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2. EXTENDING TEACHERS' WORK TO OUTDOOR LEARNING ENVIRONMENTS

Applying High-Quality Instruction for Meaningful Learning

The term "outdoor education," which gradually emerged in the United States in the early to mid-1900's, is associated with the use of natural and human-created areas as environments for learning. The term is interpreted in different ways and used to describe a variety of experiences, each of which focuses on specific goals. Such experiences include school sites, field studies, and resident experiences that address objectives of the school curriculum; camping experiences to enhance social and living skills; and environmental education experiences that focus on problems and issues associated with a quality environment. There are also adventure education programs that aim to develop self-concept, agility, and fitness, as well as programs that focus on an appreciation of nature, recreational pursuits, therapeutic programs for children and adults with disabilities, and the like.

This chapter focuses on outdoor education as it applies to teachers' work, with particular emphasis on the use of the outdoor environment as an approach with which to achieve more efficient and effective learning of concepts, skills, and dispositions as they relate to the goals and objectives of the school curriculum. A model for high-quality instruction will be offered as a means for creating meaningful learning and extending teachers' work to non-traditional settings.

OUTDOOR LEARNING ENVIRONMENTS

Unlike traditional classrooms, which are characterized by expository methods of instruction, outdoor environments provide countless opportunities for active learning of social, emotional, and academic objectives in a variety of subject areas through firsthand observation and experience. For example, many outdoor environments provide the settings for inquiry-based instruction. Exploring one's environment, asking theoretical and operational questions, making observations, engaging in investigations and experimentation, collecting and analyzing data, drawing conclusions, making inferences, and formulating new questions are some of the exciting processes that are practiced through inquiry-based instruction. Outdoor education programs "encourage

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development of openness of thinking and cognitive flexibility by exposing participants to novel ideas, viewpoints, settings, activities, cultures, and divers group members" (Neill, 2008, p. 87). Table 1 shows a number of created and natural environments that provide settings for learning beyond the classroom.

Table 1. Environments for Learning

Created (Built) Learning Environments	Natural Learning Environments
– Zoos and botanic gardens – Museums – Nature centers – Exploratoriums – Aquariums, oceanariums, and planetariums – Space centers – Technology centers – Sites with bridges, dams, tunnels, and domes – Amusement parks – Manufacturing plants – Weather stations – Airports – TV and radio stations – Government agencies – Cemeteries – Farms – Recycling centers – Water treatment facilities – Outdoor education centers	– Sea shores and tide pools – Ponds, lakes, and shorelines – River banks and stream-beds – Mountains – Valleys – Deserts – Road cuts – Quarries – Fields and forests – Nature preserves – Rainforests – National, state, and local parks – Nature preserves – School sites

A RATIONALE FOR TEACHING IN OUTDOOR LEARNING ENVIRONMENTS

The philosophical roots of outdoor education date back to the 16th century, when Czech theologian and educator John Amos Comenius (1592–1670) professed a belief in the extraordinary power of method and the search for psychologically grounded principles of teaching. Comenius (1967, pp. 89, 91) noted:

> In spring they may be taken into the garden or into the country, and may be taught the various species of plants, vying with one another to see who can recognize the greater number. ... Nothing, therefore, should be learned for its value at school, but for its use in life, that the information which a scholar has acquired may not vanish as soon he leaves school.

In the 18th century, French philosopher Jean-Jacques Rousseau (1712–1788) preached the importance of healthful physical activity in a child's education. He professed the benefits of tapping into a child's natural interests and curiosity and learning from direct

multi-sensory experience. Swiss educator Johann Heinrich Pestalozzi (1746–1827) taught practical skills through firsthand experience at his farm-home school for boys and girls. His approach to instruction was based on experiential learning, whereby experiences were later used to formulate generalizations and principles. Pestalozzi urged teachers to take students out of the classroom:

> Lead your child out into nature, teach him on the hilltops and in the valleys. There he will listen better, and the sense of freedom will give him more strength to overcome difficulties. But, in these hours of freedom let him be taught by nature rather than by you. Let him fully realize that she is the real teacher and that you, with your art, do nothing more than walk quietly at her side (cited in Hammerman, Hammerman, & Hammerman, 2001, p. 225).

The approaches advocated by Comenius, Rousseau, Pestalozzi, and others during those early years offered a base of support for the learning methods in outdoor environments that would follow decades and even centuries later.

The American philosopher, psychologist, and educator John Dewey (1859–1952) was considered to be an acknowledged leader in American educational philosophy and served as the administrator of one of the first laboratory schools in the nation at the University of Chicago in 1886. During his tenure there, he authored two educational treatises: *The School and Society* in 1899 and *The Child and the Curriculum* in 1902 (Dewey, 1950; 1953). Dewey believed that experiences of all kinds should be included in the curriculum and that educators should know how to capitalize on a child's physical, natural, and social surroundings in a way that would result in significant learning experiences. Dewey advocated an active learning environment that was closely linked to community activities and was focused on practical knowledge, both for immediate social use and for future use. These goals were part of the progressive education movement that many U.S. schools established and adopted in the early part of the 20th century. Dewey's concern for a practical, socially responsible life was a key element of the philosophical concept of pragmatism that he explicated in many of his writings.

