RUNNING HEAD: FIELD INVESTIGATIONS IN SCIENCE AND EE

Field Investigations in Science and Environmental Education Instruction: An Assessment of Educator Awareness, Attitudes, and Practices in a Large Urban School District

Abstract

A survey was administered to 277 science teachers in a large urban Texas school district to determine levels of awareness regarding an important aspect of science and environmental education: the field investigation. The state curriculum was amended in 1997 to require field investigations for all science classes. Teachers were asked to provide information about their awareness of the requirement, aspects of their participation in outdoor field investigations, and their opinions regarding benefits and motivating factors for participating in outdoor field investigations. Findings suggested that while science teachers have generally positive opinions of outdoor field studies, awareness of the requirement to provide them is low. Many science teachers are not providing opportunities for their students to experience science and environmental education instruction in natural settings.

The State of Texas (Texas Education Agency, 2006) made field investigations a required component of science instruction in 1997. The implementation of this expectation raises numerous questions regarding policy and practice for schools within the Lone Star State. The current level of awareness and practice among science teachers regarding this requirement has not been widely investigated. The impact on instruction and student learning has subsequently received little attention. Questions remain as to the effects of these changes on the practice of science instruction. What are educators' attitudes and beliefs about this expectation and field investigations in general? Has this change to the state science curriculum impacted teacher behavior? Have science teachers become more focused on providing their students with opportunities to experience field studies in connection with science and environmental education?

The U. S. House of Representatives Education and Labor Committee recently reviewed the No-Child-Left-Behind (NCLB) Legislation and considered revising and strengthening the Act in several areas. Environment education was included as an area of concern. A result of the original NCLB was significantly greater pressure and accountability placed on teachers and school district leaders for student performance and achievement. For many campus leaders and science teachers this has translated into "drill and kill" and has constrained many teachers to stay in the school and drill students on the knowledge and skills necessary to perform well on achievement tests. An unfortunate and unintended outcome has therefore been decreased teacher participation in field investigations at a time when our school children, particularly urban students, are in great need of these kinds of experiences in order to receive a complete education.

The questions addressed by this study should be of interest to science educators, curriculum coordinators, and campus administrators desiring to enhance student learning and achievement. A survey was administered to 277 science teachers in grades 5-12 in a large urban school district to explore practices and perceptions with regard to field investigations. The comprehensive examination of this topic was a mixed-method study with quantitative and qualitative components, including teacher interviews and data from campus administrators. Only portions of the quantitative findings in connection with district science teachers in grades 5-12 are reported here.

The field investigation or field study can be described as a teacher-directed event in which class time, commonly in connection with science instruction, is spent in the out-of-doors. According to Sharp (1947), "That which can be best learned inside the classroom should be learned there; and that which can best be learned through direct experience outside the classroom, in contact with native materials and life situations, should there be learned" p. 47. Outdoor field trips are taken by countless school children in connection with science instruction every year, yet they remain somewhat of a mystery within the field of education (Kaspar, 1998).

Many researchers have identified the outdoor field trip, when properly structured and employed, as an effective instructional method (Falk, 1983; Falk & Dierking, 1997; Orion, 1993; Orion & Hofstein, 1994;). Falk and Dierking (1997) found that field trips promote long-term recall. Their study revealed that 80% of children and adults could recall three or more specific concepts linked with a field trip. Studies indicate that well-designed, field-based instructional strategies promote cognitive learning and other outcomes worthy of greater attention (Lisowski & Disinger, 1987; Orion, 1993; Orion &

Hofstein, 1994). Although field trips, including trips to outdoor areas, are widely regarded as experiences that enhance learning (Griffin & Symington, 1997; Morrell, 2003; Prather, 1989; Ramey-Gassert, Walberg, & Walberg, 1994; Rennie & McClafferty, 1995), many teachers and administrators do not support or participate in nature study, field investigations, or other outdoor science and environmental education activities (Disinger, 1984; Kaspar, 1998).

