interactions with socio-cultural systems make it an especially good context for students to gain creative thinking skills and then have opportunities to apply them in diverse situations. Ninety-eight percent of respondents to the Learning Survey reported that students more effectively developed their creative-thinking skills in an EIC program than in a traditional curriculum.

The students exhibited their growing creativity in a wide variety of ways. At Florida's Wakeland Elementary School, for example, fifth-grade students demonstrated their creativity while working to build a three-acre wetland on school property. When they discovered a layer of soil completely different from the earth around it, they became intrigued and sought outside help. The local soil conservation district and Florida Division of Forestry took 30- to 60-foot core samples and provided students with the information they needed to piece together a geological history of their hometown. As they began to analyze these samples, students found cypress "knees" and sharks' teeth, as well as whale and manatee bones. They sought advice from docents at local museums as they studied the bones, shells, and other fossils found on campus. Adding up all the evidence, these fifth graders concluded that 10,000 years ago their school site had been under water.

This knowledge served as a catalyst for a flood of creativity at Wakeland. Synthesizing all they had learned, students decided to share their exciting findings and created small shoebox dioramas of the area, elaborate wall displays that included extraordinary drawings of prehistoric animals and ancient shorelines, and a program of schoolyard tours to explain their discoveries to other students. One of their displays included a geological timeline they created using an actual core sample from their schoolyard.

Wakeland teacher David Brown was pleased by what his students accomplished, but not surprised. "It all came together," he said, "this whole big elaborate thing." Brown's EIC students demonstrated that they were able to go well beyond just understanding the content. "Even some of the parents were amazed by the students," he observed.

Joy, a Wakeland third grader, sees it from a child's point of view. "Kids learn in different ways. Most kids don't catch on fast when they see it on a chalkboard, with the

sit-in-your-seat style of learning," said Joy. "It's better to touch and feel and really see what we're doing. Then, we can do more than anyone ever thought we could."

Joy's comments echoed one of the most frequent observations of teachers at study schools nationwide; most students are not given credit for what they are capable of thinking and creating. Open Charter School's Barbara Moreno simply put it this way, "You have to be willing to take the risk and you have to trust that the children are already capable learners, not that they're going to become capable learners."

Students in all the study schools showed that they could move well beyond simple understanding of content. Given the broad-ranging experiences and opportunities available within EIC programs, students consistently demonstrated their use of creative-thinking skills that led them to achievements well beyond what would be expected from them within a traditional educational setting.

Greater Proficiency in Solving Problems

When students have opportunities to connect their growing knowledge to the intricate and, from their point of view, enigmatic activities that take place in their community, they are more apt to relate what they are doing at school to what they observe in the real world. In this process, they begin to see the significance of being able to apply the skills they are learning in school to the real-life tasks they encounter on a daily basis.

Students in EIC programs begin synthesizing what they learn from their teachers, community mentors, and each other to develop solutions to complex problems. Ninety-seven percent of educators responding to the Learning Survey reported that problem-solving and strategic-thinking skills improved when students were taught using the environment as the context for their education.

The interdisciplinary, integrated methods, and project-based approaches used within EIC foster the development of students' problem-solving skills. In the process, they progress from simply responding to questions, to learning how to identify their own topics for investigation. Ultimately, they become skilled enough to understand how to solve complex, interdisciplinary problems and explain them to other students and adults. In this way, EIC programs effectively prepare them to apply what they learn in school to what they will experience as maturing members of their community.

California's Piner High School provides one example of how EIC curricula foster students' problem-solving and strategic-thinking skills. Experts mentor students to help them develop their higher-level thinking processes as they integrate environment, technology, and communications within the school's *C-TEC (Center for Technology, Environment, and Communication)* program.

In one instance, *C-TEC* students decided to focus their efforts on resolving a non-point source pollution problem in their city. With help from their mentors, they identified a variety of possible solutions. They sought input from professionals in local businesses and agencies to refine their plans and guide them as they chose among alternative solutions. The team then developed a strategy by combining their problem-solving, decision-making, and strategic-thinking skills with their knowledge of civic processes, communications, science, and technology. Their comprehensive plan, involved students, teachers, parents and city officials, and included research, public education, and community participation.

The Piner students conducted the research, wrote and published leaflets summarizing their findings, and convinced city managers to distribute them with the town's water bills. Next, they formed a speakers bureau in cooperation with local businesses and began to inform service clubs about this health concern.

These strategic-thinking opportunities help develop decision-making skills for students across a wide range of learning abilities. Ninety-six percent of teachers and principals responding to the Learning Survey reported that students' decision-making skills improved as a direct result of using the environment as a context for learning.

THINKING IT THROUGH: TAYLOR COUNTY HIGH SCHOOL

The *Environmental Academy* at Taylor County High represents an effort to improve academic achievement by creating linkages with local businesses in the rural community of Perry, Florida. Those who created the program never imagined Taylor County students might someday play a primary role in restoring a nearby bay, given the fact that over 70 percent of the *Academy's* students are considered at-risk teens. But, that is exactly what happened.

The EIC program at Taylor County High revolves around the Econfina River. Students monitor the river's ecosystem and analyze data collected during regular visits to the area. In the process, they flex critical, thinking muscles untaxed by traditional curricula.

Creating and interpreting graphs, and using computers and sophisticated statistical tools to correlate their data, Taylor County's EIC students learn to interpret their raw observations of the Econfina. "They have to take and compile the information and explain it," said science teacher Terry Zimmerman. "They have to rationalize why it's like it is."

Based on their findings, the students develop an annual presentation that they deliver to administrators of the Swanee River Water Management District.

Their efforts do not stop there, they apply what they learn to other situations in the county. For example, the students have attended meetings of the Florida Department of Environmental Protection to learn about the health of other Florida rivers and then pursued the issues raised at those meetings in their studies.

"They discuss the pH," Zimmerman said. "They plot what they've been doing at the Econfina and compare it to results from the Fenholloway River. They can tell if the data were good or not. They're showing us, by bringing it up in class, that they've thought it through and applied it to other situations."

These independent thinking skills have even led some Taylor County teens to question their textbooks. The students found, for instance, that despite its low pH and oxygen levels, the Econfina can support fish and other organisms. That is not what the books say about typical "black-water" rivers but, what their first-hand discoveries prove.

Shan'na Smith, another of Taylor County's science teachers, believes these revelations will transfer to future experiences in her students' lives. "You give them something structured to help them learn to think like this," she said. "Then, later on when they have to put their own thoughts together, it's easier for them."

"Later on" has arrived. Because of the students' accomplishments in monitoring the Econfina, Buckeye Cellulose, one of the school's business partners, has asked their help in restoring nearby San Pedro Bay. This ancient wetland is now a tree farm, but Florida's Department of Environmental Protection has ordered it restored to its original state. It is a big task, requiring soil studies, water-quality checks, well-water analyses, and an understanding of native aquatic organisms. In short, it will take critical thinking and hard work, but Taylor County High's EIC students have already proven they are up to the challenge.

"When we originally set up *C-TEC*, we thought that we needed really bright students to do this type of independent study," said James Gonzalez, a science teacher. "It's turned out that that isn't the case at all. When the kids come in we have some that are high ability, highly motivated and some that really aren't very motivated at all. They all really take to this kind of open-ended learning, where the responsibility is placed on them. We provide the tools, but then we step back and they do the work."

" I find myself trying to make connections in everything I do... After you learn this way for two years it just comes naturally."

EIC students at other study schools, like those at Piner, also learned to more effectively synthesize what they learn from their teachers, community mentors, and each other to develop creative solutions to complex problems. They learn how to combine diverse kinds of knowledge to arrive at soundly reasoned decisions and well-conceived strategies to address the issues that concern them and their communities.

Better Application of Systems Thinking

EIC approaches help students develop their capacity to examine and understand the complex interrelationships and interactions that take place among diverse socio-cultural and natural systems. EIC pedagogies move students well beyond learning about water chemistry in a school lab and completing a simplistic analysis of the data in their laboratory notebooks. Instead, EIC students have significantly deeper, first-hand experiences. They become active participants in endeavors such as: collecting and analyzing data about water quality in a local lake; discussing it with the staff at the wastewater treatment plant; sharing their data and opinions during public discussions; and, contributing to meetings as the water management board makes decisions about the future of their community.

Students in EIC programs not only see how to analyze a single factor, such as water chemistry, but they learn how data that they collected plays out in a complex network of legal, economic, and governmental systems. Eighty-nine percent of educators responding to the Learning Survey reported that EIC students improved their systems-thinking abilities when compared to students in traditional school settings.

At California's Lincoln High School, for example, this kind of systems thinking forms the backbone of an EIC approach called *ISIS (Integrated Studies in Systems). ISIS* students combine language arts, social studies, and biology as they learn about the intertwined cultural and natural networks that connect their studies of ecology, economics, history, and fisheries.

Lincoln students create their own self-selected, independent research projects so they can explore these complex relationships. Some students, for instance, built a model river delta to determine how various organisms interacted in a simulated environment. In turn, they looked at how aquaculture practices affect the health of stocked hatchery fish and compared that to native fish. Throughout their studies, they followed the interconnections among socio-cultural systems and natural systems, which ultimately prepared them to critically explore the economic and social decisions that had caused the depletion of natural stream habitats in their region.

The learning experiences that EIC approaches offer students help them integrate critical-thinking skills into their daily lives. "*ISIS* has taught me how to take integration and diversity and systems thinking to the real world," said Doug, a Lincoln junior. "Now, I find myself trying to make connections in everything I do. It's a subconscious thing that happens. After you learn this way for two years it just comes naturally."

Complex, interdisciplinary, environment-based projects such as these help students strengthen their systems-thinking skills. As they identify and investigate the interactions between human and natural systems they become better prepared to understand, evaluate, and wisely interpret any information that they collect or receive, whatever the source.

INTERPERSONAL ABILITIES: GETTING ALONG TOGETHER

SUMMARY

The emphasis of EIC approaches on problem-solving, project-based activities, cooperative learning, and team teaching creates an atmosphere of collaboration among students and teachers. As students work together, mentor their peers and younger students, and observe teachers working in teams, they have the opportunity to develop interpersonal skills that will serve them throughout their lives. Along with the skills, they develop a strong sense of belonging, fellowship, caring, and community.

As they participate in the many collaborative activities typical of EIC programs, they learn to communicate with their peers, function democratically, and work together toward mutual goals—skills that make them better prepared for life in the adult world.

Data from the Learning Survey indicates that teachers and administrators have found EIC-based learning to be an effective means of helping students develop their interpersonal skills. Table 16 summarizes data obtained from the Learning Survey on the effects of EIC on the development of students' interpersonal skills.

TABLE 16. Summary of Learning Survey on the Development of Interpersonal Skills.

Learning Survey Items	% of Educators Reporting Student Improvement	# of Educators Responding to this Survey Item
Collaborating on projects with others	98%	171
Functioning democratically	88%	156
Communicating with others	94%	167
Improved behavior and self discipline	70%	162
Giving care to self and others	91%	159
Practicing civility toward others	93%	157

Findings

"Interpersonal intelligence" is the ability to understand other people, how to cooperate with them, value their motivations, and care about them. The collaborative learning atmosphere encouraged within EIC programs helps students to understand others, develop a sense of community, and comprehend their place in the world. In EIC curricula, cooperative learning, team teaching, and integrated interdisciplinary methodologies all work to provide students with models of effective interpersonal relations.

Students who have the opportunity to collaborate on projects and problem-solving activities acquire crucial interpersonal skills. They learn to communicate with one another and work effectively in groups. As a result, they begin to venture into new working relationships with other students and adults at the same time as they achieve a greater understanding of the given subject matter.

As they work together, students discover that they can both contribute to and learn from other team members, regardless of their individual academic abilities. In EIC programs, high achievers, average, and at-risk students all grow, both in terms of academic achievement and in developing camaraderie within their community of peers.

The interpersonal skills and benefits that students in EIC programs obtain include:

- better ability to function in group settings;
- improved communication with other students; and,
- developing a sense of camaraderie and community.

Better Ability to Function in Group Settings

EIC instruction provides numerous opportunities for students to work in cooperative settings. Students learn to work together and learn from each other when they join forces to conduct a study of stream chemistry or plan a group presentation about agricultural development in their community.

Such collaborative learning experiences lead many students to become, for the first time in their educational careers, genuinely interested in working with other students. They realize that the environment is so complex that, to most effectively explore and understand it, they need to combine their skills and knowledge. Ninety-eight percent of respondents to the Learning Survey reported that after beginning to use the environment as an integrating context for their curriculum, students had learned to work together more effectively.

EIC students also learn interpersonal skills by observing their teachers working together in interdisciplinary teaching teams. They see how adults cooperate, share ideas, resolve differences, and make group decisions while acting respectfully toward each other. "It helps the kids to see the teachers working together," commented Cruz, a seventh grade student at Oregon's Waldo Middle School. "I saw the teachers working together and it looked like fun," he said, "so I wanted to try it, too."

Environment-based learning helps students discover their own skills and appreciate those of others because it capitalizes on a variety of abilities—linguistic, scientific, artistic, and mathematical. Each student has an opportunity to contribute their individual talents and to demonstrate their expertise to their peers. Students begin to recognize the value of diverse individual contributions to their group projects and encourage each other as they work side by side.

As they help one another, EIC students soon learn they are helping themselves as well. "Learning is easier with a whole bunch of people," said Andrew, a seventh grader at New Jersey's North Arlington Middle School. "You don't have to do everything by yourself. If you don't understand something there are other people to help you with it."

Placing value on the abilities, knowledge, and opinions of others motivates students to share planning and decision making—the key processes of functioning successfully in a

democratic system. Eighty-eight percent of educators responding to the Learning Survey reported that EIC students improved in their ability to function democratically when compared to their peers in traditional programs.

Students at Colorado's Logan School, for example, put their consensus-building and group-project planning skills into practice when they chose among possible environment-based field trips. Working in three teams, the class first defined selection criteria for where they might go, what they should do, and which investigations they should incorporate into their activities. Each group then discussed possible field trips and created designs for several different options. They developed arguments to support their proposals, brought them back to the class as a whole, and discussed the benefits of each alternative. Ultimately, based on the class presentations, the students voted on their preferred field trip sites.

EIC-based learning requires diverse academic and interpersonal skills. Whether a student is a good speaker, knowledgeable about the outdoors, or a creative artist, EIC provides opportunities for different team members to assume leadership roles at various times during any given project.

Students at Washington's Komachin Middle School, for example, developed their leadership skills as they designed and implemented a mentoring program for children at a nearby elementary school. The students assumed primary leadership roles and decision-making responsibilities as they organized field trips and creek studies. They designed the program and scheduled activities for the elementary students. Teachers, both at the elementary and middle schools, played secondary roles as learning guides and facilitators.