THE EVOLUTION OF OUTDOOR EDUCATION: A BRIEF HISTORY

Prior to 1930, outdoor education took the form of isolated experiences including "nature study," where science educators used field experiences in teacher education programs, and "camping education," where school personnel began to show interest in the educational potential of summer camping experiences. In his dissertation research, Hammerman (1961) identified a series of periods after 1930 through which outdoor education evolved in the United States. These periods are summarized here in order to identify the major contributions to the field during the developmental years.

The Period of Inception (1930–1939) saw a major breakthrough for outdoor education due to widening recognition among educators of the educational values inherent in the summer camp experience. During this time, key leaders from such fields

as camping education, recreation, physical education, natural science, conservation, and social welfare offered varying points of view to the movement now known as outdoor education. The civic and social values of the camping experience were stressed, but few attempts were made to correlate the outdoor learning activities to the regular school curriculum.

The Period of Experimentation (1940–1952) saw the beginning of school-sponsored camping programs and national workshops that focused on the role of camping in America. Experimentation with out-of-classroom learning at school camps, gardens, farms, and forests indicated a desire to improve traditional education programs through new approaches. Experimental programs sponsored by city and county school districts, universities, and State Departments of Education were initiated in Michigan, New York, California, Ohio, Tennessee, Texas, and Washington. The impact of school camping during this period was characterized by curricula emphasizing conservation education, healthful living, meaningful work experience, socialization, group guidance, and democratic living. By the end of this period, most resident programs were operating during the academic year with a transition from recreational, camp-type programs toward a closer relationship to the existing school curriculum.

The Period of Standardization (1953–1964) was a time of significant growth and development for outdoor education. As early as the 1950's, there was a gradual move away from the camping stereotype toward programs that were more closely related to the school curriculum. Terms such as "outdoor school" and "outdoor laboratory" came to replace the term "school camp." Newly formed organizations contributed to the formulation of standards for outdoor education.

Significant contributions towards promoting the vision of outdoor education to enhance the core curriculum were made through organizations that were developed during this period. Among these organizations were the Outdoor Education Association, founded by L. B. Sharp in the early 1950's; the California; the Association for Outdoor Education, established in 1954; and the National Outdoor Education Project, headed by Julian W. Smith in 1955.

Topics related to the use of the outdoors to expand teaching and learning were addressed at early conferences. For example, the first National Conference on Outdoor Education was held in Washington, D.C. in May, 1958, with others following shortly thereafter in Illinois and Michigan. Final sessions were devoted to two fundamental issues in outdoor education: teacher and leadership preparation and school programs in outdoor and school camp settings.

Linked to the growth of outdoor education was concern about preparing teachers to extend their work to the outdoors. The first National Conference on Outdoor Teacher Education was held at Northern Illinois University's Lorado Taft Field Campus in September of 1960. The focus of the conference was to prepare teachers to carry suitable portions of the curriculum to the outdoors. Small group sessions were devoted to topics such as the values to be attained through outdoor education; building an outdoor education philosophy for college or university staff; the impact of outdoor

education on public schools, its curriculum, and its teachers; and the use of resource people in the program.

Materials such as handbooks and manuals were developed to guide teachers in planning for outdoor experiences, since the core curriculum was the focus for the programs of many schools. The efforts put forth by the organizations and pioneers in outdoor education paved the way for the tremendous expansion of organizations and networks that followed well into the 21st century.

The Period of Resurgence and Innovation (1965–1969) was a brief transitional phase during which program emphasis ranged from the development of outdoor recreational skills to ecological studies and from brief, local field experience to cross-country expeditions. The continuing impact of outdoor education on the school sector was reflected in the extensive literature that emerged during that time. An old theme in many outdoor education programs – human-kind's relationship to the environment – gained new impetus during this period, while the relationship between outdoor education and environmental education was also recognized. The exploration of new horizons and expansion of program offerings were the dominant characteristics of the period.

The Period of New Directions (1970–1985) saw the expansion of organizations and numerous sponsored conferences for leaders in outdoor education. The resurgence of interest in using the outdoors as a laboratory for learning and the creation of innovative applications of the concept of outdoor education during the previous period led to an expanding sphere of influence as new directions became established in educational practice. Environmental education became the thrust of many outdoor education programs in the new decade. Adventure education geared towards older youths and young adults emerged as an experience of self-discovery, with the claim that individuals who experience self-discovery, in the wild can transfer lessons of self-awareness, respect for others, and environmental concerns to other aspects of life. The significant trend during this period was the growing effort to network with the variety of agencies, organizations, and associations involved with education in, for, and about the natural environment.