In much of the research literature, outdoor field trips have been considered to be extracurricular activities (Falk, Martin, & Balling, 1978). However, many educators, including State science supervisors and science curriculum specialists believe that outdoor field investigations are not extracurricular but co-curricular. Education in and about the environment is intrinsically relevant to science content and to many contemporary issues in science education. As a result, in 1996, based on a growing body of research on best practices and the most relevant ways to teach science, the Texas Administrative Code (TAC, 1998) was revised to include new language for science instruction that requires students at all grades levels and in every high school subject to be involved in field investigations and do field work (Texas Education Agency, 2006). Prior to this time, field investigations were recommended as a best practice and an effective teaching method for science, but were not required. Field investigations are now emphasized throughout the *Texas Essential Knowledge and Skills* for science and in recent science reform standards including the *National Science Education Standards* (1996) and *Benchmarks for Science Literacy* (1993).

Though the field investigation is recommended as a best practice in many science reform documents, not all science educators employ field investigations as a tool in their

instructional repertoire (Disinger, 1984; Kaspar, 1998). Contemporary science reform documents emphasize that teachers should be free to travel away from the school building or the school grounds to investigate natural settings in order to experience phenomena or environments not available in the traditional school setting. However, the outdoor learning environment is the one teaching setting that is most often neglected (Disinger, 1984; Kaspar, 1998; Orion & Hofstein, 1994). Though it was accompanied by little fanfare, the added requirement of the field investigation was an important change to the official state science curriculum. According to the revised standards for science instruction, science and environmental, fieldwork was recognized as co-curricular, not just extracurricular (Kaspar, 1998).

Subsequent to this revision of the State approved science curriculum, the Texas Education Agency (2002) produced a document entitled *Guidelines for Instructional Field Experiences* that included the following purpose:

> The purpose of these guidelines is to address the need for field investigations and for curriculum-based field trips for the students of Texas. In order to prepare citizens who understand natural and cultural phenomena, students must gain first-hand knowledge of the world. (p. 1)

This same document goes on to provide the following rationale for adding the requirement for science teachers to provide field investigations in science classes:

> Science learning experiences occur in the classroom, in the laboratory, and in the field. In these experiences, students discover facts, concepts, and laws of science for themselves, much as scientists do in their professional lives. Experiences that extend from the classroom into the field allow

> students to explore, observe, and investigate things in the natural world that cannot be brought into the classroom-learning environment. (p. 1)

An educated citizenry capable of understanding environmental problems and taking appropriate action will also be critical. Yet, in our increasingly urbanized society, public school students' opportunities for experiencing and developing an understanding of the natural world and how that world functions are diminishing (Bowers, 1995; Louv, 2005; Orr, 1992; Sobel, 1996).

Several decades of research from the 1970s to the present has demonstrated the significant educational benefits of outdoor formal and non-formal environmental education experiences, including field experiences, on student learning and achievement. A number of researchers have shown that the involvement of students in environmental field investigations produces gains in achievement along with increased motivation and interest in science and science careers (Disinger, 1987; Falk & Balling, 1979; Kisiel, 2005; Orion, 1993; Orion & Hofstein, 1994; Stronck, 1983). Studies have shown that school fieldtrips can have lasting impacts on students, providing them with strong memories in both cognitive and affective contexts (Disinger, 1984, 1987; Gottfried, 1980; Falk, 1983; Falk & Dierking, 2000; Kisiel, 2005; Morrell, 2003; Prather, 1989; Stronck, 1983). Important research has also been conducted regarding the use of the environment as an integrating context for increasing achievement in multiple subject areas in schools (Lieberman & Hoody, 1998).