Previously, when Komachin's program was more teacher-directed, the students had relatively few opportunities to develop their interpersonal skills. After implementing their program, Komachin's teachers discovered that students working in EIC teams more readily assumed responsibility and leadership roles.

"I've gotten a lot of leadership skills through this, because this whole group works without teachers," said Jessica, a Komachin eighth-grader. "We did everything on our own. We scheduled the school visits and we made up the whole program. We just did everything."

"I've gotten a lot of leadership skills through this, because this whole group works without teachers. We did everything on our own."

Students who might otherwise feel detached from the school experience have another chance to succeed when working in the context of a local forest, stream, or lake. In an outdoor setting, these students can succeed by applying their bodily-kinesthetic, spatial, or naturalist abilities. As a result, they begin to feel better about themselves and gain more respect from their peers as they demonstrate that they too have something to contribute to the learning process.

"In the classroom some kids are kind of goofing around. But, as soon as we get out in the field and we're actually doing a project, they're as serious as everyone else," reported Matt, a junior at Minnesota's Little Falls High. "It gets them more involved because it's in a different learning environment."

Students learn how to make joint decisions and work cooperatively as a result of the teamwork inherent in the project-based, problem-solving approaches used in EIC. They learn to value the skills and abilities of others and have the chance to demonstrate and gain respect for their personal strengths. EIC students gain a special satisfaction from seeing their cooperative, environment-based projects succeed and enjoy the recognition they receive for both their individual and team efforts.

Improved Communication with Other Students

EIC approaches are especially conducive to learning the dynamics of interpersonal communication. As they work together, students learn to share ideas, discuss their reasoning, and develop new ideas that emerge from team discussions.

Students in these programs frequently brainstorm their ideas, discuss alternative activities and talk about the connections between environment, community, and social issues. They learn the dynamics of interpersonal communication as they discuss who is responsible for developing different parts of a nature trail, how to conduct a wildlife survey in a local forest, or what priorities they must establish to be successful while working with officials at the local water district.

Ninety-four percent of teachers and principals responding to the Learning Survey reported that students in EIC programs developed stronger interpersonal communication skills than did their traditional peers.

In Oregon, students at Waldo Middle School strengthen these skills as they design endangered species "recovery plans," create habitat management strategies, and develop their team presentations. Through this process, they learn to respectfully discuss each other's ideas, solicit support from peers, and reach team decisions.

Working on a team fosters learning to communicate with other students. "If you leave a kid alone, with a couple of other kids, they start learning more things by themselves," said Tracy, a Waldo seventh grader. "Their communication skills jump up. I know a couple of kids who got into this project and they were really shy," she continued. "After the project they were really talkative. They had a lot of things to say. Now, they express their opinions when they never would have before."

Educators in the study schools use both team teaching and participation of community members as integral components of their EIC programs to reinforce the interpersonal communication skills that students learn through their teamwork. Observing the communication between teachers, parents, community members, and business leaders helps students understand group dynamics and how various segments of their community work together to resolve differences.

Developing a Sense of Camaraderie and Community

The cooperative learning and collaborative teaching approaches intrinsic to EIC-based learning give students the chance to work together more frequently than do traditional educational settings. As a direct result of working closely together, students begin to better understand one another and their teachers. Understanding and respect for others lay the groundwork for a growing sense of belonging and a feeling of community among EIC students and teachers. The environment is an especially good context for this kind of experience since it provides good examples of how the behavior of one part of a social or natural system affects another.

Teachers at the study schools found that combining individual and group learning methods with environment-based studies, encouraged students to demonstrate greater mutual respect and camaraderie. One of the ways that students manifested these improving attitudes was by beginning to monitor their own behavior in order to avoid disappointing either their peers or teachers.

At Kentucky's Jackson County Middle School, for example, John saw a fellow student transform from class clown to team leader as a result of his motivation to collaborate with his classmates on creating their outdoor learning facilities. "There was one kid in my group who's a goof-off all around school," he said. "But when it came down to this project he was chewing us out; he took the lead. He'd say, 'Come on, you've got to get this done.'" Jackson County's teachers believe that this student was inspired by the chance to work in the forest behind the school, where he could demonstrate his expertise and leadership skills.

Twenty-five Heads are Better Than One: Chariton Middle School

Inspired by a series of field trips to a nearby marsh, the seventh graders at Iowa's Chariton Middle School sought even greater challenges. After they read an article in class about a student-run nature club at another school, a small group of students put their heads together and decided to organize a club of their own.

Their initial idea was to start a club for kids who wanted to help animals. They asked their science teacher, Lowell Wiele, what he thought about the idea. Wiele loved it and carved out plenty of class time each day for organizational brainstorming sessions.

The students' enthusiasm was contagious. The school newspaper published their story and before they knew it, Chariton's new club had mushroomed from 12 to 25 members. Others soon heard about the new group and asked to join.

At first, the students explored traditional ideas. They thought it might be fun to focus on endangered species, "adopt" a whale, or "buy" an acre of rainforest. Wiele agreed, but urged the kids to keep thinking. The more they talked about it, the more they started to question their preconceived notions about their club. Maybe they did not have to settle for token involvement in a remote wildlife project. Perhaps, they could do something bigger and closer to home.

The students then had the task of fleshing out their goals. Ideas flew back and forth as they worked to reach a consensus. At their request, Wiele contributed occasional suggestions, but left the decision-making up to the students. In the end, they decided to focus on three specific projects: mentoring students at a nearby elementary school, working with sixth graders at their own school, and helping military veterans living in a nearby retirement home. Then, they got busy.

They wrote a sequel to Dr. Seuss' book "The Lorax" and shared it with third graders at nearby Van Allen Elementary School. Then, they helped Van Allen's fourth graders test the qualities of popcorn as a packing material—a project tied to their most important local cash crop.

At their own school, they worked with sixth grade students, teaching them about plant growth and local soils. Then, so they could share their experiences with others, they started a newsletter about the local environment and began to broadcast updates about their activities, over Chariton's public address system as part of the daily announcements.

Having realized the connection between the health of the natural environment and the human community, these ambitious students set out collection boxes to gather supplies for the veteran's home. When they visited the veterans they learned things about their community that they had never heard before, its history, how it had grown, and what it looked like "back then."

Working together, Chariton's seventh graders had taken an idea from conception to reality, learning that 25 heads can be better than one. They also learned how to work effectively with others to achieve common goals.

Clyde Cruce, principal at Florida's Taylor County High School, witnessed similar effects at the secondary level. Taylor's *Environmental Academy*, he said, "gives a lot of these kids a sense of structure, and a sense of feeling and belonging that they don't otherwise have." Cruce believes the sense of community that develops among Taylor

County's EIC students exerts a direct effect on their commitment to their peers and their schoolwork. "As a general rule, *Academy* kids police themselves," he observed. "If they're not doing what they're supposed to, not only do they feel like they're letting themselves down, but they know they're letting others down too."

Seventy percent of educators responding to the Learning Survey reported that students in EIC programs demonstrated more self-discipline than did their traditionally educated peers.

When teachers involve parents, administrators, community members, and business leaders in the teaching process, they give students a greater sense of community. Students see that others care and want to support them in their educational pursuits. Such community participation helps students avoid the feelings of isolation they may experience in traditional educational settings. Educators and students at all 40 study schools reported that they felt a greater sense of community and belonging in their EIC program than in a traditional program.

A sense of caring frequently develops across grade levels as strong relationships form between older and younger students. "I see a real sense of community building with the kids," remarked Larry Wolfe, a fifth-grade teacher at Iowa's Waterville Elementary. "They almost become big brothers and sisters to the younger kids. It's like passing the torch to the next group."

Wolfe believes the camaraderie his students share contributes to a "sense of cooperation and success among them." Experience tells him these children will take their sense of caring and community with them "into the next class, and the next class, and the years after they leave Waterville," he said.

Ninety-one percent of teachers and administrators responding to the Learning Survey reported that, as a result of participating in EIC programs, students exhibited more caring behaviors than did students in traditional programs.

This finding is especially significant because many students reported that, before participating in their school's EIC program, they had ignored or found it difficult to interact with some members of their peer group. The developing sense of camaraderie, community, and caring brought together students who otherwise might have never worked together. In many cases, this extended to distinctly different groups, such as high achievers and students with limited capabilities.

As they work in concert to achieve their mutual goals, students in EIC programs learn to act with greater civility toward each other. The bonds that form, as they join together to solve problems and conduct studies of their local environment and community, stay with them throughout the school year. Ninety-three percent of respondents to the Learning Survey reported that as a result of EIC learning students began to act with greater civility toward others.

Cross-grade mentoring, a strategy used at most of the study schools, also fosters a sense of community and cooperation among students. It benefits both older and younger learners. The older students discover that it feels good to be treated with respect, while the younger ones have the chance to observe individuals, whom they admire and want to emulate, playing the role of teacher.

The team teaching, collaborative learning, and group projects that are key components of EIC programs give students the chance to develop strong interpersonal relationships with teachers, peers, and other community members. When students participate in these activities, they develop a sense of belonging, community, and caring for fellow students and teachers.

REVITALIZED TEACHING:
THROUGH ENVIRONMENT-BASED EDUCATION

SUMMARY

The vast majority of educators who use the environment as a context for teaching report renewed enthusiasm for and engagement in their profession. Many teachers consider their EIC endeavors the highlight of their professional careers.

Working together closely with their students in real-world situations, these teachers feel deeply rewarded as they see students, some for the first time ever, respond enthusiastically to what they are learning. They also enjoy the improved rapport they build as they work side-by-side on projects and problems with their students and colleagues.

Teachers explore new subject matter as they design interdisciplinary curricula. They enjoy the opportunities for continued learning as they sharpen their skills, expand their knowledge, and dare to enter new instructional territory.

Data from the Teaching Survey indicate that teachers and administrators have found EIC-based instruction to be both beneficial to their teaching and personally gratifying. Table 17 summarizes data obtained from the Teaching Survey on the effects of EIC programs on teachers' attitudes toward their work.

FINDINGS

The positive effects of using the environment as the context for learning reach beyond students to encompass teachers as well. Teacher interest and engagement are important, not just so they enjoy their work more, but because enthusiastic teachers help develop more enthusiastic students.

When teachers are intellectually stimulated, learning along with their students and exploring new teaching methods, they are constantly revitalized. "It keeps you stimulated and challenged," said Shan'na Smith, a science teacher at Florida's Taylor County High. "You look forward to coming to work every day. It's fun for the teacher."

"It keeps you stimulated and challenged. You look forward to coming to work every day."

Teachers and administrators at all 40 study schools described consistent and significant growth in their own levels of enthusiasm and commitment to teaching. They reported that teaching in the context of the environment, in interdisciplinary teams, made them more enthusiastic about their work than they

TABLE 17. Summary of Data from Teaching Survey on Teachers' Attitudes.

Teacher Survey Items	% of Educators Reporting Benefit or Increased Use	# of Educators Responding to this Survey Item
Enthusiasm and engagement	95%	172
Quality of interaction with students	94%	172
Team teaching and teacher collaboration	94%	172
Opportunities to explore new subject matter	95%	172
Willingness to use new teaching methods	96%	171
Theme-based instruction	94%	173
Interdisciplinary approaches	96%	173
Hands-on learning opportunities	98%	173
Inquiry-based instruction	93%	170
Cooperative learning and group projects	95%	173
Learner-centered activities	95%	171
Use of advanced educational technologies	80%	168
Peer tutoring or coaching	84%	169
Participation of community members	84%	170
Grouping in non-traditional ways (e.g., multi-age)	68%	167
Block-scheduling or other non-traditional schedules	76%	165
Authentic assessment of student progress	84%	167

had ever been before. Many commented that adopting EIC approaches had revitalized their interest in education and their profession.

Educators attribute their reinvigorated attitudes to a variety of factors related to both the students and themselves. The more active and enthusiastic participation of students in EIC programs makes them more receptive to their teachers. In turn, teachers feel more valued. Teachers also enjoy learning new instructional methods, planning and working with colleagues, and participating in their students' discoveries.

The teachers' reports of the influence of EIC approaches on their attitudes are especially noteworthy since the average tenure of educators participating in this study was over 16 years. Since many had spent at least half of their careers in traditional educational settings, their opinions constitute a valuable comparison between teachers' experiences and attitudes in EIC-based and traditional education.

Educators reported that, as a result of using EIC approaches, they experienced:

- increased engagement in and enthusiasm for teaching;
- improved interactions with students and colleagues;
- expanded opportunities for professional development and personal growth;
- greater willingness to use innovative instructional strategies; and,
- growing administrative support.

Increased Engagement in and Enthusiasm for Teaching

Nearly all the teachers at the study schools considered their EIC teaching experience a highlight of their professional careers. Virtually all the teachers involved in these programs, many with over twenty years' experience, reported greater enthusiasm and commitment toward teaching after their school began using EIC approaches.

Teaching in the context of the environment and working in integrated, interdisciplinary teams increases the engagement of teachers in their programs. Ninety-five percent of teachers and administrators responding to the Teaching Survey reported that they became more enthusiastic about their work after their schools adopted EIC.

Comments from Wayne Pikal, a teacher at Minnesota's Little Falls High School, are typical. "It's far and away the most exciting part of my whole career," he said. Pikal reported that he feels more committed to teaching since his students and colleagues began their interdisciplinary program of studying the Mississippi River and forests at nearby Camp Ripley. "I'm on my 33rd year of teaching and I have never been more excited about anything in that whole 33-year period than I am about this program," he concluded.

Many other teachers report a similar revitalization of interest in their profession and attribute it to a renewed interest in the subject matter, the chance to participate in collegial teams, and increased opportunities to explore new instructional methods.

"It's far and away the most exciting part of my whole career."

Several teachers reported that participation in their EIC program was responsible for pulling them out of the rut of using the same lessons and instructional approaches year after year. Joyce Steffenson, a teacher at Iowa's Waterville Elementary, has spent more than 20 years in the classroom. "In my first couple of years of teaching, when I was truly enthused, I thought I could save the world," she said. "But then, there was that slump when I got comfortable and in a rut." Working with students in Waterville's prairie-based program has changed all of that. "This type of teaching got me out of that rut," Steffenson said. "I'll probably be here until I'm 90, which doesn't scare me because they can push me around in a wheelchair and I think I'll probably still like it here."

One important factor in teachers' enthusiasm for EIC is that this approach enables them to link schoolwork to the real world. "I've finally got a purpose for the kids to implement what I have always tried to teach them," Pikal said. "This program has enabled us to take the science, technology, and communication skills—everything that we try to get across in a high school class setting—and convince students that there is a correlation between what we ask them to do in school and what the real world is like. It has added credibility to what we ask the students to do."