The Period of Diversity and Networking (1986–present) continues to expand and nurture the diversification that characterized the previous period. The spectrum of outdoor education has broadened to include an array of new and innovative programs and approaches to learning, including cultural journalism, urban ecology, adventure education, challenge courses for youth-at-risk, and environmental education, as well as an extension of the school curriculum. The growing diversity and new trends in outdoor education are reflected in the numerous publications during this period. Such contemporary factors as heightened awareness of the environmental degradation of the Earth, social conditions of inner cities, and problems of youth-at-risk coupled with mediocre academic performance on international standardized tests have prompted educators to seriously consider the benefits of using the outdoors as a context for meaningful learning.

THE IMPACT OF ORGANIZATIONS AND NETWORKS ON PROFESSIONAL DEVELOPMENT

The 1990's saw a dramatic increase in the number of conferences devoted to the impact of experiential and adventure education programs on participants of all ages. Teacher education and professional development efforts were expanded through the many conferences offered by professional organizations that emerged during this period. Annual conferences were held by the American Alliance for Health, Physical Education, Recreation, and Dance; the American Camping Association; the Association for Experiential Education; the Association of Nature Center Administrators; the Council of Outdoor Educators of Ontario; the Coalition for Education in the Outdoors; the Wilderness Education Association, and many others. State organizations numbered in the thousands.

Several networks of agencies, organizations, institutions, centers, and businesses were established that joined forces to support the broad aims of educating in, for, and about the outdoors. Among these was the Coalition for Education in the Outdoors, which is housed at the State University of New York at Cortland and publishes a journal called Taproot. This journal features outdoor and environmental news and reviews, research information, a comprehensive list of resources, professional opportunities, and more. Information is available on the web-site maintained by the Coalition for Education in the Outdoors.

The Institute for Global Communications (IGC) has played a formative role in bringing advanced communications technologies to grass-roots organizations around the world that are working for environmental sustainability. EcoNet, billed as the computer network for the planet, is an example of the impact of telecommunications on the broad field of outdoor/environmental education. Its users are able to communicate with individuals and organizations throughout the world. EcoNet has established partnerships with similar networks in Australia, Brazil, Canada, England, Japan, Nicaragua, Russia, Sweden, and Zimbabwe.

RESEARCH SUPPORT FOR OUTDOOR EDUCATION: TEACHING AND LEARNING

Throughout the Period of Diversity and Networking, it was becoming increasingly difficult for scholars and practitioners to define the term "outdoor education" due to the variety of educational goals, teaching methods, and the diversity of learning environments listed under the heading of outdoor education. Researchers and educators created models to explain the relationships that exist between outdoor experiential learning methods. One such model, offered by Julian Smith, used the term "umbrella" as a metaphor and included terms such as camping education, outdoor education, earth education, environmental education, wilderness education, and experiential education. As the period expanded, additional terms were added to reflect new trends and approaches.

A number of research efforts relate directly to the use of outdoor environments for the purpose of extending teachers' work to enhance the school instructional programs and increase learning. Studies that were designed around student involvement in school camping programs and outdoor education experiences were reviewed.

As early as 1947, L. B. Sharp was involved in an experiment undertaken by the Board of Education of the City of New York. A small-scale design was developed around the involvement of fifth and seventh-grade students in a three-week resident outdoor education program. One of the major questions explored in the research project was: Is educational camping an effective medium for meeting the objectives of education? A wide variety of tests and other measurement techniques were used on a pre/post-test basis that provided objective, semi-objective, and clinical data. Statistically significant gains favored the experimental group in two areas: interest at the fifth-grade level and vocabulary at the seventh-grade level. The experimental group also displayed gains in written expression, increased visual impressions, and artistic ability. The implications from the data were that the experimental groups benefitted in ways that would not have been possible in *indoor* classroom programs.

Cragg (1953) attempted to determine how the development of sixth-grade campers compared to that of non-campers and also to appraise the educational achievements of the camp program in terms of addressing the educational objectives identified by the school. The four areas of development Cragg measured were intellectual development, physical health, social relationships, and emotional development. She concluded that some definite contributions had been made to the educational development of students, most notably in intellectual development. The camp group showed a greater improvement in nature study than students who remained in the classroom. Another notable finding was that the camping experience produced a strong emotional impact in the joy and enthusiasm expressed by the children.

Hollenbeck's (1958) doctoral dissertation studied the educational outcomes of a school camping program. Part of the study involved analyzing pre and post-camp interest inventories. She found that fifth-grade children made significant gains in science interests and fifth-grade boys showed gains in the eight areas of the inventory: art, music, social studies, active play, quiet play, manual arts, home arts, and science.