Even this cursory review of the literature regarding the use of outdoor field studies raises significant questions for educators that remain unanswered or only partially answered. What kinds of experiences are most valuable for students to participate in

when time, money, and other factors constrain teachers to make difficult choices about how to best implement science and environmental education objectives? What factors are involved in teachers' decisions to participate in outdoor field trips? What are teacher and administrator perceptions about the effectiveness and practicality of the field investigation in the present instructional and political contexts? What knowledge, skills, and experiences are really important for students to have in a complex and fast changing world? What experiences are most valuable in producing a responsible citizenry capable of making informed choices about the world they live in? What barriers or perceived barriers may be preventing more widespread use of the environmental field trip, particularly among urban, "inner city" schools? These questions have significance for both policy and practice with regard to science and environmental education in public schools.

These questions provide the framework for a discussion about the "systems" (real) world and the "values" world as these relate to science and environmental education and the field investigation. State and local curriculum requirements and growing pressure to increase student achievement are the realities in the "systems world" that teachers and school administrators must deal with on a daily basis. How are pressures such as testing, accountability, performance measures, crowded curricula, and assessments of yearly progress measured and balanced against the "values" world or, what many might consider to be the "right" things to do in providing our children with a complete education? Do creative and effective ways exist to achieve both without sacrificing one or the other? Do educators have an obligation to impart to our youth an understanding of concepts such as sustainability, community, biodiversity, and global

responsibility through relevant, real-world experiences? What implications do these questions have for policy and practice in our schools?

Students and teachers participating in field trips consume substantial amounts of time and money. In an era of very limited financial resources for K-12 public education, one could take a purely economic perspective and ask, "Is all of the time and money spent on field trips really worthwhile? Are teachers and students getting real educational value for the money?" Though students participating in outdoor field trips may spend significant amounts of time outside of the regular classroom environment, the answer to both questions would appear to be a resounding "yes." If field trips, particularly outdoor field investigations in natural settings, are to continue as a viable and relevant way of teaching science and environmental concepts, more research should be done to explore and understand the influences and factors that act upon teachers and administrators.

Context of the Study

Considerable discussion among many prominent science and environmental education leaders, teachers, and support organizations exists with regard to the need to involve students in some level of direct contact with nature during science and environmental education instruction. Are science teachers getting their students outdoors to teach science and environmental concepts? Science teachers and campuses within the school district that was the subject of this study had widely varying participation levels in the district's environmental learning center program. Some science teachers use the district's environmental learning center and are obviously aware that, in the state of Texas, field investigations are required in science instruction. They therefore seek to provide opportunities for field investigations for their students through the district's

environmental learning center program and in other ways. Many other science teachers appear: a) to be unaware of the requirement to provide students with field investigations, b) to know about the requirement but are choosing to ignore it, or c) to be implementing the requirement, but are not using the district's environmental learning center program to do so. These issues became obvious from an examination of district environmental learning center participation databases over the last four years. The subject district typically has more than 160,000 students enrolled and almost 400 science teachers of record. Only 20% of the potential pool of science teachers made visits to the district environmental learning center during the 2005-06 school year. Percentages for the school years 2002-2004 are similar.

Why certain schools/teachers participate in the program regularly, while others participate infrequently, or not at all, was not fully understood. Additionally, little was known about teacher beliefs and perceptions of the program among the non-user group. Further examination was called for to determine if those science teachers who are not participating in the district environmental learning center program are or are not providing their students with some other venue in which to experience outdoor field investigations in order to meet professional obligations to implement the *Texas Essential Knowledge and Skills* for Science according to the current, amended guidelines. General consensus exists among educators, parents, and state-level school administrators concerning the need to involve all students in science field investigations and environmental education experiences (TAC, 1998). Particularly among urban students, importance of these kinds of experiences should not be underestimated. Factors underlying educator participation in these types of activities must be examined to

facilitate increased teacher and student participation and to inform policy and practice in this area of science and environmental education.