EIC teachers feel rewarded for their effort when they see students become increasingly involved in learning. Laurie Erekson, principal at Oregon's Waldo Middle School, believes the synergy EIC generates between students and teachers speaks to the essence of the educational profession. "Having that interaction with kids when they're so highly involved in their own learning," she said, "that's exciting; that's why we get into education."

Improved Interactions with Students and Colleagues

EIC educators also enjoy better working relationships with their students and colleagues. The increased enthusiasm of both teachers and students helps them become a learning-teaching team focused, on the same objective: understanding their natural surroundings and local community.

The cooperative learning methods typical of EIC programs foster the development of mutual understanding between teachers and students. Student-teacher learning partnerships prosper and working relationships flourish. EIC's constructivist, learner-centered approaches indicate to students that their teachers care about their individual learning needs and styles, further strengthening the "team spirit."

The improved quality of interaction with their students is an important reason teachers enjoy EIC approaches. Ninety-four percent of respondents to the Teaching Survey reported that the quality of interaction with their students improved since they implemented an environment-based curriculum.

When teachers share in the physical effort of gathering water samples or planting a hillside, students view them as equal partners. "We're no longer that sage on the stage," commented Clay County High science teacher Jocelyn Wolfe. As she and her colleagues worked with students to develop the school's outdoor learning areas, their shared experience transformed the relationships between teachers and students. Working together to create their Kentucky pioneer village, nature trail, and herb gardens, "We've become human beings now," Wolfe said. "We're safe and they can talk to us. I don't think they would have come to me if I was still just lecturing."

"I've always learned from students, but never in this kind of a deep way."

Clay County students, like those at the other study schools, agreed that student-teacher relationships had never been better. "Everybody sees that everybody is on the same level," said Chad, a senior. "Working together on the nature trail has been an enriching experience, because it's not only brought the teachers closer to the students, but also the students closer to the students." Chad sees this as a direct outgrowth of working closely with the teachers in an outdoor learning setting. As they work together on environment-based projects and problems, teachers and students begin to treat each other with more respect and consideration.

Teachers report, while working in teams with their colleagues from different subject areas in developing and implementing EIC-based activities, they learn both subject matter content and teaching skills from each other. This, in turn, changes the nature of their professional relationships and promotes a feeling of professional community. Ninety-four percent of teachers and administrators responding to the Teaching Survey reported that EIC-based instruction provided them with more opportunities to collaborate and team teach than traditional pedagogies.

Expanded Opportunities for Professional Development and Personal Growth

Teachers find that environment-based programs challenge them to continue their own learning. Barbara Moreno, a teacher with over 30 years in the profession, is one who enjoys the challenge. "This is just like discovering all the time," she said, "it's so exciting." Since implementing their integrated, systems-thinking program at California's Open Charter Elementary, she has grown personally and professionally. "I've always learned from students, but never in this kind of a deep way," Moreno continued, "Now, I don't have to know everything, I can be a learner right along with the kids."

Ninety-five percent of respondents to the Teaching Survey reported that EIC-based teaching provides them with more opportunities to explore new subject matter than traditional, discipline-based teaching.

As teachers continue learning, students benefit directly. Mary Roderick, a teacher at Maryland's Hollywood Elementary with 20 years experience, uses her own learning process to benefit her students. "Because I'm learning too," she said, "my attitude is contagious and helpful for my students." Students see their teachers model life-long learning and gain more from teachers who have up-to-date knowledge and skills.

"Because I'm learning too, my attitude is contagious and helpful for my students."

The learning and enjoyment that teachers derive from involvement in EIC programs often inspire them to return to graduate school and pursue higher degrees. At Minnesota's Little Falls High School, for example, three teachers with 12 to 15 years of teaching experience and four of five first- and second-year teachers began master's degree studies since becoming involved in the school's EIC curriculum. "They've told me that the [EIC program] was a springboard for that," reported Malcomb Wax, an assistant principal, "and a lot of them are doing interdisciplinary research or courses." Wax believes that his colleagues' renewed commitment to professional development stems from the innovative approaches they have used while implementing Little Fall's river-based curriculum. The integrated approach to education, he said, "is never a finished package. It makes you see how things fit, it gets you off your seat, and makes you think about things."

The interdisciplinary nature of EIC-based instruction provides teachers with an opportunity to find out how other disciplines function, learn content and skills in new areas, and learn how to connect their subject area with other disciplines.

Greater Willingness to Use Innovative Instructional Strategies

In designing and implementing EIC programs, teachers discover that they need to modify traditional instructional strategies and create new ones; traditional textbook-, worksheet-, or laboratory-based approaches no longer work well. Instead, EIC teachers have to adopt innovative methods and design alternative strategies to teach in teams and cross disciplinary boundaries. In this process, teachers frequently become risk-takers willing to venture out of the "comfort zone" of familiar experiences. Ninety-six percent of respondents to the Teaching Survey reported that EIC approaches motivated them to explore and implement new teaching methods.

As she and her colleagues moved outside of their old "comfort zones," Jean Krogstad, a teacher at Washington's Bagley Elementary, saw rising confidence replace trepidation. "We're not scared to try something new," Krogstad said. "Now everybody's thinking, 'Okay, let's try it. Let's do something different.'" After witnessing the advantages of an integrated curriculum, Bagley teachers are more willing to try innovative approaches.

As EIC teaching teams move from traditional classrooms to environment- and community-based approaches they begin to use a wider variety of experiential, project-based, problem-solving, and inquiry-based pedagogies in combination with authentic assessment methods.

Educators at all 40 study schools reported that EIC-based instruction allowed them to incorporate more innovative teaching methods and instructional practices into their programs than customary, discipline-based curricula. The methods they use range from providing hands-on learning opportunities to making greater use of advanced educational technologies. The practices include everything from peer tutoring, to modified schedules, and authentic assessment. Table 17, at the beginning of this section, summarizes the

instructional methods and facilitation, grouping, and scheduling practices that educators use as they implement EIC programs.

Teachers occasionally feel some measure of discomfort as they begin to explore and adopt alternative instructional methods. Many have had little or no prior training in these innovative pedagogies. They most typically learn these skills on the job, from their colleagues, or through in-service professional development opportunities.

A River Runs Through It: Central Middle School

The teachers at Central Junior High School in East Grand Forks, Minnesota, did their homework. Together, they reviewed the brain research on learning, explored the middle-school concept, and investigated the benefits of integrated approaches to learning. As a result, when they proposed that Central Junior High should become Central Middle School, the school board in East Grand Forks listened. In 1990, funded by the local school board and start-up grants from the Blandin Foundation, with assistance from the Center for School Change, Central made the switch. It became a middle school, committed to team teaching and theme-based, interdisciplinary instruction.

As their first step, the teachers had to determine the theme that would drive Central's curriculum. Again, they joined forces to brainstorm. At first, they decided to build on East Grand Fork's relationship with a sister city in Russia. But within just a few months they concluded that learning about Russia did not create as much interest or value for their students as they had hoped.

So Central's teachers launched a trial balloon: a simple, short-term integrated unit on agriculture and economics, appropriate topics for their farming community. The idea worked and the teachers went on to design a whole-school program focusing on the surrounding *Red River Valley of the North (RRVN)*.

They divided the curriculum into three stages. Sixth graders would explore the present Red River Valley. Seventh graders would investigate what the area must have been like a hundred years ago. The eighth graders would delve into what the future might hold for the valley. The natural environment, farming, and business influences would all be a part of this educational framework.

Central's new educational direction soon permeated its teachers' planning and instructional approaches, as well as their attitudes. They discovered that team teaching within an environment-based curriculum is more rewarding, more stimulating, and more enjoyable. The camaraderie built support that went beyond curriculum development. "I'm not alone anymore," said teacher Jill Thompson. "I'm not just stuck in my own classroom. The possibilities are endless as to what we want to do. I can get help from all kinds of places and people."

The test of their new direction came when the money from the Blandin Foundation ran out and the *RRVN* program faced a crisis. To continue the curriculum, Central needed to get full financial support from their school district.

"We presented this project to the school board last fall and we got a standing ovation," Wenzel said. "So they funded this year." It is doubtful, Wenzel and his colleagues said, that they would have won equal support with their original Russian theme. There is just something about the environment that creates enthusiasm—for students, teachers, and their community.

"Any change is going to cause a little bit of discomfort," said Randy Tabatt of Little Falls High. The benefits, however, far outweigh the apprehension entailed in sacrificing the familiar. Tabatt believes their river-based EIC program "gives me the opportunity to do things outside of what my normal teaching day would otherwise be."

It takes time and patience, but most teachers make the transition to these new instructional methods with few difficulties. Within a short time, they become both comfortable and confident with pedagogies that they could never have imagined using when they were in their more traditional teaching modes. Nonetheless, even the best teachers sometimes catch themselves reverting to some of their old, ingrained habits of traditional instruction.

Growing Administrative Support

Administrative support plays a crucial role as teachers move from their long-practiced methods toward innovative pedagogies and more effective student assessment. The professional and intellectual guidance of principals, assistant principals, and school district personnel appear to be crucial in teachers' willingness to "take risks" and move outside their "comfort zones."

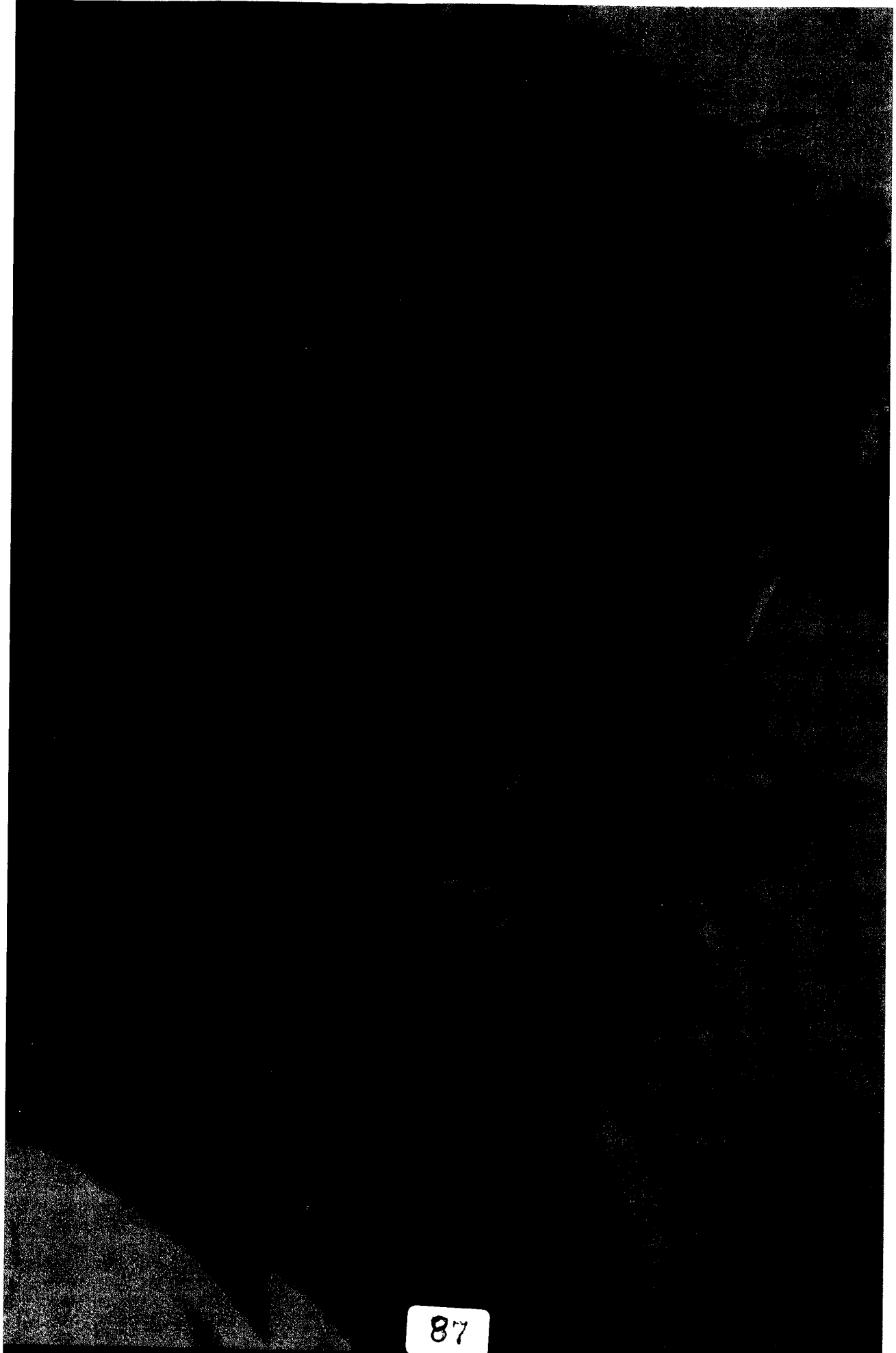
"Our administrator is very supportive," remarked Jerry Wenzel, a seventh grade teacher at Minnesota's Central Middle School. "The principal has given a great deal of the power, for curriculum development, to the teachers. He shows great confidence in the teaching staff and realizes that if the teachers have a sense of ownership it goes a long way toward success."

"If the teachers have a sense of ownership it goes a long way toward success."

At most of the study schools, principals motivated teachers to develop and test new instructional approaches. They also encouraged them to work within their teams to make decisions about implementing their EIC programs.

Teachers at all 40 study schools reported that the encouragement of school and district administrators was key to the success of EIC programs. Most frequently this support came in the form of authorizing flexible schedules and arranging an abundance of planning time. In other cases, administrators provided their teachers with opportunities to participate in professional development programs. While, in a few instances, they even gave them financial assistance for equipment and transportation needs.

Whatever form it takes, administrative backing is important to achieving success in developing an EIC program. Encouragement from their principals helps teachers become risk takers, willing to make changes in their instructional practices.



LAST WORDS—FIRST STEPS

LAST WORDS—FIRST STEPS

This study indicates that EIC, using the environment as an integrating context for learning, holds great promise for helping to "close the achievement gap" in K-12 education. The environment can provide a meaningful context around which educators can create a curricular framework that intrigues learners and revitalizes teachers.

Encouraged by recent brain research, many educators have begun to recognize the value of hands-on, project- and problem-based learning methods, and integrated-interdisciplinary approaches. Using the natural environment and local community as the backdrop, the EIC approach offers teachers the chance to incorporate these proven pedagogies into their classrooms.

Educators, from some of the most successful EIC programs, suggest that the first steps toward starting an EIC program include:

- building a team with like-minded teachers;
- designating one or two individuals to be the team's hub for communications;
- beginning planning well in advance of implementation;
- investing ample time right from the start—formulating team plans for curricular integration requires substantial preparation;
- starting small—perhaps one teaching team and one or two month-long study units;
- building gradually—adding new team members and increasing the number of study units;
- seeking administrative guidance, "buy-in," and support from the inception;
- establishing a network of support—involving both community and technical resources such as: parents, local businesses, other community members, university faculty, resource management agencies (water district, parks department, etc.), nature centers, zoos, and museums;
- reviewing your progress—self-evaluating, and asking others for suggestions about how to improve and expand your program; and,
- being patient—experiences at the study schools suggest that it takes three to four years for teams to solidify and programs to gain stability.