In 1982, the Orange County (California) Department of Education gathered data on the longitudinal impact of the resident school program on sixth-grade students six years after their participation during the 1975–1976 school year. Around one tenth (13%, i.e., 449 students) responded to a survey pertaining to 10 key areas of potential impact. Some of the key findings were:

- More than half of the students indicated that their interest in the natural sciences increased because of the outdoor school experience.
- Appreciation for the environment increased in 80 percent of the students.
- Approximately three quarters (77%) of the students indicated increased positive feelings about conservation and preservation of wilderness and national forest areas.

– Three categories of personal relationships were impacted in a positive way: closer peer-to-peer positive attitude, cabin leaders as positive role models, and to a minimal extent willingness to accept responsibilities at home as a result of sharing responsibilities at the outdoor school (Hammerman et al., 2001, pp. 204–205).

The State Education and Environment Roundtable (SEER) is a cooperative endeavor of education agencies from 12 states that works to improve student learning by integrating the environment into K–12 curricula and school reform efforts. The members of SEER were interested in the potential of environment-based education programs to improve student learning, change traditional pedagogical paradigms, and influence the way children learn to live successfully in the world around them. With this in mind, they designed a study to identify and describe innovative and successful programs, and analyzed the similarities and differences among them. Other goals were to identify factors that contributed to the success of the programs and the challenges they faced during implementation.

SEER used the term Environment as an Integrating Context (EIC) for learning to define a framework for interdisciplinary, collaborative, student-centered, hands-on, and engaged learning that they believed should form the foundation of environment-based education in America's schools. The EIC-based programs use the environment as a comprehensive focus for learning in the following areas: general and disciplinary knowledge, thinking and problem-solving skills, basic life skills, and understanding one's relationship with the environment – community and natural surroundings.

Evidence gathered from site visits, interviews, and surveys, as well as gains on standardized test scores and grade-point averages from over 60 schools, indicated that students learn more effectively within an environment-based context than within a traditional educational framework. The academic benefits of an EIC-based program included better performance on standardized measures of academic achievement in reading, writing, math, science, and social studies. In addition, benefits were observed in the form of reduced discipline and classroom management, increased engagement and enthusiasm for learning, and greater pride in and ownership of accomplishments. The study concluded that the EIC educational framework significantly improves student performance throughout the curriculum and enriches the overall school experience.

The American Institutes for Research conducted an evaluation to measure the impact of week-long residential outdoor education programs for at-risk sixth- grade students in California (*Effects of Outdoor Education Programs for Children in California*, 2005, pp. iii–vi). The study involved 255 students from four elementary schools who attended three outdoor education programs (outdoor science schools) during a three-month period. The study was designed to compare a treatment group with a control group in order to address the following research questions:

1. How does participation in outdoor education programs impact students' personal and social skills?
2. How does participation in outdoor education programs foster students' stewardship of the environment and appreciation of the importance of the wise use of natural resources?

3. How does the science instruction received through the outdoor program increase students' knowledge and understanding of science concepts?

Quantitative and qualitative data was collected from three rounds of surveys from students and two rounds from parents and teachers, site visits, and interviews. An overview of the study's findings is presented below:

1. *Social and personal skills*. Students and parents were surveyed in order to measure changes across five constructs: conflict resolution, self-esteem, cooperation, leadership, and relationship with a teacher. Teachers rated each student on eight constructs: self-esteem, cooperation, conflict resolution, leadership, relationship with peers, problem solving, motivation to learn, and behavior in class. Teacher ratings provided evidence of a wide range of positive outcomes in social and personal skills related to participation in the outdoor science school. Children who attended the program showed significantly larger gains than the control group in six of the eight constructs.
2. *Knowledge and understanding of science concepts*. Children who attended the outdoor school program significantly raised their science test scores by 27 percent, as measured by a pre-post survey conducted upon their return to school. The increase in science knowledge was maintained six to 10 weeks after participation with no significant loss in science scores.

A Review of Research on Outdoor Learning, commissioned by the National Foundation for Educational Research (NFER), was conducted in response to the growing concern that opportunities for outdoor learning for students in England had decreased substantially in recent years (Rickinson, Dillon, Teamey, Morris, Choi, Sanders, & Benefield, 2004, pp. 5–8). The review critically examined 150 research studies on outdoor learning published in England between 1993 and 2003. Three major types of outdoor learning were studied with primary and secondary students as well as undergraduate learners: field work and outdoor visits, outdoor adventure education, and school grounds/community projects. Research findings related to teachers' work and findings that influence practice are highlighted here:

1. *Impact of fieldwork and visits*. The study found substantial evidence to indicate that fieldwork that is well conceived, adequately planned, well taught, and effectively followed up provides opportunities for students to develop knowledge and skills in ways that enhance classroom experiences. The study also concluded that poor fieldwork is likely to lead to poor learning and that fieldwork can have a positive impact on long-term memory, due to the nature of the setting, and can lead to an improvement in social skills. In addition, the researchers reported that "there can be a reinforcement between the affective and the cognitive, with each influencing the other and providing a bridge to higher order learning" (Rickinson et al., 2004, p. 5).
2. *The impact of outdoor adventure activities*. Evidence suggests that the impact of outdoor adventure programs is greater on attitudes, beliefs and self-perceptions, and interpersonal and social skills than it is on cognitive and physical/behavioral benefits. However, when outdoor adventure programs focused on cognitive and

physical/behavioral measures, benefits were observed in the development of academic skills and improved engagement and achievement. Positive behavior was also promoted, as was improved self-image and fitness.