Purpose of the Study

The purpose of this study was to address the following research questions:

1. What is the level of awareness among 5-12 grade science teachers concerning the mandated changes to the Texas Essential Knowledge and Skills, Chapter 112: Science, requiring field investigations?
2. What are the current levels of participation in outdoor field investigations among district science teachers?
3. Do science teachers believe that field investigation trips to the district's environmental learning center should be required or optional?
4. For those science teachers who do participate in field investigations at the district's environmental learning center, what are the primary reasons for doing so?

Method

Science teachers in grades 5-12 were surveyed to obtain basic categorical and demographic information such as gender, age, and years of science teaching experience. Information regarding teacher utilization of outdoor field investigations was also obtained. Respondents were asked to prioritize their top three reasons for using the district's environmental learning center for outdoor field investigations and to provide brief information about their own personal history of outdoor field trip participation. Finally, the survey asked two open-ended questions designed to gather information about: a) whether or not district teachers and principals were aware of the changes to the TEA

curriculum for science requiring that students be provided with opportunities to do field investigations, and b) whether or not they thought that field investigations to the district's environmental learning center should be a required part of the curriculum.

The survey was sent to 277 elementary and secondary science teachers. High school science instructors teaching Anatomy & Physiology, Astronomy, Physics, and other courses for which no curricular reason existed to visit the district's environmental learning center for outdoor field trips, were not included in the survey. The included science teachers were all district teachers of record with participation data from the environmental learning center's databases for the school years 2002 through 2006.

Preliminary examination of the data indicated that 40 science teachers from the original mail out of 277 would not be able to participate in the survey. Some had left the district, several retired, several were on administrative or medical leaves of absence, and some had become campus administrators or had moved into central office positions. The final number of teacher surveys that could have potentially been returned was therefore reduced to 237. Of these 237 surveys, 128 were returned for a return rate of 54% among the science teachers.

The surveys for this study were pilot tested in August and September of 2006 with 25 district science teachers. The teachers represented a cross section of ages, years of experience, and grade levels within the district. None of the teachers involved in the pilot testing were participants in the final survey.

Findings

What are the characteristics of the science teachers participating or not participating in the district's environmental learning center program? Do identifiable frequencies or patterns exist among science teachers who use or do not use the program? The survey instruments examined the sample populations with regard to their participation and some specific characteristics of teacher users and non-users. Users were defined as those teachers who had taken students to the district's environmental learning center at least once in the last four years. Non-users were science teachers who, according to environmental learning center databases, had never taken an outdoor field trip to the center. Information from the surveys provided detailed data about district science teachers including age, gender, grade level taught, years of experience in science teaching and information about prior and current use of field trips with their classes.

General descriptive analysis of the environmental learning center program databases and the survey data revealed that of the 128 teachers who returned a survey, 65 (50.8%) had not used the environmental education center program (non-users) and 63 (49.2%) had visited the district environmental learning center at least once in the previous four years (users). The mean age of all science teachers surveyed was 45 years. The final teacher sample contained 103, or 80.5% females, and 25, or 19.5% males. Elementary teachers comprised 42.9% (55) of all returned surveys, followed by middle school teachers at 33.5% (43), and high school teachers at 23.4% (30). The sample mean number of years of experience in science teaching was 14.75. Table 1 summarizes additional general characteristics of the science teachers surveyed broken down by user and non-user categories.

Table 1

Science Teacher General Survey Data

	District Environmental Learning Center			
	Users (n = 63)		Non-users (n = 65)	
	Number	Percent	Number	Percent
	Gender			
Male	13	20.6	12	18.4
Female	50	79.4	53	81.6
	Age Groups			
20-30	8	12.6	10	15.3
31-40	13	20.6	12	18.4
41-50	22	34.9	19	29.2
51 and over	20	31.7	24	36.9
	Ethnicity			
Hispanic	3	4.8	3	4.6
African-American	33	52.4	23	35.4
White	25	39.7	37	56.9
Native American	1	1.6	2	3.1
Multi-ethnic	1	1.6	0	0
	Years taught science			
4-9	17	27.4	28	43.6
10-19	27	43.5	17	27.0
20-29	14	22.6	15	23.2
30-39	4	6.5	3	4.7
40 or more	0	0	1	1.5

Science Teacher Field Trip Experiences

Teachers were asked to provide information about their personal history of field trip experiences, whether or not they had taken an outdoor field trip with their students, and how many outdoor field experiences they normally participate in per year with their classes. The results of these questions are presented in Table 2.