Should you decide to start an EIC program in your school, please keep in mind the comment that the research team heard again and again from educators in EIC programs—"It may be harder, but I wouldn't give it up for anything."

Resources for Getting Started

The Roundtable has produced two videos that are companion pieces to this report:

> **"Closing the Achievement Gap: A Video Summary"** provides an overview of the results of this study including comments from several educators (14 minutes).
>
> **"Beyond Walls, Across Disciplines"** is a CINE Golden Eagle award-winning video in two parts. Part One presents a series of visits, over an eight-month period, to an elementary, middle, and high school that are implementing EIC (39 minutes). Part Two shows the creative ways that teachers at these three schools are using the environment to integrate instruction across the disciplines (27 minutes).

The videos and additional copies of this report are available for a nominal price from:

> State Education and Environment Roundtable
> 16486 Bernardo Center Drive, Suite 328
> San Diego, California 92128
>
> Telephone: (619) 676-0272
> Fax: (619) 676-1088
> Internet Site: http://www.seer.org

The Roundtable also offers technical resources on its Internet site, including:

- names and contact information for the state department of education members of the Roundtable;
- a Technical Assistance Register (TAR) that lists educators from the study schools who are willing to share their knowledge and experiences;
- a list of reference books on related educational topics; and,
- links to other education- and environment-related Internet sites.

Five books that are readily available may provide useful guidance, these and other reference documents are fully listed in the References Section. These books include:

> *Designing & Implementing an Integrated Curriculum: A Student-centered Approach* by E. T. Clark
>
> *Interdisciplinary Curriculum: Design and Implementation* by H. H. Jacobs
>
> *Integrated Thematic Instruction: The Model* by S. Kovalik and K. Olsen
>
> *Making Integrated Curriculum Work: Teachers, Students, and the Quest for Coherent Curriculum* by P. E. Pate, E. R Homestead, and K. L. McGinnis
>
> *Inventing Better Schools: An Action Plan for Educational Reform* by P. C. Schlechty

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STORIES OF SUCCESS

STORIES OF SUCCESS:
EIC PROGRAMS AND EDUCATORS AT WORK

OPEN CHARTER ELEMENTARY: OPEN CHARTER, OPEN MINDS

It is not the sort of neighborhood where you would expect to find a pace-setting public school. Open Charter Elementary lies in the bustling heart of urban Los Angeles. But, almost everything about Open Charter is surprising.

Open Charter was a pioneer in education reform, founded in the late 1970's as an "open school," a school run not only by administrators, but also by teachers and parents. Twenty years later, the concept is still working. Today, Open Charter has evolved into a popular magnet for individualized learning. Every day, all over the enormous "City of Angels," 384 children of all racial and ethnic backgrounds climb onto early-morning buses for the long ride to Open Charter—because they want to.

It is a school that does not put much stock in textbooks and worksheets. Rather, Open Charter's philosophy revolves around the idea that children are natural learners who thrive in experiential educational settings. "It means that we try to provide activities which are meaningful to the children in a real-world sense," explained principal Grace Arnold. "They learn all of the skills they should learn in school through the process of doing meaningful projects."

Open Charter does not divide children by age group. Rather, its students are organized into clusters combining two grades. It does not divide lessons along disciplinary lines. In fact, the school's educators have almost completely erased those traditional boundaries, opting instead for a broad, integrated, and environment-based perspective. "The natural environment represents our schoolwide theme: human interaction with the environment," Arnold said.

The focus at Open Charter dates back to its inception. But its broad, "sans-disciplinary" approach represents a rather recent curricular development. When fourth-/fifth-grade teacher Barbara Moreno first came to Open Charter nine years ago, each grade was focused on a different environment-based topic. "The lower grades did the ponds; the next grade did the deserts, then the cities and the oceans," she explained.

It was a workable concept, but Moreno, who holds a doctorate in education, sensed something was missing. Consequently, she began working on a new program. She won plenty of support from the school's administrators, who routinely encourage teachers to construct their own curricula. In fact, Open Charter has earned an international reputation for its innovative approach to teaching. Many educators see it as an instructional laboratory where new ideas are invented, tested, and evaluated.

Moreno envisioned rich outdoor learning experiences for students and professional development opportunities for teachers. Inspired, she saw everything about teaching in a new light. "I saw how important systems were in thinking about the environment," she said, "and I saw new ways of interconnecting learning."

Luckily, Judy Utvich, Moreno's teammate in the fourth-/fifth-grade cluster, saw it, too. Together they set about implementing a fully integrated curriculum, focusing on the natural world surrounding Open Charter. It was a logical progression in a school that celebrates transdisciplinary learning. Already, Open Charter's educators believed in connecting subject lessons to central concepts or key ideas, then using real-world activities and projects to uncover meanings, solutions, and interrelationships. Moreno and Utvich's plans were simply another big step in that direction.

Open Charter's approach gives teachers and students freedom to explore evolving interests within a flexible learning process in which students' curiosity often drives the curriculum. "Last year we focused on California's bioregions because of all of the flooding then,"

Utvich commented. "We did it because the kids were interested in it. In other teaching environments it's harder to do that because depending on the time of year, you are supposed to be teaching something specific."

Arnold supports that sort of classroom exploration. "If the children show an interest in certain aspects of a program or lesson, the teacher will go in that direction," she commented. "In some cases children are asked in the beginning of the year what they would like to learn and their input is essential. We take into account the enthusiasm of the students and let them create projects."

Moreno has seen the positive effects of that approach. "I find that there is so much more buy-in when the students can direct their learning," she said. "If you can choose a vehicle that the children have signed onto, something they are excited about and interested in, that helps them learn what they need to know."

Open Charter's learner-centered philosophy came to the fore in fall 1995, when a teacher's aide suggested a class trip to the Ballona Wetlands in nearby Playa Del Ray. Both Utvich and Moreno agreed, feeling it would fit in with their instructional theme.

Taking their cue from the students' innate response to the wetlands, that summer Barbara and Judy attended a program at UCLA called Project ISSUES. It taught them how to build a curriculum around a specific theme or issue. They chose the Ballona Wetlands.

"We studied soil composition, took water samples and analyzed salinity, studied plants and finally planted a wetlands garden here at the school by gathering seeds and cuttings at Ballona," Utvich explained. "Eventually these plants can be transplanted back to Ballona."

The Ballona project continues to thread through the students' learning experiences. When the cluster visited the La Brea Tar Pits, just five miles from Open Charter, they learned from a biopaleontologist at the site that the tar pits had once been part of the Ballona Wetlands. "That was very exciting for them," Utvich said. Even more exciting, she added, "they also learned that the school site had once been part of the wetlands, too."

Not surprisingly, Open Charter's educators don't rely on traditional grading systems to assess how students respond to all this experiential activity. Exams are rare occurrences; letter grades are non-existent. Rather, Open Charter students take home a report card checked in one of three areas—area of strength, making progress, or needs development—and augmented by a narrative progress report. Twice a year, they hold parent/student/teacher conferences, orchestrated by the students, to discuss the child's progress, strengths, and weaknesses.

Yet for all its innovative ways, Open Charter keeps pace or exceeds the performance levels of more traditional campuses. "We have always scored above the district's median and most times noticeably better than the state's median," Arnold noted. "And we were featured in the L.A. Times when the CLAS test (California Learning Assessment) was given in 1993—a hands-on, performance-based test—because our school did so well."

After their successful team experience at Open Charter, both Moreno and Utvich say they would never teach alone again. Moreno claims she could never teach another way. The benefits are just too great. "We double each other's knowledge, energy and information," she said. "For the last 20 years this school has had teacher teams. It doubles or triples what we are able to give to the students."

Of course, the team approach requires a lot of collaboration. "We work together constantly, assessing how we are going to organize the curriculum," Moreno continued. "How are we going to integrate social studies? How are we going to have this or that apply to math? It takes a lot of concentration, but it's exciting and it is totally integrated."

Last spring, for example, when the students focused on rivers, they took that emphasis into every subject area, singing river songs, constructing rain sticks in art class, writing books about their river projects, and using data from those projects to create problem-solving math games.

It is an approach Open Charter students have come to appreciate. "Because we are a constructivist school," Moreno explained, "students are involved in team-based learning from kindergarten on up. So by the time they get to us, in the fourth and fifth grades, that is what they expect."

It is also an approach that works, helping Open Charter to fulfill its mission: "to enable students to become life-long learners, responsible citizens, successful members of the work force, and caring individuals with an understanding of the society in which they live."

Moreno sees these goals unfolding among her students every day. Children who work together are always questioning and often outspoken. She said, "These children are not afraid to engage in dialogue, to try and figure something out they don't understand."

These processes lead students to self discovery. Moreno said the integrated, environment-based approach to instruction at Open Charter is the most successful approach for engaging and educating young children that she has ever seen.

"That's because it's about where they live," she said. "It's transforming our children."

Judy Utvich, 4th-/5th-Grade Teacher: A Journey of Math and Music

The story of Judy Utvich's journey into elementary education began at the piano. As a young mother, she taught music to children, mostly in private lessons, but occasionally at preschools. When her own two children began school, Utvich decided to volunteer her services as a music mentor for their school. That proved a turning point.

"The principal came in to observe my class and watch me teach," Utvich recalled. "She said, 'I didn't know you were a credentialed teacher.' And I said, 'I'm not.'" At that moment her teaching career was born.

Recognizing Utvich's talents both as a musician and a teacher, the principal pushed her to become certified. Utvich took the advice. She went back to school and became credentialed in multiple subjects at the fourth- and fifth-grade levels. "I liked those grades, integrating music into the class program," she said. "So nine years later, here I am."

Before joining Open Charter Elementary in Los Angeles, Utvich taught at two other schools. She describes both as very traditional and, for her, stifling. Part of the problem in those schools, she said, was the lack of collaboration among teachers. It was that concern that ultimately led her to Open Charter, known for its non-traditional approach to learning and its creative use of teaching teams.

It was a match. Utvich said she loves the team atmosphere at Open Charter and she especially enjoys teaching with her partner, Barbara Moreno.

Open Charter has embraced an environment-based curriculum—centering around the theme of human survival—since its founding in the 1970s. That environmental focus was new to Utvich, but today, her class—a fourth-/fifth-grade combination known as a cluster—is the most environment-focused at the school.

Utvich has enjoyed mastering the science tied to Open Charter's environment-based programs right along with her students—so much so that she'll never go back to traditional teaching approaches.

"I became a learner myself being here," she said. "You get really tied into the curriculum and lesson plans in a traditional school, but here I learn something new every day, from the students and other teachers. Here, we really believe in letting students take us in a direction. The Ballona project is not something we would have chosen; the children took us there."

And Judy Utvich has enjoyed the journey.

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Hollywood Elementary: A Living Laboratory

Adults in Saint Mary's County, Maryland, a wedge of farmland bordering the Chesapeake Bay, had tried for 25 years to start a community recycling program; for some reason the idea just never caught on. But once the fifth graders at Hollywood Elementary School decided to solve the problem, it did not take long for them to turn their campus into a neighborhood recycling center.

It was the children's enthusiasm more than anything that motivated parents and neighbors to join their efforts. Soon, Hollywood's hallways bulged with giant boxes of old newspapers and the school's parking lot became a regular Saturday-morning stop for residents eager to dump their cans and glass. Teachers helped, but students ran the show. Parents offered their vans, trucks, and even horse trailers to help haul the goods to the nearest recycling station in the next county. Eventually Saint Mary's County itself caught on, set up a few recycling transfer stations of its own and hired a recycling coordinator. But it all started at Hollywood.

"It was just as grass-roots as anything can get," remembers Betty Brady, the teacher who initiated the project. "We were a very small school at the time, less than 300 students, and we became a little place where people rallied."

Hollywood Elementary is not such a little place anymore. Enrollment is up to 600 now, housed in a spacious new facility designed to accommodate the real-world teaching that Brady and her colleagues practice. But the campus remains a rallying point for parents, educators, and other area residents dedicated to the task of maximizing individual learning through integrated, environment-based education.

During the past 15 years, aided by community volunteers and funded through a series of small grants from the Chesapeake Bay Trust, Hollywood's students have turned their 72-acre campus into a living lab—blazing a nature trail, creating a butterfly garden, planting a forest habitat for migrating birds, and transforming a drainage pond into a natural wetland. Each project capitalized on the children's innate attraction to the natural world while providing unique opportunities to combine traditional subject areas in a meaningful whole. The results? At Hollywood Elementary, education works.

"As teachers, we always look at what works with and for children, paying attention to what causes that learner engagement that's so crucial

to learning that lasts," explained principal, Kathleen Glaser. "We're very concerned about not just teaching something so that students can pass a test and then forget it a month later, but teaching something that will be part of their knowledge base, something they can work from to solve problems and enhance their lives."

Glaser and her staff, as well as the parents and students of Hollywood Elementary, clearly believe the school's real-world emphasis produces that kind of learning. And recent empirical evidence confirms it. Since 1992, the state of Maryland has required a year-end performance assessment for all students in grades three, five, and eight. It is a demanding yardstick, built around a child's ability to perform integrated tasks, such as life-science experiments and writing research reports. But it is a perfect tool to measure the effects of integrated education on real-world problem-solving.

Following five years of steady progress, Hollywood's students turned in a bellwether performance in 1997. In contrast to a statewide average of 38 percent, 67 percent of Hollywood's third graders achieved satisfactory assessment scores. At the fifth-grade level, Hollywood hit Maryland's ideal 70th percentile, with 70 percent of students performing in the satisfactory zone, as contrasted to 46 percent statewide.

Glaser attributes her school's stellar performance in large part to her staff of hard-working and innovative teachers, including Betty Brady and Julie Tracy.

Tracy found Glaser's supportive leadership style reason enough to choose Hollywood over another job offer when she finished her master's certification program in 1990. "I think it was probably the teachers and Mrs. Glaser's encouragement and her openness to suggestions," she said. "The other school was not as open to innovative ideas."

For instance, while partnering with a class in Costa Rica during a Smithsonian-sponsored study on migratory birds, Tracy's students learned that loss of habitat was causing a decrease in the birds' populations. Their solution? Creating a habitat on the school grounds. Teaming up with other classes, they identified likely planting areas, including a stand of recently planted trees that still lacked native underbrush, and filled in the area with berry shrubs chosen from the birds' regular menu.