3. *The impact of school grounds and community projects*. Among the benefits related to the impact of school grounds and community projects were positive gains in science process skills and improved understanding of design and technology-related issues. With regard to the affective domain, the impact of learning in school grounds and community settings included greater confidence, renewed pride in community, stronger motivation to learn, and a greater sense of belonging and responsibility. The settings also had a positive impact on social development and relationships with peers, teachers, and the community.

With regard to thoughtful planning, the study suggests a number of factors that influence learning in outdoor settings and should be considered when thinking about how the quality and depth of outdoor learning might be improved. These factors include: program factors such as structure, duration, and pedagogy; participant factors such as characteristics, interests, and preferences of learners; and factors related to the nature and novelty of the setting.

IMPLICATIONS OF RESEARCH ON TEACHERS' WORK

Two of the many contributions of educational research are that, firstly, it raises new questions and, secondly, it identifies various approaches for teachers to consider as they work toward improving teaching and learning. Positive research findings support and justify curricular approaches that extend beyond traditional models to more student and community-centered models that result in more meaningful learning. The findings from past and recent research studies in outdoor education offer valuable insights into teaching and learning that can and should influence what teachers do and how they do it.

Among the implications for practice that the studies identified are the importance of high quality and meaningful instruction and formative assessment to guide effective learning in outdoor settings. Curriculum and goal-based planning, implementation of thoughtfully designed activities and experiences, follow-up reflection on and application of learning, and on-going assessments to monitor and guide the learning process are components of a model for high-quality teaching and learning that will be the focus of the next section.

DEFINING HIGH-QUALITY INSTRUCTION

High-quality instruction has been the focus of research and a topic of discussion. Four resources that offer overlapping and consistent descriptions of what is "high quality" provide useful information for operationally defining high-quality and meaningful instruction.

I. Carol Tomlinson (1999; 2004) offered indicators of high-quality instruction as they relate to academic diversity. She identified factors that assist teachers in providing

for diverse populations of students. Among the indicators of high-quality curriculum and instruction are the following:

- There is a focus on essential knowledge, understanding, and skills valued by professionals in the field.
- Curriculum and instruction are organized, unified, and sensible to the student.
- Student misconceptions are addressed.
- Instruction enables students to participate in respectful work.
- Students are able to use the learning in important ways.
- Instruction includes cognition and metacognition.
- Instruction and assessment are inseparable.
- Students generate knowledge.

II. In the study entitled *Looking Inside the Classroom: A Study of K–12 Mathematics and Science Education in the United States*, researchers observed more than 350 mathematics and science lessons and rated them on lesson design, lesson implementation, content addressed, and classroom culture (Weiss, Pasley, Smith, Banilower, & Heck, 2003). Assessment levels ranged from Level 1: Ineffective Instruction (passive learning and activity for activity's sake) to Level 5: Exemplary Instruction. Based on the observers' judgments, only 15 percent of the lessons were considered to be of high quality, while 27 percent were rated medium, and 59 percent were considered to be of low quality. Findings at the middle-school level were even more surprising. Only seven percent of science lessons were rated high, while 78 percent were rated low. Such findings send an important message about what teachers teach and, more importantly, how they teach.

Although the study viewed high-quality lessons in the context of mathematics and science, the indicators of effective lessons are relevant to all areas of the curriculum. These indicators are as follows:

- Engage students with worthwhile (mathematics/science) content.
- Create an environment that is conducive to learning.
- Ensure access for all students.
- Use questioning to monitor and promote understanding.
- Help students make sense of the (mathematics/science) content they are learning.

The research also reported that although teachers seem to know and be comfortable with the content of their lessons, their classrooms fell short of providing high-quality mathematics and science education for all students. Intellectual rigor, opportunities for creating meaning, and good use of questions for the development of concepts and skills are just a few of the important components that were found to be missing from classroom instruction.

According to the study, implications for professional development are as follows: Given that both content and methods are linked to student achievement, professional development programs must target goals to improve both the knowledge base of teachers and the skills of their discipline. Confidence and efficacy are needed in order to develop and maintain learning-centered environments.

III. James Stronge (2002) defined effective teaching as a product of good classroom management, organization, effective planning, and a teacher's personal characteristics. He pointed to the importance of the presentation of material and the student's ability to make authentic connections to it. He also identified the following behaviors of effective teachers:

- Use of student questions to guide lessons;
- Use of strategies to promote higher-order thinking;
- Use of a variety of activities and strategies to engage students;
- Monitoring of student engagement in all activities;
- Maintaining a student-centered classroom;
- Providing feedback;
- Designing assignments based on objectives; and
- Implementing elements of effective lessons.