Table 2

Science Teacher Field Trip Experiences

	District Environmental Learning Center	
	Users (n = 63)	Non-users (n = 65)
Average number of personal field trips taken:		
Elementary	7.19	5.02
High School	4.03	3.02
College	1.81	1.03
Taken outdoor field trips with students: (1)		
Yes	63	36 (55%)
No	0	29 (45%)

	Number	Percent	Number	Percent
Average number of outdoor field trips taken per year: (2)				
none	0	0%	15	23.1%
1 or 2	23	36.5%	33	50.8%
3 or 4	19	30.2%	8	12.3%
4 to 10	17	27.0%	6	9.2%
11 or more	4	6.3%	3	4.6%

(1) Pearson Chi-Square = 14.02, p = .000, Cramer's V = .331.
(2) Pearson Chi-Square = 26.64, p = .000, Cramer's V = .456.

In general, science teachers who utilized the district environmental learning center for field investigations were more likely to have taken more field trips when they were in school. This was true for this particular sample of teachers for elementary school, high school, and college level field trips. The numbers reported for personal field trip experiences were not statistically significant.

Environmental learning center users were also more likely to have taken outdoor field trips with their students. All of the users reported taking outdoor field trips with students whereas among the non-users, 45% reported that they had not taken outdoor field trips. The difference was significant between users and non-users; Pearson Chi-square = 14.02, p = .000, Cramer's V = .331. Fifty-five percent (55%) of the non-users reported that although they had not visited the district's environmental learning center, they had taken outdoor field trips with their students. These trips may have been into the schoolyard, or to other sites such as zoos, gardens, or other informal science centers.

Users of the district environmental learning center also took more outdoor field trips during the course of a school year than the non-users. Almost 60% of the environmental learning center users reported taking between three and ten outdoor field trips per year. In contrast, the non-users were more likely to take none, or only one or two, outdoor excursions during a school year. More than 70% from the non-user group reported none or only one or two outdoor field trips per year. The difference between users and non-users with respect to the number of outdoor field trips taken per school year was significant, Pearson Chi-Square = 26.64, p = .000, Cramer's V = .456.

Results of Open-ended Questions

Teachers were asked to respond to two open-ended questions at the end of the survey designed to gather information about two factors: a) whether or not they were aware that the K-12 Texas Essential Knowledge and Skills for Science (Chapter 112) requires that teachers provide students in all grade levels and all high school courses with opportunities for students to be involved in field investigations, and b) whether or not they believed that visits to the district's environmental learning center should be a required part of the science curriculum or strictly extracurricular. The results for these questions, broken down by "users" and "non-users," are presented in Table 3. Worthy of particular attention is the fact that, overall, whether they were users or non-users of the environmental center program, 47% of all teachers surveyed were not aware that the Texas Essential Knowledge and Skills requires the utilization of field investigations.

As was expected, the level of awareness about the requirement to provide students with field investigations was notably higher among environmental learning center users (83%), although some environmental center users (17%) were not aware of the requirement. Among non-users, 24% reported knowledge of the requirement and 76% responded that they were unaware that field investigations were required as a part of the science curriculum. The difference between the non-users and the users with respect to this question was statistically significant, Pearson's Chi-Square = 43.696, $p = .000$, Cramer's V = .596.