Tracy believes allowing that sort of student initiative is crucial to the learning. "If you approach a project saying, 'we're going to go out and plant a tree,' then it's the teacher's project," she said. " But if the students are engaged in real scientific inquiry, and they're the decision-makers directing the project, then it's authentic, and they're engaged in meaningful learning."

With its integrated, environment-based curriculum now expanding, and recognition of its effectiveness spreading, Hollywood Elementary has become a living portrait of the mature EIC school.

Looking back, Hollywood's recycling program, begun in the late 1980s, constitutes an important benchmark in an evolutionary process that started in 1982 when Glaser became principal of the school. From her own experiences first as a classroom teacher and later as a resource teacher, Glaser brought a dual focus to her new position: to encourage individual learning and support innovative teaching.

"I think we communicated pretty early, after I became principal, that what was most important was the individual learner," Glaser said. "I think it's also important for teachers to grow professionally, so when they found a program or a resource or a good working idea we began to try some of those out."

As Brady and her fellow teachers continued to brainstorm and experiment, they made two discoveries. First, they found that students learned most effectively when previously disjointed subjects came together in an integrated curriculum. Second, they realized that the environment provided a perfect integrating context for learning.

Brady has a simple explanation for that: "All things are connected." Tracy agrees. "All the subject areas are right there," she said. "You don't have to try to plug anything in; it all just fits in naturally when you use the environment."

Add to that children's innate love of animals and curiosity about nature, and Hollywood had found a sure-fire recipe for effective education. "We saw children really engaging with the real world in a way they weren't engaging with the textbooks," Glaser explained, "and we saw the learning really lasting." "They see the big picture," Tracy added. "They see the goal."

Encouraged by their early successes and Glaser's never-wavering support, Hollywood's teachers began to design more and more environment-based projects and to tighten the teamwork so crucial to integrated learning. In some instances, teachers paired up based on their differing preferences: a nature nut, unfazed by bugs and dirt, and a bookworm, more comfortable juggling papers and pencils.

"We have such a spirit here of being a community of learners and leaders that people welcome someone with a different strength," Glaser commented. "I'd like to think that one of the things we do well is to blend the teaching strengths we have available, then nurture not only the students, but also support each other where we need it."

Hollywood's distinctive approach to teaching

caught the national limelight in 1996, when Julie Tracy's idea that second and third graders could turn a drainage pond into a natural habitat earned her a 1996 presidential award for excellence in teaching. In a project that combined biology, botany, ecology, math, and language arts, Tracy's students explored the types of aquatic plants and animals they could expect to thrive in the little pond, then drafted a planting plan, calculating depths and distances for optimal growth, and recruited parents and local college students to help with the work. Today, the former drainage basin is home to fish, birds, amphibians, and even a raccoon or two.

Not surprisingly, with Hollywood's thriving EIC emphasis drawing attention throughout Maryland and beyond, people are beginning to take notice. Glaser has been fielding frequent calls from other schools eager to duplicate Hollywood's success. She is eager to respond. "They want to know more about the nature trail or the butterfly garden, how that sort of thing gets organized," Glaser said. "I'm getting more interested in how to help other teachers integrate some of these ideas. How can we help people benefit from our years of experience?"

"I'm seeing lots of indicators that this kind of work is growing," Glaser said. "Hopefully, we can be a place people can visit or know about, so they can learn more about how to do it." If American education is indeed headed toward a new paradigm of integrated, environment-based instruction, Hollywood is already out front and eager to lead the way.

Kathy Glaser: A Principal's Story

Kathleen Glaser did not set out to grow an EIC school. It just turned out that way. But, like any effective leader, she did have a vision in mind from the moment she became principal of Hollywood Elementary in 1982.

"I've always kept the focus on individual children's achievements," she said. "That's the clear goal. The evolving vision really is one of how do we pool resources? How do we utilize our diverse understanding to create an optimal learning environment for the child?"

Glaser's egalitarian leadership style banks on diverse understanding. She does not dictate any one-size-fits-all policies. Rather, her's is a balanced approach that assigns equal weight to the individual student and the individual teacher, giving each educator the support and encouragement to customize curricula to students' varying interests and needs.

Just as her staff has let students follow their curiosity, Glaser has encouraged teachers to run with their best ideas. Over the past 15 years, the combined creativity of Hollywood's talented staff has transformed a little school in rural Maryland into a thriving national model of integrated, environment-based education. It is an approach, true to Glaser's dual commitment, that satisfies both learners and teachers.

Glaser's concern for teachers, as well as students, comes from personal experience. After five years as a classroom teacher, Glaser worked as a staff developer, a position that piqued her interest in teacher education. "One of the reasons I wanted to be a principal," she said, "was that in my years as a staff developer going to different schools, I really became convinced that the principal was in a key role to facilitate and support the teaching and to nurture that innovation that teachers are so good at, and you need some support to take some risks."

Glaser's role in Hollywood's evolution has been a seminal one, informed by her own subscription to the educational philosophies of Howard Gardner and Roland Barth. "Our school has been, for many years now, committed to integrated approaches to curriculum and delivery of instruction," Glaser said, "and Howard Gardner's work is so supportive of that kind of integration." She noted particularly that Gardner has recently added a "naturalist intelligence" to his catalog of "multiple intelligences." For Hollywood teachers, already convinced of the benefits of environment-based education, it was a welcome validation.

"I think as educators, frequently we are so immersed in the day-to-day that we rarely get time to step out of that, maybe to look at a different way of approaching learning and reflect on our own practice," Glaser said. "So I spent a year visiting both British and U.S. schools that I had wanted to see, putting images and ideas together with my vision to give that vision more life."

No one who visits Hollywood Elementary, a place where environment-based instruction works for both learners and leaders, can say Glaser's vision is not a lively one. Constantly evolving curricula, children leading as well as following—it is all risky business. Fortunately for Hollywood, Kathy Glaser realizes "you need some support to take some risks."

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Huntingdon Area Middle School: Streams of Knowledge

The students at Huntingdon Area Middle School are making adults in their rural Pennsylvania community sit up and take notice. Their active engagement in their community is an outgrowth of an innovative, homegrown EIC program called *STREAMS*—a regional grand-prize winner of the National Middle School Association's Team-teaching Award.

STREAMS, which stands for Science Teams in Rural Environments for Aquatic Management Studies, is an interdisciplinary program that aims to increase students' awareness of and concern for their immediate environment and to engage them in the community at large. As its name suggests, the program focuses on water and emphasizes active learning and real-world issues.

Student enthusiasm for the program keeps building. Every year, Huntingdon students clamor to begin projects earlier and earlier. "We used to start in January," said Fred Wilson, social studies teacher. "Then it was in November and this year some kids were ready in September." The accelerated schedule means more work for Wilson and his colleagues. But there is a certain synergy created when students are so eager, he said. And that is what gives him the energy to keep up.

The genesis of the *STREAMS* program occurred eight years ago when the sixth-grade teaching team, including Wilson, began looking for a new theme to incorporate across their existing interdisciplinary curriculum. They decided a program tied to the water studies presented in Tim Julian's science class would be ideal because they could tie it into all the disciplines.

"We wanted to examine problems in our community—such as water quality, storm-water runoff and erosion—to make the subject more meaningful to our students," Wilson explained. It was a perfect choice. With four separate watersheds converging within two miles of the school, he pointed out, Huntingdon already had a phenomenal outdoor lab at its doorstep.

Wilson volunteered to develop the interdisciplinary program and contacted a number of organizations in his search for suitable learning projects. But, while he discovered lots of suggestions for activities, there was no program that could be "plugged in" to Huntingdon's existing curriculum. By 1991, the first year Wilson and his teammates taught the *STREAMS* unit, he had developed his own instructional segments dealing with storm-water runoff, erosion and sedimentation, water quality monitoring, household pollutants, and community involvement. At the same time, Julian expanded the portion of his science curriculum that dealt with water to include the study of local watersheds as well as water and wastewater treatment facilities.

Student response was overwhelming, so overwhelming that the following summer Wilson and his colleagues developed more *STREAMS* topics—wetlands, groundwater, acidity, and nutrient enrichment—and added more water quality studies plus two additional watersheds to monitor.

The team effort regularly crosses disciplinary lines, with each teacher contributing his or her expertise toward common projects. In science class, for instance, Julian teaches the students about the properties of water, purification processes, and wastewater treatment. Before they go out on a field trip to conduct tests, they also learn how to use the proper monitoring equipment. "Our kids don't go out unless they are prepped," Wilson said. "That's so they can succeed."

Rose Taylor, Huntingdon's sixth-grade language arts teacher, reinforces the vocabulary students need to know in their studies and works with students on *STREAMS*-related writing assignments. Math teacher Mike Simpson helps the students learn to interpret statistics, construct charts and graphs, and use computer database programs to report their findings. He also incorporates the data they collect into problems he uses to teach important math concepts such as fractions and percentages. "Rather than use cookbook problems," he said, "we use real field data."

Wilson's part of the curriculum emphasizes the consequences of land use—residential, agricultural, and mining—on the water supply, as well as various types of pollution and the function of wetlands. Wilson's students also learn about the effects of storm-water runoff, a significant problem in the Huntingdon vicinity because of over-development in what was once a wetland.

Everything comes together out in the field, where all the team members get their hands dirty. Their eagerness to dig right in can be traced in large measure to their lengthy history as a team. "We've teamed together so long—15 years—that we can be frank and open," Wilson explained. Another secret of the *STREAMS* staff is a willingness to step outside the bounds of their own disciplines. "You have to be willing," he said, "to wear different hats."

Indeed, *STREAMS* teachers seem entirely comfortable sharing their teaching responsibilities all around. All the team members, for example, teach reading. Tim Julian and Mike Simpson capitalize on the interrelationships between science and math;

both, for instance, teach students to interpret charts and graphs. "Science uses a lot of math—averaging, graphing, measuring speed," Julian pointed out. "Sometimes we work together; sometimes we handle it separately." Julian also supports Rose Taylor's efforts in language arts by having students write reports on their field activities. "I do correct their grammar," he said, "but I don't lower their science grade for mistakes."

The teachers are equally flexible about class time. "I could go into school tomorrow and say that I need a block of time," Wilson said, "and we'd revamp the schedule in a minute." *STREAMS* team members synchronize and evaluate their lesson plans and schedules in regular weekly meetings, but they can also meet daily during a common planning period.

Wilson conducts an annual formal assessment of what students learned in the program. In the 1994/95 school year, 97 percent of *STREAMS* students failed a pre-test with an average score of 38 percent. Two months after the program concluded, the students' average score, on an unannounced post-test, was 81 percent, with only a 2 percent failure rate. In the 1996/97 school year, Wilson conducted the post-test five months after they completed the initial *STREAMS* unit. Even after that lengthy interval, the students' averaged 71 percent on the test. Those results, Wilson pointed out, indicate that most students not only mastered the content, but also retained that knowledge months after completing the program.

When Wilson and his colleagues started the *STREAMS* program, no one dreamed how successful and far-reaching it would become. Beyond the creativity and effort of the Huntingdon team, Wilson said, another key reason for their success is partnering with various organizations in the community.

Parents are another valuable resource. Without them, Wilson said, he could not accommodate all the students who want to do independent work, often after school and on weekends. They help transport and chaperone students giving presentations to public groups, civic organizations, teacher conferences, and workshops, as well as those taking special field trips or traveling to the biotechnology lab at Penn State. Parents also help with tree-planting projects and water-quality monitoring.

The students, too, have tapped into the partnering concept. When they proposed creating a wetland near the school, for example, they raised $1,000 and then found partners to contribute the $3,000 needed to complete the project—proof that they have learned to leverage their dollars and attract broad-based support.

The community that spawned these savvy students and teachers is by some standards an unlikely one. Huntingdon, a town of 7,000, is located in south central Pennsylvania, an area that historically has reported the highest unemployment figures in the state. The average family income here is $20,000 annually. Only 9.4 percent of adults in the county have earned a post-secondary degree, compared to 18 percent statewide.

Wilson also noted a dichotomy in the region's attitudes toward education, with some residents very supportive and others indifferent. Consequently, it has been exciting for Huntingdon's teachers to watch a gradual shift in the public's attitude toward the students' endeavors. "At first, they were taken rather lightly," Julian noted, "but now the community is coming and asking them for help."

Without a doubt, Wilson observed, the Huntingdon teachers' decision to use the environment as an umbrella for interdisciplinary study and hands-on instructional strategies has produced tremendous results. "I think that our students are engaged in a meaningful learning experience that will help to empower them to be critical thinkers and become more independent learners," he said.

As principal Jill Adams sees it, programs like *STREAMS* and teachers like Wilson and his colleagues hold the key to reshaping the entire educational process. "The future of education really depends on people like this," she said. "We cannot continue to teach the way that we were taught."

Fred Wilson, 6th-Grade Social Studies Teacher: Shaping Learners and Leaders

Why does a social studies teacher spend so much time studying the environment with his students? That is a question Fred Wilson, a sixth-grade social studies teacher at Pennsylvania's Huntingdon Area Middle School, is frequently asked. He has a ready answer: "I want our kids to be learners and leaders."

Studying real-world issues that affect their families and community makes learning more meaningful for the students. It also serves as a natural vehicle for promoting the dual concepts of citizenship and stewardship. "That's the social studies aspect," Wilson said.

Starting the school's interdisciplinary *STREAMS* curriculum took extra effort. When Wilson offered to take on the task, he had no background in science so he took a few classes to give himself the confidence to teach the subject.

Then he set about collecting materials and developing a curriculum to complement what science teacher Tim Julian was already teaching.

"The program would never have developed as it has," he said, "without everyone's cooperation." Wilson is quick to point out that the *STREAMS* curriculum is a collaborative effort involving all the other members of the sixth-grade team: science, math, and language arts teachers.

The team-teaching approach is not new at Huntingdon. It was already a reality when Wilson began teaching there 24 years ago. But since the advent, in 1991, of the *STREAMS* program, Wilson reports that teaming has expanded across the curriculum.

In addition to collaborating in instruction, Huntingdon's teachers have increased their use of hands-on teaching strategies and alternative assessment techniques. A lot of that assessment involves students' applying what they learn. "They have to do a lot more writing and thinking," Wilson said. In both areas, he added, students are getting better.

"Seventy percent of our kids," he said, "elect to do this work on their own time." Wilson does, too. He devotes many hours after school and on weekends to working with students on independent projects and attending meetings where they present their findings and proposed solutions before elected officials, local civic groups, and educational conferences.

"The kids are excited and the parents are enthused," said Wilson. That is what keeps him going. "When you have kids involved in so many things and making a real impact, you feed on that," he said. "It's a symbiotic relationship."

Seeing the program help students become self-reliant leaders has made Fred Wilson an enthusiastic advocate of environment-based education. "We are getting that result," he said, "by using the EIC approach."