The research-based indicators of effective teaching provide a framework for high-quality instruction that addresses the content standards for which teachers are held accountable and for the provision of a rich program of activities and experiences to maximize learning. Therefore, the indicators of high quality are powerful resources for the work that teachers do. They inform the design or modification of instructional materials – units of instruction and the activities and experiences that encompass it – that may be used to guide the teaching and learning process.

IV. Hammerman (2006a) used a review of national standards documents, literature, and research on effective teaching to identify eight indicators of high-quality teaching, in order to guide the development of curriculum and instructional processes. The review found that high-quality instructional programs:

- address clear and appropriate learning goals,
- build concepts and principles, develop skills, and practice dispositions valued by the scientific community,
- accommodate diversity through a meaningful context,
- include a variety of methods in a stimulating environment that engage and challenge students intellectually with attention to prior learning, misconceptions, and new learning,
- embed strategies that allow students to develop new or modified thinking frames (conceptual change) with links to their own lives, technology, and issues relevant to their community, state, nation, and world,
- develop thinking and problem-solving skills by using questioning, reflection, applications, graphic organizers, and other strategies that help students to make sense of what they are learning,
- incorporate a well-designed assessment system to monitor and guide the learning process and to provide frequent feedback to students about their learning, and
- utilize equipment, materials, and resources to enhance learning and provide a challenging learning environment.

MAKING INSTRUCTION MEANINGFUL

Every teacher is an instructional designer who makes hundreds of decisions related to classroom practices, activities, experiences, materials, and resources. Teachers have access to thousands of instructional activities and commercial products, as well as an endless supply of books, websites, and resources to support teaching and learning. Nevertheless, their efforts often fall short of expectations for high student achievement. The mere availability of instructional materials is not enough to ensure student success. The quality of the lessons that guide the teaching and learning process is a key factor in increasing student achievement.

In order for learning to be meaningful, it must incorporate new information into existing mental frames that comprise the learners' prior knowledge and experiences. Learning is meaningful when it builds on what is known and deepens learners' understanding of concepts by taking them to higher levels of cognition. Meaningful learning is often associated with engaged learning, in which students are actively involved in the instructional process and knowledge is processed and constructed through discussion, debate, mapping, and thinking.

Much has been written about how brain research can inform and guide more effective teaching and learning. Jensen (2000, p. 12) described the extraordinary potential of the human brain and its capacity for learning as follows:

> The brain simultaneously operates on many levels of consciousness, processing all at once a world of colors, movements, emotions, shapes smells, sounds, tastes, feelings and more. It assembles patterns, composes meaning, and sorts daily life experience from an extraordinary number of clues. It is so efficient at processing information that nothing in the living or man-made world comes close to matching human learning potential.

Jensen expressed the concern that teaching in a "linear, structured and predictable fashion" inhibits the brain's learning ability and bores and/or frustrates learners.

Within the 12 brain/mind learning principles presented by Caine and Caine (1997), there is a strong emphasis on the ways the brain seeks and creates meaning. Caine and Caine defined meaningful learning as that which includes both *deep* and *felt* meaning. They described deep meaning as "whatever drives us and governs our sense of purpose. It includes all the instincts embedded in our reptilian brain, from survival and territoriality to nesting and flocking. It includes needs for social relationships and an emotionally rich life. And it includes our [...] intellectual and spiritual needs" (ibid., p. 111). Felt meaning is defined as the "coming together of thoughts and ideas and senses and impressions and emotions, something like a chemical reaction" (ibid., p. 113). Therefore, understanding results from the integration of thought with emotion.

Table 2 shows a stark contrast between traditional approaches and student-centered instruction. Statements related to teacher behaviors, students as learners, and the nature of student work are not unlike those described in the literature on engaged learning or observed in classrooms. The indicators provide two lenses through which instruction can be viewed and assessed: Traditional and Student-Centered.

Table 2. A Comparison between Traditional Instruction and Student-Centered Instruction (Modified from Hammerman, 2006b)