The second question concerned the teachers' opinions about whether or not they believe that visits to the district's environmental learning center should be required or extracurricular. The results for this question are also provided in Table 3. Overall, 63%

of the science teachers believed that visits to the center should be a required part of the curriculum in science while 37% stated that they thought this experience should remain an extracurricular choice left up to the individual teacher. Again, among users, those who thought visits should be required was higher at 89%, whereas among non-users, only 39% thought field trips to the district outdoor learning center should be required. The difference between the users and the non-users in response to this question was also statistically significant; Pearson's Chi-Square = 31.358, p = .000, Cramer's V = .522.

Table 3

Science Teacher Responses to Open-ended Questions

		District Environmental Learning Center			
		Users (n = 63)		Non-users (n = 65)	
		Number	Percent	Number	Percent
Awareness of requirement to provide field investigations? (1) (n = 123)*	Yes	50	83%	15	24%
	No	10	17%	48	76%
Should visits to environmental learning center be required? (2) (n = 115) †	Yes	50	89%	23	39%
	No	6	11%	36	61%

*5 teachers did not respond to this question. †13 teachers did not respond to this question.

(1) Pearson's Chi-Square = 43.696, p = .000, Cramer's V = .596
(2) Pearson's Chi-Square = 31.358, p = .000, Cramer's V = .522.

Science Teacher Motivations for Field Investigations at the District's Environmental Learning Center

The third item on the teacher survey was designed to provide science teachers with an opportunity to rank their top three selections from among nine choices regarding advantages in visiting the district's environmental learning center for an outdoor field trip. This ranking question was designed to explore science teacher motivators for outdoor field investigations. The choice most popular among all science teachers, whether they had used the environmental learning center or not, was choice number three on the survey instrument; "The field investigation enhances the science unit the students are working on." This was the first choice for 41.3% of the science teacher users and 26.2% of the non-users. The response of users and non-users diverged in regard to the second most popular response to the ranking question. Users showed a preference for item three, "Environmental learning center programs help students to perform better the science TAKS," (Texas Assessment of Knowledge and Skills). Teacher users selected this response 25.4% of the time; however, non-users did not rank this item in their top three choices. Instead, the non-users chose item one, "The field trip addresses the Texas Essential Knowledge and Skills, (TEKS).

Environmental center users and non-users were also in agreement with their third most popular choice. This item had to do with the setting for instruction. The item stated, "The field trip addresses educational objectives that cannot be met in the normal classroom setting." Environmental center users selected this 22.2% of the time, and non-users chose this response 21.5% of the time. This might suggest that non-users may be taking their students outside to conduct field investigations but they are not using the

district's environmental learning center to do so. Alternatively, the premise may be suggested that non-users also believe that taking students outside may help the students to grasp certain concepts of science and ecology even though, as was shown by the questions about field trip experiences, 45% of the non-users are not taking students outdoors for field experiences. Table 4 presents the data about the user responses to the ranking question, and Table 5 presents similar information for the non-users.

Interesting to note is the fact that science teachers who use the district's environmental learning center for outdoor field investigations with their students chose ranking item number eight second overall among the nine choices with 25.4% of the teachers selecting this item. Teachers who use the environmental center program appear to believe that these types of experiences help their students to perform better on the state science achievement tests. Surprisingly, among non-users, this item was not a popular response and did not rank in their top three choices overall. Though they had not used the environmental learning center for outdoor field trips, non-users did, however, still appear to see the value in field investigations and were mostly likely to select items regarding the field trip's connection with the state curriculum (TEKS), the fact that the field trip enhances the science unit the students are studying, and that the field trip provides an opportunity for students to learn and gain experiences that cannot be met in a normal classroom setting.

Table 4

Top Three Science Teacher Responses to Ranking Question: Users

	District Environmental Learning Center Users (n = 63)	
	Number	Percent
Choice Number 3 The field investigation enhances the science unit the students are working on.	26	41.3%
Choice Number 8 Environmental learning center programs help students to perform better on the science TAKS.	16	25.4%
Choice Number 5 The field trip addresses educational objectives that cannot be met in the normal classroom setting.	14	22.2%

Note: Columns do not add up to total sample sizes or 100% because only the top three responses are shown.