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Chariton Middle School: A Harvest of Learning

When Chariton Middle School was built four years ago, students noticed something was missing. The spanking new building was surrounded only by black Iowa soil. The children decided to do something to remedy the situation. With their science teachers they visited nurseries, developed plans, and came up with the plants and funds to landscape their campus. They presented their proposal to the school board, who agreed to provide funding for seeding and custodial staff to prepare the land. A local nursery donated a number of trees and a truckload of mulch for much-needed pathways. A year later, Chariton's new campus looked green and complete.

These students' take-charge attitude was a natural consequence of the way they had learned to tackle problems. Chariton's curriculum encourages youngsters to examine the world around them, show initiative, and get involved in issues affecting them. The school's science club, for example, is in the third year of a five-year contract with Iowa's Department of Natural Resources and the Lucas County Soil and Water Conservation District. Their joint goal is to monitor water quality for Chariton's water system, which comes from three local lakes. "That is real science with a real purpose," said seventh-grade science teacher Lowell Wiele.

The hands-on, interdisciplinary approach to education, that characterizes a significant amount of the instruction at Chariton Middle School today, had its origins in a decision Wiele made 15 years ago to find better ways to teach. He wanted to get through to kids he knew he was not reaching with traditional methods. He wanted to make learning exciting and meaningful. The best way to do that, he surmised, was to work with real-world topics that grabbed the students' attention.

As an extension of hands-on projects he already did in class, Wiele brought the outside into his classroom and took his classes outdoors. He started small: inviting local experts from the forestry district and conservation board to talk with students and taking field trips for on-site learning. Student reaction told Wiele he was on the right track. "When students come in early and bring things into class," he said, "you know they are hooked."

About 10 years ago, Chariton initiated its first interdisciplinary theme when a seventh-grade math teacher joined Wiele's classes in their studies at Little White Breast Creek. The science students profiled the stream and the math class measured its flow. Putting the information together, the children determined the stream's velocity: how much water flows through it in a minute, an hour, or a day.

Soon other seventh-grade teachers joined in planning similar cross-disciplinary studies. At the time, seventh graders were housed in a building separate from the other grades, waiting for a middle school bond issue to pass. The measure failed three times before voters finally approved it, but in the interim the seventh grade teachers began to develop a teaming approach in their teaching. Today, team teaching is a schoolwide strategy at Chariton. Teachers of all core subjects—geography, language arts, math, reading, and science—as well as art and home economics, are involved to varying degrees in an interdisciplinary instructional effort for which the environment is often the central focus. "It's easy to use the environment as a hub because it affects everybody," Wiele said. Even when the environment is not the stated theme, he notes, it often works in naturally.

As a subject for study, the environment is a natural in the southern Iowa community of Chariton (population 5,000). Its rolling hills, lakes, and acres of timber offer a variety of opportunities for study. "Right outside our back door," Wiele said, "we have a prairie area, timber, and four ponds within walking distance."

Today, each of the three grade levels at Chariton is led by an interdisciplinary team composed of teachers of: geography, math, language arts, and science, and, in sixth and seventh grades, reading. Every grade tackles at least one interdisciplinary topic a quarter, explains Todd Lettow, the school's principal, but they take different approaches. The sixth and eighth grades change topics every year. "That keeps things fresh," Lettow said. In seventh grade two of the topics—the marsh and the streams—are continuing themes. "That way," he notes, "teachers and students can build on them every year, getting better and more efficient."

Core-subject teachers meet daily to plan their interdisciplinary units or discuss ways to "team up" and engage a particular student. The instructional day is divided into eight periods: five for subject classes, plus one period each of prep time, teaming, and study skills.

How do Chariton's teachers make the interdisciplinary approach work? "By brainstorming and cooperative planning," said Susan Fogle, the seventh-grade geography teacher. The teaming period is a crucial part of the process, Fogle said, but that is only the beginning of the teachers' collaborative work.

The seventh grade teachers spend several weeks each summer working together to develop and revise learning modules and activities. As a result, the interdisciplinary curriculum is based on a scope and sequence developed by the whole team, not individual teachers. One result of such varied input, Wiele explains, is that there is no such thing as a typical unit of study. Some last for a day; others for a week or longer.

If the teachers decide to share an activity, instead of teaching three separate 42-minute periods, they can block out most of the morning and combine their efforts. Each teacher adds a unique perspective to the mix. In the week-long marsh unit, for example, the science students test the soil for percolation and soil type, and measure the water's temperature, turbidity, and pH. Then they bring their data back to class and organize their findings into a report. The geography teacher focuses on prairie grasses and evidence of fur-bearing animals, in preparation for the Iowa history unit she will teach later.

Collaboration at Chariton occurs between grades as well as among subject areas. Three years ago, the sixth and seventh graders performed experiments for a weather unit. When a weatherman came to talk to the students, the eighth graders were invited to listen, too. When the seventh graders study the marsh, an eighth-grade mentor goes along. "The eighth graders did the activity themselves a year ago, so they know what to do," Wiele said.

Students as well as teachers have a role in shaping the learning process. At the beginning of the year, Wiele asks each student to name a community concern. Together, the class makes a graph of those concerns and chooses which ones to address. "I do a lot of guiding, but if the students come up with an idea and they want to do it, it's important to let them," Wiele explained.

"I do almost continual assessment," Wiele said, "but I give few paper and pencil tests." In the marsh unit, for example, points are assigned for activities such as whether students used a control in the turbidity testing, labeled their graphs, and recorded data correctly in their science journal. But much of what the students are involved with is open-ended.

When it comes to proof of learning, performance on a basic skills test is not the only relevant evidence. "The students are beginning to ask questions and answer more of their own questions," Wiele observes. "Then they start developing their own conclusions." The result: the students are learning to think.

They are also excited about learning. "Last year, I thought school was boring and I didn't like it," said Jeff, a seventh grader. "I'd get C and D grades. Now, I'm getting A's... I think it's really changed school for me."

Education is important to Chariton Middle School's 350 students who come from a small, rural community, located in an old coal mining area approximately 50 miles from Des Moines. Chariton has a population of roughly 10,000 with an economy that depends on farming, but the town's biggest employer is a food store chain.

Community involvement is very important to the success of Chariton's innovative curriculum. Wiele estimates that 50 different people, experts and parents, participate in class activities during the year. "Some for one day, some for a whole week in the field," he said. Wiele plans to see that his students reciprocate by staying involved in their community. Students will help in designing and working on trails for a new $300,000 nature center currently being planned.

It is just that sort of real-world opportunity that makes learning relevant and exciting to Chariton's students. Principal Lettow attests to that fact, "as soon as we can teach them something that is part of their world, like the environment, all of a sudden it's more meaningful to them." The kids do not always realize that they are learning, but educators know that learning can occur in many different ways. They know that by moving away from traditional textbook-based learning, they are able to reach more kids. And that, after all, is the bottom line.

Lowell Wiele, 7th-Grade Teacher and Department Chair: Directed Constructivism

Teaching the same subject at the same grade level in the same town for nearly 31 years has not dulled Lowell Wiele's enthusiasm one whit. This seventh-grade science teacher's back burner is brimming with projects he is eager to share with his students. There are trails to be planned, trees to be transplanted, and lakes to be studied—just to start the list of pending activities. So much to do, in fact, "there just isn't enough time," he said.

Wiele's enthusiasm stems from the positive reactions of his students to the interdisciplinary, environment-based teaching approach he and his colleagues at Chariton Middle School have developed. Students respond to the opportunities it offers for hands-on learning in an outdoor setting.

Wiele did not always teach this way. For the first half of his career, he relied on a more traditional, classroom-based approach. But 15 years ago, realizing he was not reaching all his students, he started moving outdoors, looking for local topics and projects the students could relate to. In the rural town of Chariton, the outdoor classroom was an easy concept to realize and the environment was a natural theme.

The methods of instruction Wiele uses today are very different from the techniques his high school and college teachers employed, the ones he emulated when he first began to teach. He now relies on textbooks only for reference and his students participate actively in shaping their learning experience.

"Directed constructivism" is the term Wiele uses to describe his teaching method. He knows where he wants the students to go, he said, but he lets them make decisions, within reasonable limits, about how to get there. "If I see they need to step back and do more foundation work," he said,"I rein them back in."

Wiele and his fellow teachers spend tremendous energy and long hours refining and implementing their programs. But knowing that the kids are hooked on learning now makes it all worthwhile. "The sparks in the kids' eyes tell me they are excited to learn this way," he said. "That's why we're doing it."

A firm believer in the benefits of the environment-based approach, Wiele spreads the good work about EIC at conferences throughout the country and internationally as well. Would he ever resume a more traditional approach to teaching? Not a chance.

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Clay County High School: A Heritage Rediscovered

Clay County High School is situated in rural, southeastern Kentucky. It is the heart of Appalachia, an area of the country known mostly for coal mines and tobacco, although the coal is long gone. Clay County suffers from a variety of social problems, not the least of which is rampant poverty. Only 17 percent of residents can report taxable income and many families have depended on public assistance for three or more generations.

Only four of every 10 Clay County High graduates go on to some type of post-secondary education and only one finishes that training. Three of every 10 grads go straight to work, said librarian Linda Cornett, who runs the CCHS School-to-Work program. "I wish I could say the others also go to work," she said, "but unfortunately that's not true."

It was in this harsh and sometimes hopeless reality that Clay County educators began a program to invigorate their curriculum by using the environment as an integrating framework. Biology teacher Jocelyn Wolfe was one of the program's originators.

"About five years ago a group of teachers was having lunch and discussing moving into the new school we had wanted for years," she recalled. "The new property gave us 80 acres of woods, a five-acre river bottom, and a five-acre field right beside the school building, as well as streams and a river that bordered the property. We started discussing doing something with all that land."

Sitting at lunch with Wolfe and her colleagues that day was Douglas Adams, principal, now assistant superintendent of Clay County Schools. Wolfe approached him about using the land for outside learning, tied into various math and science courses. Adams loved the idea. "And from that moment on we started planning," Wolfe said.

Enthusiasm for the new outdoor program spread quickly. Each teacher had a project in mind. Home economics wanted a garden planted with herbs and flowers from the 1700's and 1800's. "I wanted the trails planted with trees and wildflowers; another teacher wanted a wetland; and the agricultural department wanted to plant crops," Wolfe said.

So the program began, carried by three teachers and the enthusiastic support of administrators. At first, two biology classes and a construction technology class conducted projects and experiments outside using the trails, woods, and streams. Each year after that, two or three more teachers joined the program, adding art, anthropology, math, and other subjects to the list of environment-based courses.

Teachers working within the program can decide to team teach or go it alone. Wolfe herself generally conducts classes on her own because state mandates make her science courses less flexible than other academic courses. But she cited a variety of team-teaching success stories. In one case, math and science joined forces with home economics.

Anthropology and biology teacher Deann Allen provides another example of collaborative success; she is heavily involved in team teaching.

"I teach my anthropology course with the art department, because art is such an important part of culture," Allen said. "A lot of anthropology students don't get to take art, because we have only one art teacher. This gives them a chance to be exposed to the fine arts through anthropology. It shows them how various subjects are interrelated."

One EIC project Allen cited involved her anthropology class and an algebra class. The lesson centered around the diet of a Native American in 1700 versus the modern American diet. "We met in the library, all 60 of us, and talked about caloric content and we had students devise a day's meal. Then the math teacher took over and talked about statistics and the appropriate use of them. And then we finished up by discussing changes in lifestyles over time and related diseases. This kind of teaching makes it relevant to the real world."

Another of Allen's classes conducted an archeological dig with the U.S. Forest Service, excavating a rock shelter in the Daniel Boone National Forest. "It was one of the best things we have done," she said. "We brought the stuff back from the dig and we had to clean up the artifacts, identify them, do the analysis. Then students presented a paper at a state historical conference."

These opportunities have boosted Clay County students' interest in their studies, Wolfe pointed out. With the EIC program, she said, student participation is hardly ever a problem. "In every class you are going to have those who don't want to take part, of course," Wolfe explained. "But most students are pretty enthusiastic about working outside together."

Working together on Clay County High's outdoor projects has also fostered new relationships among students, some of whom otherwise would not have the chance to interact. For example, the EIC program encompasses special education students, who work alongside mainstream students as part of collaborative teams. "The special education students are learning and behaviorally disabled," Allen explained. "But many times when I mix them into mainstream student groups, the mainstream kids don't even realize the other kids are special education students. It's good for them to be exposed to different kinds of people," she said.

Despite the success of Clay County's collaborative, environment-based efforts, Allen is the first to admit team teaching can be difficult, particularly if you do not work with teachers who conduct classroom discipline in the same way you do. "Teachers need to understand that when you have 60 kids in one room it can't be 'my student' or 'your student,'" she said. Allen believes when teams are in sync classroom problems become easier to handle.

"With another teacher there you are more willing to go out on the edge a bit and try something different, especially if you have discipline problems, because that other teacher is a second set of eyes for you and helps manage the class," she said.

Willingness to edge into the unknown is another advantage of teaming, Allen said. Teachers at Clay County pair up on their own and consequently choose other teachers with whom they enjoy working. The resulting camaraderie can be stimulating, providing the confidence to take chances and try new instructional methods.

Whether working alone or in teams, Allen and her colleagues at Clay County High have found the EIC program a means of revitalizing the educational experience for themselves and their students. Recognizing their success, the community and other outside entities have offered their support to make sure the program continues. Much of the work on the nature trails is now grant-funded, giving Clay County students even more opportunities to learn in real-world settings.

It seems everyone in Clay County realizes something special is going on at their local high school. Students there are gaining much more than book learning. Working in a real-world, outdoor setting, they are discovering valuable lessons about appreciating their heritage, about applying knowledge to life, and working together to achieve mutual goals.

"As a student, when you're in a classroom learning from a teacher, you realize the teacher is the superior one and you are the one there to learn," explained one student. "But when you are working outside... making some of the calls, it makes you feel like you've got as much to do with the project as the teacher does. That makes me feel good as a student and as a person."

Douglas Adams, Assistant Superintendent: Lessons from a Log Cabin

Douglas Adams has always been a man with a mission: to educate young minds and shape young lives.

He began his professional career in the mid-1970's as a reading and history teacher at Lorel Creek Elementary School in rural Clay County, Kentucky. In 1986, he was named assistant principal at Clay County High School. Two years later, he took over as principal and finally, in 1995, he became assistant superintendent for all of Clay County's Schools. Yet despite his successes, Adams remains a modest man, and, above all, one with an open mind. That is why, when high school science teacher Jocelyn Wolfe came to him in 1990 with an innovative teaching concept, Adams was all ears.

"In 1990 the school moved to a new facility on a site with over 90 acres of land that included a river, large wooded areas and a river bottom area with fertile soil," Adams recalls. "Ms. Wolfe brought me some ideas about how we could use these different spots to teach. She thought we could apply some of what was learned in the classroom to real-life situations."