Traditional Instruction Teacher Behaviors	Student-Centered Instruction Teacher Behaviors
– Expository method dominates; "teach is tell" mentality; test preparation is a major focus	– Uses a variety of methods and strategies to address goals and standards
– Directs all activities for students; uses a "cook book" – one-right-answer approach	– Allows students to ask questions and design activities; includes problem, project, and inquiry-based learning; mediates and monitors learning
– Tells students what they will learn; explains the concepts and relationships; assesses knowledge through weekly tests	– Facilitates student thinking; allows students to explain concepts; uses "wait time"; provides frequent feedback
– Uses same content every year	– Learns with students; revises content/approach
– Uses text for content and verification of concepts	– Uses a variety of resources; provides contexts for learning that are relevant and meaningful
– Instruction focused on "right" answers with minimal relevance or application to real world	– Instruction guides students to concept development and applications to lives, community, world
Student as a Learner	**Student as a Learner**
– Listens to lectures and/or takes notes from video or power point presentations	– Builds understanding through engaged learning and inquiry-based activities
– Memorizes terms and facts from text; answers questions at the end of chapters	– Processes information for meaning through analyzing data, reflective questioning, and using terms and facts to communicate understanding
– Follows teacher or worksheet directions with little or no opportunity to deviate	– Has opportunities to design activities or investigations and conduct research to answer questions
– Regards teacher as authority	– Shares responsibility for learning
Nature of Student Work – Prescribed	**Nature of Student Work – Varied**
– Emphasis on notes and worksheets or end of chapter questions	– Emphasis on research, investigations, data, and meaning; students have choices and opportunities to work collaboratively
– All students complete the same tasks and answer the same questions	– Tasks vary; investigations and experiences are "real world" with emphasis on data and/or research
– Teacher directs all tasks	– Teacher and students direct instruction and share responsibility for learning
– Shows little/no thinking or reasoning, problem solving, or explanations	– Shows evidence of thinking, reasoning, problem solving, and/or explanations
– Little/no use of visuals to show understanding or relationships	– Uses visuals and/or graphic organizers to show understanding and relationships between concepts

EXTENDING TEACHERS' WORK TOWARD MEANINGFUL INSTRUCTION IN THE OUTDOORS

Outdoors as a Climate for Learning

Researchers have identified the need to provide rich and relaxed environments for learning to occur. Outdoor environments provide a climate similar to what Caine and Caine (1997) called "relaxed alertness" (low threat and high challenge) where students can be free to investigate and explore and/or be inspired and create without the barriers to learning that are often found in the classroom.

Diamond and Hopson (1998) defined an enriched environment for learning as one that:

- is free of stress and pressure,
- provides positive emotional support,
- ensures a nutritious diet,
- provides social interaction, and
- presents opportunities for sensory stimulation through active participation in appropriately challenging activities.

Outdoor environments provide novel and stimulating settings for active participation and sensory stimulation, which are often missing in traditional classroom settings. Through outdoor education experiences, teachers encourage thinking and cognitive flexibility by exposing students to novel ideas, viewpoints, settings, activities, cultures, and diverse group members.

A Model for Student-Centered Instruction

High-quality instruction results through thoughtful planning. Consideration must be given to a variety of important components that comprise a well-developed "blueprint" for instruction. High-quality lessons:

- focus on important concepts and principles, skills, and dispositions,
- provide a context for learning that is interesting and meaningful for students,
- involve numerous investigations and firsthand experiences that follow a learning-cycle model, address misconceptions, and use a variety of tools and technologies to engage learners,
- provide opportunities for students to investigate and explore, collect and record data, develop skills, and/or create products, reflect on experiences, make sense of experiences, and frame knowledge,
- provide frequent interactions between students and teacher, develop critical and creative thinking, formulate thought, and develop a deep understanding of concepts,
- link learning to the lives of students, technology, careers, community, state, national, and world issues, and other subject areas, and
- use a variety of formative assessments for providing feedback and monitoring learning.

Applying the Model to Outdoor Environments

Outdoor environments provide teachers with opportunities to extend their work by applying a wide range of instructional methods and strategies. Such environments are especially suited to multi-sensory experiences and investigations that provide challenges and deepen students' understanding of natural phenomena. Students can assume any number of roles and responsibilities, regardless of whether they are investigating their school grounds or visiting informal science centers. Out-of-school experiences are exciting for students, especially if they have not previously had such opportunities.

Learning is the dynamic process of shaping and reshaping thoughts based on new knowledge and experiences. It is the creative, on-going synthesis of observations, reflections, and information about the physical and social worlds. The process of inquiry defines the context and processes that enable the knower to craft understanding. Inquiry is the careful, on-going questioning of our understanding of the world around us; it is a dynamic, creative endeavor filled with wonder and surprise.

The ability to apply inquiry as a method of teaching is one of the major advantages of teaching in the outdoors. The stimulating environments provide an abundance of living and non-living things with which to engage students in active learning. As a multifaceted method of instruction, inquiry provides opportunities for students to:

- make observations,
- pose questions,
- access and use relevant information,
- plan and carry out data-rich investigations,
- use tools and technologies to collect, analyze, and interpret data,
- propose predictions, answers, and explanations,
- communicate, and
- apply and develop critical thinking, logic, and reasoning skills.

IMPLICATIONS AND CONCLUSIONS

Inquiry and Problem Solving in an Outdoor Laboratory

Inquiry Approach

Inquiry embodies elements of other approaches to learning, such as discovery learning, the exploratory approach, and the leading-question technique. The one basic aim of the inquiry approach is to involve learners in and with experience to the extent that they are able to formulate their own questions and deepen their understanding of concepts and the relationships among concepts. The following is an example of an inquiry-based experience linked to standards and objectives that are common to a middle-school science curriculum.