Table 5

Top Three Science Teacher Responses to Ranking Question: Non-users

	District Environmental Learning Center Non-users (n = 65)	
	Number	Percent
Choice Number 3 The field investigation enhances the science unit the students are working on.	17	26.2%
Choice Number 1 The field experience addresses the Texas Essential Knowledge and Skills. (TEKS) Note: Among users, choice #1 was not among the top three items. This item was selected only 3 times or by 4.8% of users.	15	23.1%
Choice Number 5 The field trip addresses educational objectives that cannot be met in the normal classroom setting.	14	21.5%

Note: Columns do not add up to total sample sizes or 100% because only the top three responses are shown.

Conclusions and Recommendations

The decision to make field investigations a requirement in the state science curriculum was based upon a growing body of studies from many researchers, authors, and leading science and environmental education organizations. Multiple studies indicate that many science and environmental concepts are most effectively addressed by teaching them in the field; in natural settings where students can actually experience habitats and ecosystems and be exposed to the study of science and environmental concepts in practical and relevant ways. This decision is an important consideration for urban children, particularly those in large urban school districts such as the district that was the subject of this study. Despite many documented benefits, many science teachers are not employing the field investigation as a science teaching method of instruction, nor are they providing their students with opportunities to learn about the natural systems in their own communities that surround and sustain them. These concerns have been related to the overall educational goals of scientific and environmental literacy. They are related to themes in contemporary education such as sustainability, sense of community or "sense of place," and the nurturing of scientifically and environmentally literate competitive thinkers and problem-solvers able to contribute knowledge and understanding in a global economy and an interdependent world.

Given the importance of these kinds of experiences for urban students, and the general consensus among educators, parents, and state-level school administrators concerning the need to involve all students in field investigations and environmental education programs, the various factors that may be involved in order to increase teacher

participation in programs of this type and to inform policy and practice in this area of science and environmental education must be clearly understood.

The data from this study may serve to document several conclusions. First, many science teachers believe in and value the field investigation as an important instructional tool for science learning and are providing opportunities for their students to be involved in them. Second, a significant number of science teachers are not aware that field investigations are required in connection with science instruction. Therefore, many students are not being given opportunities to participate in these types of experiences. A rhetoric-reality gap exists between what is required and actual science teacher awareness and science teaching practice. In addition, even though many science teachers in the district had not used the district's environmental learning center and a significant portion of them (45%) stated that they had not taken outdoor field trips with their classes, they still seemed to believe that these experiences were important, connected to science instruction, and that they helped students learn science concepts and perform better on standardized state tests of science achievement. Third, with the existing rhetoric-reality gap between what is in the curriculum and what science teachers are doing, a number of additional questions that should be explored. Unfortunately a number of students are not being given the chance to connect with nature and learn science and environmental concepts in a real-life setting even with the documented positive impacts on science learning that utilization of these experiences has shown.

The data from this study are not conclusive but suggest the possibility that personal histories of field trip experiences may have some bearing on whether or not science teachers decide to participate in outdoor field trips with students. Teachers who

used the environmental learning center had higher average numbers of personal field trip experiences in their past.

Perhaps the most significant finding from this study was the relatively low level of awareness among many science teachers concerning the requirement in the state science curriculum for students to be provided with opportunities to conduct field investigations in connection with their science classes. This is alarming since the state level requirement for field investigations has been in effect for ten years. Science curriculum directors, campus leaders, and science education professionals should work to implement more widespread awareness of the state curriculum requirement for field investigations. These types of experiences should be encouraged and, if they have not already been added, they should be added to local curriculum documents and guides along with suggested teaching resources, training possibilities, and potential or existing sites where these types of activities can be conducted. In light of the importance and educational validity for students to get away from the school and into natural settings for well-structured instruction about local ecology and environmental concepts, a simple trip outside to the school grounds can sometimes bring significant benefits for no cost at all. Some schools in very crowded city environments may not have immediate surroundings conducive to an outdoor experience. Other options should be made available and encouraged for students on these campuses.