Adams thought so, too. From that moment, he was on board.

The program began with simple projects such as plant identification, soil testing, and water quality testing. Feedback about the new program was so favorable that the concept soon spread to other academic areas.

Adams thinks that using the nature trail, wooded areas, and a log cabin construction project infuses fresh blood into established teaching and learning patterns, allowing both teachers and students to interact in new ways. Teachers often get in a rut, especially when they have taught the same subject for many years, Adams said. "You've got all your lecture notes written and tests made. All you have to do year after year is open your file cabinets."

But incorporating the natural environment into their teaching lessons has challenged faculty members. "They have to find new ways to apply their teaching and see if it is relevant to the world outside the classroom," Adams said. It has allowed teachers to come down off their stage and become real people to the students.

From the beginning, when Ms. Wolfe first brought her idea to Adams, "he wondered why someone hadn't thought of the approach sooner. It just made so much sense.

"When I was a student," Adams continued, "I often sat in class and wondered why I had to take algebra, for instance. Sometimes the reason you need the information you are learning is not apparent when you are in school. But if you have a known problem, then it becomes clear why you must know certain things."

It is certainly clear to Doug Adams that using the environment as an integrating context for education works for Clay County students.

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Taylor County High School: Partners in Education

The dropout rate is dropping at Florida's Taylor County High School—at least among the at-risk students enrolled in its six-year-old *Environmental Academy*. Although entry to the *Academy* is now handled on an open enrollment basis, the original target audience consisted of students identified as likely to fail or drop out of the traditional high school curriculum. Roughly 70 percent of the 88 students currently enrolled still fit that description, but clearly the alternative approach works. Now, *Academy* dropouts are the exception, not the rule. What is more, most participants earn not only a high school diploma but college credits as well. They also gain on-the-job experience through summer internships for which they receive academic credit and a stipend ranging from $150 to $200, depending on the grades they earn.

"We lose from five to seven students a year, mostly to moves," said Terrence Zimmerman, lead science teacher and program coordinator, "but only about one or two a year drop out." That is an impressive record in view of the fact that, when the *Academy* was proposed, the school as a whole had a dropout rate of about 10 percent a year, with 40 percent of entering ninth graders failing to graduate—one of the worst records in the state.

What holds the students interest and motivates them to do well?

In a traditional classroom, students frequently question what they are getting out of the classes they take. In the *Academy's* four-year EIC curriculum, the English, math, and science studies are focused on real-world applications of what students are learning. "In our program," said Shan'na Smith, who teaches the ninth- and tenth-grade science classes, "we can show them what they can get out of this. It makes it so much more meaningful."

The *Academy's* alternative approach to learning does not mean that the content is watered down or less demanding. Not only must the curriculum meet state standards for high school science, English, and math, but the eleventh and twelfth grade students participate in dual-enrollment science classes with Santa Fe

Community College, which offers a two-year environmental science degree. *Academy* students can earn nine college credits in hard sciences—three hours of credit for introduction to environmental science and six hours for technical chemistry I and II.

Challenges await them in other disciplines as well. Honors students involved in research projects write a paper, points out English teacher Ruth Harvey, but her students are required to do that and more. "Our kids go a step beyond," she said, "to teach everyone what they've learned." Their presentations must include a class activity designed to interest the rest of the students.

In their "school within a school," *Academy* students are not isolated. They attend *Environmental Academy* classes in the morning and then take regular college prep or vocational classes in the afternoon. "As a general rule," said principal Clyde Cruce, "the *Academy* kids have the best of both worlds."

The success of Taylor's award-winning program has echoed throughout the state. It has had a double barrel effect, said Pete Kreis, project consultant for business and education alliances in the office of the state commissioner of education. "It has stimulated development of academy-type programs, as well as environmental studies." Kreis estimates that 15 to 25 other high schools in the state have programs that are spin-offs from Taylor.

When Taylor *Academy* students earned a 1994 state of Florida Education Award for their longitudinal research project studying the nearby Econfina River for the Swanee River Water Management District, that triggered a lot of interest, Kreis notes. The St. John's River Water Management District, one of five such districts in the state, launched a similar program, called *Legacy*, in all 17 of the counties in its district.

One man's frustration with the existing system provided the initial impetus for creation of Taylor's pioneering program. Rennell Wilburn, an engineer at Buckeye Cellulose, a local paper manufacturer, was a volunteer science and math tutor at Taylor County High. He was stymied by the restrictions that the school system placed on his efforts to help students who had difficulty mastering concepts taught in traditional math and science classes. "He thought that the material was very abstract and boring," Kreis said, "but the school did not want the volunteers to teach the kids any shortcuts or different ways to do things." When Wilburn ran into Kreis at a meeting, he said "We have to talk." He had heard about business/education partnerships that Kreis was running. Taylor County High should have a program that was more interesting to the students, the engineer argued, one that could lead to employment. Kreis proposed developing an alternative curriculum focused on the environment.

The topic was a natural. Not only is it interesting to kids, but it is a front-burner issue in Florida. "The state has sensitive lands and water bodies almost everywhere," Kreis points out. With its *Preservation 2000* program, the state has spent $300 million a year since 1990 for the purchase of sensitive lands to protect fresh water and marine coastlines. "So there are ready-made public partners—agencies such as water districts, local counties, and the State Game and Fresh Water Fish Commission," he explains. Furthermore, Taylor County, a rural area located in the Florida panhandle with extensive shoreline in the northeastern corner of the Gulf of Mexico, has environmentally sensitive lands, extensive timber lands, and—apart from the paper products manufacturer—a limited job market.

Taylor County has a population of about 17,000, with about 12,000 living in the town of Perry, where Taylor County High is located. "Many of our kids are the first ones in their family to graduate from high school," Zimmerman said. Students needed greater incentive to obtain their diploma. Area businesses needed more competent graduates with skills required for employment.

They formed the Taylor Compact Partnership to request federal funds for the startup of the innovative environment-based program. It was a real business/education partnership that went beyond the more typical donor-recipient relationship. Business was a driving force behind creation of the program and its continued involvement, in the form of internships, mentors, and guest speakers. Initial members included the Taylor County School District, the Florida Department of Education, the Taylor County Chamber of Commerce, and Proctor & Gamble, then the parenr corporation for Buckeye Cellulose.

A number of factors are responsible for the *Academy's* success, participants and observers agree. The teachers work as a team and go the extra mile. "That's something you have to look for when you're putting together an *Academy*," said Harvey. "You can't chose people that are going to shut the book at 3:30 and go home. It doesn't work that way."

In addition to having a common planning period each day, they also meet for lunch on Mondays. That gives them plenty of time to discuss problems or upcoming projects. E-mail capability, Zimmerman said, also helps them keep in touch with one anorher.

Continuity is another key to *Academy* students' success. The English and math teachers teach all four grade levels in their respective disciplines, and two teachers handle the four science classes. "Having the same teachers over an extended period of time and developing relationships with those teachers has really

helped the kids," Zimmerman notes. It helps the teachers, too. In the traditional high school setting, teachers have students in class for just one year, but it can easily take half that time to get to know them. "When you have them year after year," he points out, "you learn in the first half year what the student is like, what his problems are, what his psychological makeup is. After that teachers know when to intervene, and may be better able to spot a problem."

Closer interaction makes it easier for teachers and parents to work in tandem to address problems that may crop up. "The *Academy* teachers burn up the phone lines with these parents," said principal Cruce. "If they see that a kid is getting off a little bit, they want the parent to take ownership, too. It's not just a school problem."

Peer pressure also helps promote a responsible attitude toward assignments. "There's so much cooperative learning," Harvey explains, "that everybody's going to suffer if they're not all pulling their weight."

It also helps to have a supportive and appreciative administration. "The principal is willing to try things and experiment," Zimmerman pointed out.

As principal Cruce sees it, the reason for the program's ability to achieve such impressive results is its relevance. Relevance has become an overused buzz word in education—an out-of-date cliché, he concedes. But nonetheless, he maintains, it is the beauty of the *Academy*—"the family relevance, the student teacher relevance, the relevance to everything that's going on in the world."

Ruth Harvey: A Teacher Who Loves to Learn

Ruth Harvey loves to learn. Fortunately for her, "there's something brand new every single day" in the *Environmental Academy*.

A veteran English teacher, Harvey enjoys the chances the interdisciplinary program offers to expand her students'—and her own—horizons with fresh literary topics. If, for example, the morning paper runs an article about the manatee in south Florida, she incorporates it into that day's lesson. Keeping an eye out for fresh material often means that Harvey must create "spur-of-the-moment" lesson plans. But that is a challenge she enjoys; that is where the learning comes in.

The *Academy* attracted Harvey because its environment-based, integrated curriculum incorporates varied teaching strategies that adapt nicely to students' different learning styles. "I had experience working with exceptional students—learning disabled, handicapped and gifted—who did not learn well with traditional methods," Harvey said. But the *Academy's* hands-on, project-based approach, she explained, offers something for everyone.

Getting out of the classroom for field work makes for a more participatory learning setting—a major part of the program's appeal for Harvey as well as her students. In the field, shy students sometimes turn into class leaders; academic stragglers can become enlightened experts. Turning to fresh resources such as the media, the Internet, and guest speakers, who provide students with first-hand accounts, also grabs the students' attention, while keeping their subject matter current.

Watching her students warm up to the new approach and reach new levels of personal success makes the extra effort of keeping things up-to-date worthwhile for Harvey. "When even at-risk students begin making the honor roll," she explained, "you know you're doing something right."

With her students enthusiastically delving into subjects that interest them personally, Harvey now views herself as more of a facilitator than a teacher. And that is the way she likes it. "I taught in a traditional classroom for 14 years," she said, "everything from basic English to honors. And I would not go back."

Now, thanks to the *Academy's* interdisciplinary, hands-on approach, Harvey is devouring new lessons about science and the environment, as well as brushing up on math. Even her reading habits have changed; she is branching out beyond traditional literature to embrace a wider range of subject matter. "It's really refreshing, so wide open," Harvey said of her new perspective. "It's just been great for me."

Not a surprising statement for a teacher who loves to learn.

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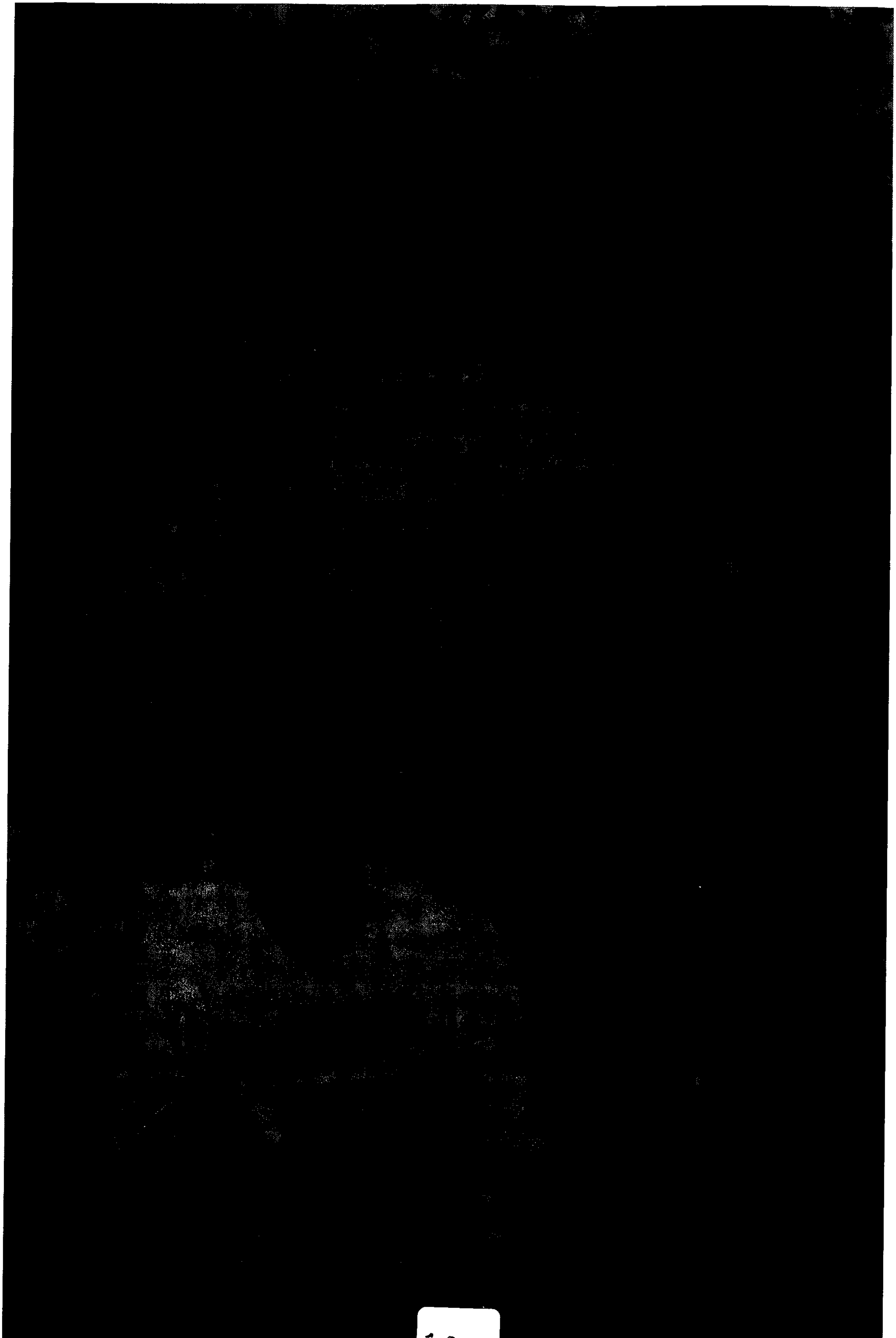

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APPENDIX A:

STUDY SCHOOL ADDRESSES, TELEPHONE AND FAX NUMBERS

CALIFORNIA

Kimbark Elementary School
18021 Kenwood Ave., Devore, CA 92407
(909) 880-6641 (phone)
(909) 880-6644 (fax)

N. Verdemont Elementary School
3555 Meyers Road, San Bernardino, CA 92407
(909) 880-6730 (phone)
(909) 880-6734 (fax)

Open Charter Elementary School
6085 Airdrome, Los Angeles, CA 90035
(323) 937-6249 (phone)
(323) 937-2884 (fax)

Lincoln High School
6844 Alexandria Place, Stockton, CA 95207
(209) 953-8920 (phone)
(209) 952-4646 (fax)

Piner High School
1700 Fulton Road, Santa Rosa, CA 95403
(707) 528-5175 (phone)
(707) 528-5246 (fax)