As an introduction to a unit on energy transfer in living systems, students are able to assume the role of a naturalist and explore the school grounds or a nearby park to

discover a variety of habitats for local animals. The experience provides them with the following opportunities:

- Make careful observations and map the locations of habitats;
- Describe the habitats for birds, insects, squirrels, and other animals in detail;
- Look for evidence of food at or near the habitat (i.e., observe animals feeding, nut shells near a habitat, or stored food near a site) and infer the diet of local animals;
- Use data that they and other groups have collected to create food chains and food webs; and
- Apply their learning to the exploration of new environments.

Problem-Solving Approach

Students have an endless supply of questions about the natural environment. A problem solving approach can be used to motivate students to uncover and discover the processes, cycles, and patterns found in the natural world. When teachers encourage students to ask operational questions (i.e., questions that can be answered by investigating), they are setting the stage for active learning to occur. Problems may take the form of why or how something occurs, what will happen in certain circumstances, what effect does a human-created or natural disaster have on animals, plants, humans, the environment, and other forms. As students investigate problems, teachers are free to facilitate and monitor the learning process.

Investigating in Informal and Outdoor Environments

Table 3 provides a list of instructional activities for informal centers and outdoor settings. Although the list is by no means complete, it offers a vision for enhancing learning outside the classroom.

Extending Teachers' Work to Outdoor Settings

Through carefully planned and implemented instruction, teachers are able to assume the role of facilitators of learning. In this role, teachers are free to interact with students in small groups or to individually affirm or correct their work, listen to their ideas and explanations, and make sure they are not misinterpreting or misunderstanding concepts or processes. Interaction with students enables teachers to ask higher-level questions, share their thinking with students, and guide them toward successful learning. As a bonus, teachers and students can capitalize on the "teachable moment" as new, exciting, and unexpected opportunities arise.

Following investigations, teacher or student-led discussions may focus on student experience, data and/or products, and conclusions related to the inquiry questions and investigations. Students should not be left on their own to interpret data and experiences, as misconceptions may arise. By asking thoughtful questions, teachers

Table 3. Instructional Activities for Informal Centers and Outdoor Settings

Outdoor and Informal Learning Environments	Sample Engaged Learning Activities
Zoo, aquarium, aviary	– Investigate animal habitats – Discover food chains for animals – Observe exhibits and performances to determine characteristics of animals and their abilities to "perform"
Amusement parks	– Investigate forces and motion in roller coasters and other rides – Observe and investigate potential energy and kinetic energy, Newton's Laws of Motion, simple machines, speed and acceleration, gravity, and other concepts firsthand
Natural science museums and displays	– Observe specimens and models – Learn about artifacts that relate to science content – Interact with specimens, such as rocks and minerals, animal skulls, pelts, fossils, plants and others – Identify the characteristics of natural materials and artifacts
School-sites, parks, cemeteries, botanic gardens, weather stations, water treatment facilities, outdoor education centers, nature centers, recycling centers, and other informal science centers	– Follow self-guided trails that lead to native specimens and natural phenomena – Observe a variety of plants and animals to identify unique features of organisms; observe similarities and differences – Attend performances and video presentations and create graphic organizers to show concepts and relationships between concepts – Engage in firsthand observation and activities, such as hunting for fossils, observing or collecting rocks, investigating cemeteries, planting trees, collecting sap to make maple syrup, investigating a variety of natural phenomena in fields and forests, ponds, lakes, or rivers, mapmaking, orienteering, creative writing, drawing – Observe rock outcrops and geologic features of the landscape – Follow stream beds to learn about weathering, erosion, and deposition – Study the historical markers, epitaphs, and grave stones in a cemetery – Observe the use of technology for identifying weather patterns and conditions – Identify problems and issues that arise due to weather-related forces and factors – Investigate sources of fresh water and the ways water is treated for human consumption – Identify problems and issues related to the availability of fresh water
Technology centers	– Observe the role of technology for enhancing data collection and measurement and use in visual displays – Observe technological design – Study relationships between structure and function in technology – Use the tools of technology to solve problems and extend learning – Identify strengths and limitations to technology – Identify "trade-offs" in the use of technology for solving problems
Outdoor structures, such as bridges, tunnels, dams, skyscrapers, and domes	– Identify natural materials used in building structures – Study the technological designs and the forces of compression and tension in bridges and domes – Study the shape and construction of: tunnels for bearing weight, dams for controlling the flow of water, and skyscrapers for dealing with forces of weight, wind, earthquakes, and others

help students reflect on their experiences, make sense of their work, connect learning to prior knowledge to build deeper conceptual understanding, and create meaning through applications to their lives, technology, and/or society.

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