Science curriculum leaders and campus administrators must encourage and support science teachers in making better use of outdoor settings to teach science and environmental concepts. Support can come in several ways including, but not limited to: encouraging field excursions to natural sites, providing assistance in making

arrangements for trips, and providing adequate resources for transportation costs. If funds are extremely limited or not available for trips to more distant sites, constructing habitats or garden areas on the school grounds is another option. Campus administrators and science curriculum specialists should encourage teachers both within and among departments or grade levels to plan together so that field investigations are given appropriate priority when the subject of field trips is discussed or planned. Outdoor field experiences are not required in other subjects, but are required in science. Allocation of campus level resources for field trips should therefore be distributed with this requirement in mind.

Science curriculum leaders and principals can also support more widespread use and implementation of field experiences for students by encouraging teacher participation in training programs at informal science or nature centers, and by encouraging teacher participation in award winning, proven science and environmental education programs such as Project WILD, Project Learning Tree, Aquatic WILD, the Leopold Education Project and other supplemental curricula.

Although science teachers had somewhat different reasons for participating in the district's environmental learning center program, they did generally agree that the experience was conducive to students' learning of science concepts, that these kinds of activities address the state curriculum effectively, and that these kinds of experiences are "place" or setting appropriate. That is, many science teachers placed a high importance on natural settings and the importance of real-world, hands-on experiences in the field. When science lessons are more appropriate for an outdoor setting, that's where they can or should be taught. Many science teachers believed that outdoor science field

investigations might also help to improve student performance on state science achievement tests.

School district personnel, including science supervisors, campus principals, teachers, and science departmental or grade level chairpersons should attempt to direct existing resources toward enhancing teacher participation in these types of activities. Many outdoor field trips can be very inexpensive or involve no costs at all, such as a simple excursion into the schoolyard.

Further Research

This study raises a number of questions that need further exploration. Is the level of awareness about the requirement to provide field investigations in science classes similar in other districts, large or small, in Texas or in other states? What do science teachers believe about the efficacy of implementing field investigations? What are their perceptions about the barriers or perceived barriers to making more widespread use of the outdoor field investigation in science instruction? Many of the questions examined in this study should be directed to a larger sample of teachers. The connection between student performance on science achievement tests and their levels of involvement in field studies might also be an important area for further exploration.

More research should be done regarding specific factors that may inhibit or encourage teachers to provide students with opportunities for field investigations. Inhibitors might include a lack of funds for transportation, excessive approval procedures, lack of teacher confidence about teaching in outdoor areas, and a lack of support from campus administrators. Time constraints and scheduling conflicts may also be factors involved. Increasingly urbanized populations of both students and teachers

may have specific fears about being outdoors in natural settings such as deep woods, grasslands, wetlands, or other natural areas.

Another area that should be explored is the response of principals to a similar survey in order to obtain data and information about campus administrators' perspectives on this issue. This study was limited to only one school district and to teacher participation in only one program within the district. Teacher participation patterns in outdoor field investigations might be better understood by examining larger populations of teachers and campus leaders in order to gather more information about attitudes, perceptions, and barriers or perceived barriers regarding the implementation of field investigations with students.

Definitions

TEKS: The Texas Essential Knowledge and Skills. The official curriculum for the State of Texas. Texas Administrative Code (TAC), *Texas Essential Knowledge and Skills for Science,* Title 19, Part II §112.

TAKS: The Texas Assessment of Knowledge and Skills. This is the official achievement test for all students in public schools in the state.

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