COLORADO

Nederland Elementary School
#1 Sundown Trail, Nederland, CO 80466
(303) 258-7092 (phone)
(303) 447-5576 (fax)

Logan School
1836 Logan, Denver, CO 80203
(303) 830-0326 (phone)
(303) 830-0849 (fax)

Glenwood Springs High School
Box 1700, Glenwood Springs, CO 81602
(970) 945-5762 (phone)
(970) 945-0136 (fax)

FLORIDA

Wakeland Elementary School
1812 E. 27th Street,
Bradenton, FL 34208
(941) 741-3358 (phone)
(941) 741-3459 (fax)

Merritt Brown Middle School
5044 Merritt Brown Way
Panama City, FL 32404
(904) 872-4740 (phone)
(904) 872-7625 (fax)

Taylor County High School
601 E. Lafayette St., Perry, FL 32347
(904) 838-2525 (phone)
(904) 838-2521 (fax)

IOWA

Waterville Elementary School
115 Main Street, Waterville, IA 52170
(319) 535-7245 (phone)
(319) 568-2677 (fax)

Chariton Middle School
1300 N. 16th Street, Chariton, IA 50049
(515) 774-5114 (phone)
(515) 774-4109 (fax)

Metro High School
1212 7th Street, S.E.,
Cedar Rapids, IA 52403
(319) 398-2193 (phone)
(319) 398-2117 (fax)

KENTUCKY

Wheatley Elementary School
1107 S. 17th Street, Louisville, KY 40210
(502) 485-8348 (phone)
(502) 585-5262 (fax)

Jackson County Middle School
P.O. Box 1329, McKee, KY 40447
(606) 287-8351 (phone)
(606) 287-8360 (fax)

Clay County High School
Route 7 Box 44, Manchester, KY 40962
(606) 598-3737 (phone)
(606) 598-8976 (fax)

Valley High School
10200 Dixie Highway, Louisville, KY 40272
(502) 485-8339 (phone)
(502) 485-8666 (fax)

MARYLAND

Hollywood Elementary School
160 Joy Chapel Rd., Hollywood, MD 20636
(301) 373-4350 (phone)
(301) 373-4353 (fax)

Centreville Middle School
231 Rulhsburg Road
Centreville, MD 21617
(410) 758-0883 (phone)
(410) 758-4447 (fax)

Western School of Technology
and Environmental Science
100 Kenwood Ave., Baltimore, MD 21228
(410) 887-0840 (phone)
(410) 887-1024 (fax)

MINNESOTA

Dowling Elementary School
3900 W. River Parkway,
Minneapolis, MN 55406
(612) 627-2732 (phone)
(612) 627-2740 (fax)

Central Middle School
210 5th Street NW, E. Grand Forks, MN 56721
(218) 773-1141 (phone)
(218) 773-7408 (fax)

Little Falls High School
1001 S. E. Fifth Ave., Little Falls, MN 56345
(320) 632-2921 (phone)
(320) 632-5139 (fax)

NEW JERSEY

Watchung Elementary School
14 Garden Street, Montclair, NJ 07042
(973) 509-4266 (phone)
(973) 509-1344 (fax)

North Arlington Middle School
44 Argyle Place, North Arlington, NJ 07031
(201) 955-5265 (phone)
(201) 955-5266 (fax)

Marine Academy of Science and Technology
Monmouth County Vocational School Dist.
Building 305, Sandy Hook, NJ 07732
(732) 291-0995 (phone)
(732) 291-9367 (fax)

OHIO

Indian Hills Elementary School
401 Glenwood Road, Rossford, OH 43571
(419) 666-0140 (phone)
(419) 661-2856 (fax)

Troy Intermediate School
237 Belmar Road, Avon Lake, OH 44012
(440) 933-2701 (phone)
(440) 933-8965 (fax)

OREGON

Waldo Middle School
2805 Lansing Ave., N.E., Salem, OR 97303
(503) 399-3215 (phone)
(503) 391-4070 (fax)

PENNSYLVANIA

Park Forest Elementary School
2181 School Dr., State College, PA 16803
(814) 231-5010 (phone)
(814) 231-4166 (fax)

Huntingdon Area Middle School
2500 Cassady, Huntingdon, PA 16652
(814) 643-2900 (phone)
(814) 643-6513 (fax)

Radnor Middle School
131 S. Wayne Ave., Wayne, PA 19087
(610) 688-8100 (phone)
(610) 688-2491 (fax)

State College High School
653 Westerly Pkwy., State College, PA 16801
(814) 231-1111 (phone)
(814) 231-5024 (fax)

TEXAS

Hotchkiss Elementary School
6929 Town North Drive, Dallas, TX 75231
(214) 553-4430 (phone)
(214) 553-4428 (fax)

Baker Junior High School
301 E. Fairmont, La Porte, TX 77571
(281) 842-2800 (phone)
(281) 842-2817 (fax)

WASHINGTON

Bagley Elementary School
7821 Stone Avenue N., Seattle, WA 98103
(206) 729-3290 (phone)
(206) 729-3291 (fax)

Rock Creek Elementary School
25700 Maple Valley-Black-Diamond Rd., SE,
Maple Valley, WA 98038
(425) 432-7664 (phone)
(425) 432-7290 (fax)

Komachin Middle School
3650 College St., S. E., Lacey, WA 98503
(360) 438-8800 (phone)
(360) 438-8802 (fax)

Tahoma High School
P.O. Box 710, Maple Valley, WA 98038
(425) 432-4484 (phone)
(425) 432-8977 (fax)

APPENDIX B:

STUDY DESIGN

SITE SELECTION CRITERIA - SCHOOL CHARACTERISTICS

The Roundtable's research team established eight requisite criteria that schools had to meet to be included in the study. All the study schools had:

- environment as an integrating context for the whole school or a program within the school;
- an EIC program in place for a minimum of two years;
- a minimum of two classes of students involved in the endeavor;
- teams of teachers working together and, at the secondary level, representing at least three subject matter disciplines;
- curricular integration in place the majority of the school year;
- curricular planning and instruction organized around the environment as the core concept;
- students actively involved in projects and problem-solving; and,
- a learner-centered, constructivist instructional atmosphere.

The research plan called for site visits to an elementary, middle and high school in each Roundtable member state, although ultimately the pattern varied slightly. This plan made it possible for the team to gather a broad base of information about implementation strategies, successes, and challenges within the context of different state education systems.

The Roundtable's state agency members identified candidate schools in their states that met selection criteria. In some cases, the state representatives recommended one school at each level. In others, they provided extensive lists.

Using the site selection criteria, the research team screened all schools before scheduling a visit. This process involved 45-90 minute telephone interviews with each school's principal, a "lead" teacher, or both. The Roundtable's team selected only schools that met the research criteria.

As the pre-visit screening process eliminated candidate schools, research staff asked state representatives to identify additional candidate schools or approve schools located through other contacts. The research team screened over 200 schools before making the final selections.

METHODS

The team designed site visits to provide access to each school for at least a full school day. The length of the visits averaged about seven hours, with exceptional, individual cases extending to eight hours and one limited to three hours. In the latter case, the team conducted several follow-up telephone interviews.

During the visits, researchers interviewed teachers, principals, school district staff, students, and community members. Wherever possible, the researchers also included parents and former students in the interview process.

The research team field-tested the interview methods and questions at two elementary schools in San Bernardino County, California. They made minor adjustments in the procedures before visiting other study schools.

The team sent an introductory letter, a summary of the case study research plan, and a general site information survey to the contact at each school before visiting.

The researchers developed a series of standard questions that served as the basis for interviews. As needed, they adapted the questions to individual interviewees and schools.

The research team developed three general categories of questions: effects on learning, effects on teaching, and program structure and support. The team designed the questions to elicit information related to:

- qualitative effects of using the environment as an integrating context;
- indicators and specific evidence of change; and,
- educators' insights into the causes of observed changes.

A short time after the site visit process began, the research team realized the need for a survey instrument to collect uniform data about the effects of EIC. Consequently, they developed instruments to survey teachers and administrators.

The team designed the instruments to aid with the analysis of site visit interviews, not to replace them. This approach allowed teachers and administrators to categorize their own responses, reducing researcher bias.

The team divided this survey into two instruments, one about effects on students and learning, and the other to determine effects on teachers and instruction. They then further subdivided each of these sections into several topics.

The "Learning Survey" included items related to:

- student learning of subject matter;
- development of students' basic life skills;
- development of students' thinking skills;
- relevance of EIC to different learning styles;
- effects on students' enthusiasm and attitudes; and,
- summative achievement indicators.

The "Teachers Survey" included items related to:

- incorporation of various instructional strategies;
- approaches to grouping students;
- use of alternate curricular design and structure;
- availability of educational resources; and,
- effects on teachers' enthusiasm and motivation.

In most cases, the research team collected the surveys during site visits. The survey team distributed copies, to be returned by mail, to schools they had visited prior to the development of these instruments.

Several months after the research team developed the first two surveys, they developed a "Domains Survey" to measure the effects of EIC on student learning in the four core subject areas: language arts, math, science, and social studies. The questions covered five topics related to each discipline:

- knowledge;
- skills;
- retention;
- attitudes toward learning; and,
- opportunities for further understanding.

The team developed the Domains Survey after the school visits and distributed it by mail. The researchers mailed out 185 Domains Survey instruments; 137 teachers and administrators responded.

Analytical Methods

The researchers conducted interviews with a total of 219 teachers, 33 administrators and over 400 students, plus a small number of parents, district staff, and community members. The researchers recorded all interviews on audio cassettes for review and analysis. Both research staff and professional transcribers summarized and transcribed the tapes.

The research team compiled and analyzed results of the surveys using computer spreadsheets. They did not include responses marked "did not observe" in the calculation of results. Thus, in reviewing the data, it is important to note the number of respondents "reporting" for each question.

APPENDIX C:

DESCRIPTIONS OF STANDARDIZED TESTS REFERENCED IN THIS REPORT

CAT, the California Achievement Test, is a test series designed to measure achievement in the basic skills from K-12. The subject areas measured are reading, language, spelling, mathematics, study skills, science, and social studies. The Basic Skills Battery provides norm-referenced and curriculum-referenced data.

CMSWT, the Central Middle School Writing Test, is a writing performance test developed by teachers at Central. They give it to sixth-, seventh-, and eighth-grade students early in the school year and then give a "post-test" toward the end of the year to assess progress.

CFAS, the Curriculum Frameworks Assessment System, is designed to support schools' need for national normative information, statewide normative information, and framework outcome information. It measures how well students meet the educational goals of their state and local curriculum. CFAS directly measures outcomes that can be assessed using multiple-choice test items and helps integrate performance assessment data for other outcomes to give a more complete picture of student attainment.

ITBS, the Iowa Test of Basic Skills, assesses individual accomplishment. It is designed to assess current performance in reading, language, and mathematics. It is often used to predict future academic success. Individual achievement is determined by comparison of results with average scores derived from large representative national samples. These tests are administered in the fall of each year.

KIRIS, the Kentucky Instructional Results Information System, tests knowledge of the traditional basics and what students can do with the basics. Subjects included are reading, math, science, writing, social studies, arts and humanities, and practical living/vocational studies. KIRIS asks students not only to provide correct answers, but also to explain how they arrive at their answers. The KIRIS assessment consists of several different kinds of tests: "open-response" questions, "writing prompts," multiple-choice questions, and writing portfolios.

MSPAP, the Maryland State Performance Assessment Program, is a testing program whose primary purpose is to provide information that can be used to improve instruction in schools. The MSPAP measures the performance of schools by assessing how well students: solve problems cooperatively and individually; apply what they have learned to real-world problems; and, can relate and use knowledge from different subject areas. Tasks typically require students to write extensively. It is intended to measure school improvement, not individual student performance.

PSSA, the Pennsylvania State System of Assessment, is a test administered statewide to determine achievement levels in the basic skills of reading, writing, and mathematics. It provides data in a wide range of curricular areas to help schools further identify strengths and weaknesses, and foster improvement in academic programs. Fifth-, eighth- and eleventh-grade students are tested in spring.

SAT, the Scholastic Aptitude Test, is a multiple-choice test designed to assist colleges and universities in evaluating applications for admission. It measures verbal and mathematical reasoning abilities.

SAM, the School Attitude Measure, examines several dimensions of student attitudes that are linked to school behavior and outcomes. It focuses on school experience. Students respond based on their feelings about each statement. It is useful for identifying "at-risk" students and offering insight to students with high academic ability who perform poorly in school.

STANFORD NINE, the Stanford Nine Achievement Test, assesses basic skills. The Stanford Nine is a "norm-referenced" test. The scores measure how individual students or groups perform in relation to other group scores or "norms".

TAAS, the Texas Assessment of Academic Skills, measures the statewide curriculum in reading, writing, mathematics, science, and social studies. The implementation of TAAS shifted the focus of assessment from minimum skills to academic skills. TAAS tests represent a comprehensive assessment of the instructional targets delineated in the "essential elements," it also assesses higher-order thinking skills, and problem-solving abilities.

Appendix D:

Notes on Programs Reported in Comparative Analyses

Bagley Elementary:

EIC program includes entire school population and has a 6 year history.

Dowling Elementary:

EIC program includes entire school population and has an 11 year history.

Hollywood Elementary:

EIC program includes entire school population and has a 5 year history.

Hotchkiss Elementary:

EIC program includes entire school population and has a 4 year history.

Open Charter Elementary:

EIC program includes 34% of fourth and fifth graders and has an 8 year history. Students apply to enter the school, however, selection is not based on academic scores.

Park Forest Elementary:

EIC program includes the entire school population and has an 8 year history.

Central Middle:

EIC program includes entire school population and has a 6 year history.

Chariton Middle:

EIC program includes the entire school population and has a 12 year history.

Huntingdon Area Middle:

EIC program includes 34% of sixth graders and has a 7 year history. Participants are randomly selected from entire school population.

Jackson County Middle:

EIC program includes entire school population and has a 7 year history.

Radnor Middle:

EIC program includes 20% of entire seventh-grade population, and has a 12 year history. Participants are randomly selected from the 90% of seventh graders who apply to the program. This program has expanded significantly since the study.

Little Falls High School:

EIC program includes 46% of ninth graders and has an 8 year history. Participants are randomly selected from the entire school population excluding students in the top 10% in math.

Tahoma High School:

EIC program includes 34% each of ninth and tenth graders and has a 5 year history. Participants are randomly selected from the entire school population. Some analyses compared eleventh graders, who had been in the program during ninth and tenth grades, with other students. This program has expanded significantly since the study.

Valley High School:

EIC program includes 26% of eleventh and twelfth graders and has a 9 year history. Participants apply to the school.

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Dr. Lieberman received his Ph.D. and M.A. from Princeton University and his B.A. from U.C.L.A. He is a past Chair of the Commission on Education of the World Conservation Union—IUCN.

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