Environmental education in Oaxaca Mexico: Attitudes and schoolyard-based environmental inquiries

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ENVIRONMENTAL EDUCATION IN OAXACA, MEXICO: ATTITUDES AND SCHOOLYARD-BASED ENVIRONMENTAL INQUIRIES

by

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B.S. University of Michigan, 1992

presented in partial fulfillment of the requirements

for the degree of

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This was a two-part study conducted in six schools on the coast of Oaxaca, Mexico. The objectives of the study were to ascertain the attitudes of children in rural and town schools towards the natural world, to gain an understanding of how teachers felt about taking their students outside of the classroom to conduct ecological investigations, and to implement an inquiry-based, schoolyard ecology unit. Questionnaire data and interviews pertaining to children’s attitudes towards the natural world suggest that children have a strong appreciation of nature and are interested in learning more about it. Teacher’s attitudes were positive toward teaching about the natural world, and they were interested in using inquiry-based investigations to teach about the local environment. However, they reported needing more scientific content and they felt insecure about not having sufficient scientific and environmental knowledge. A four-day inquiry-based unit focused on the schoolyard was implemented in two rural schools. The goal of the unit was to pilot an inquiry-based investigation that took advantage of local ecological resources. For children, the goals were to gain an appreciation of the diversity of habitat types in the schoolyard, and to learn through observing and recording information that habitats for organisms exist on large and small scales. Children participated in a four-day series of investigations that took advantage of local resources in their environment. Investigations included mapping the schoolyard on macro and micro scales, and observing birds in the habitats that they had mapped. Interviews with teachers suggest that they felt the unit was something they would like to do again. Children’s post-investigation attitudes show positive changes towards the natural world. They reported liking nature and enjoying the explorations. This approach to schoolyard-based investigations can serve as a model for future projects. It appears that it could be easily adapted to other classes in Mexico, as well as to other countries.
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# Summary

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## Chapter three: Executive Summary

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Overview

Maintaining global biodiversity has emerged as a paramount international conservation issue (Ham and Castillo, 1990, and references within). Developing countries, especially those located in or near the tropics, contain much of the world's biodiversity (Stapp, 1976). Here, an estimated 50% of the world's plant and animal species reside (Tangley, 1988). Many approaches to altering land-use patterns exist, and there is debate over which methods yield the best conservation results and offer long lasting solutions. Environmental education has been recommended by many education researchers, instructors, and administrators as a labor-intensive, but cost effective means of effecting attitudinal change (Jacobson, 1991). Environmental education programs has been shown to increase ecological awareness, further favorable attitudes toward the environment, and promote natural resource conservation (Jacobson, 1990, and references within).

The attitudes of children are a major focus of many environmental education programs. The development of environmentally sensitive attitudes in youth is important to their behavior later in life (Eagles and Demare, 1999). Adequate understanding of students' attitudes at the beginning of an environmental education program’s planning process may provide the key information for the ultimate success of any environmental
education program (Roth and Perez, 1989). Baseline information that assesses students' knowledge and attitudes may provide answers to the basic questions posed at the beginning of an environmental education planning process (Roth and Perez, 1989). In addition, baseline data can be used to measure change in attitudes by applying similar, or comparable, instruments to the same target population over time and at different stages of program development (Roth and Perez, 1989).

If environmental education programs are to be developed in schools, teachers must be involved in the planning process to ensure that the program is suitable for their needs. For example, many teachers in Mexico feel that they do not have the expertise to teach science or environmental education (Moreno, 1999). In Mexico, formal environmental education programs are written as lessons in primary education books that emphasize pollution prevention and environmental care (Moreno, 1999). Teachers often feel that they lack the skills to go beyond the content of these books to teach about the environment in a way that is meaningful and engaging to their students.

Science curricula that use student-centered inquiry methods have been shown to be highly effective in improving content learning, science process, creativity, logic, language skills and attitudes towards science and science learning (Snetsinger et al. 1999; Caton et al. in press). Yet, many teachers feel uncomfortable with an inquiry-based approach to teaching and may be reluctant to use inquiry-based methods. Especially in the elementary and middle school setting, teachers report feeling that they have inadequate training to teach science, and that they lack access to teaching materials and the most recent scientific information (Caton et al. 1997, and references within).
In tropical countries, most environmental education efforts have been focused on large cities and capitals rather than in the communities adjacent to national parks or biological reserves (Colvin, 1993). In the present study, my objective was to assess the needs and limitations, in areas outside of major cities, identified by teachers for teaching science and environmental education through outdoor inquiry. Moreover, I looked at attitudes of students toward the natural world and about learning science outdoors using an inquiry method.

The Problem

Recently in Mexico, 2.5 million acres of forest were being lost every year (Simon, 1997). By some reports, environmental degradation seems to be undermining the capacity of the land to support its people and is gradually reducing the resource base upon which future Mexicans must depend. Studies suggest widespread non-sustainable use of natural resources in Central America (and Mexico) is causing massive, and in many cases, irrevocable degradation of tropical environments (Simon, 1997). The destruction of the environment is largely driven by social and economic factors, such as rapidly growing populations, large international debts and low levels of education attained by the majority of the populace (Simon, 1997).

The countryside of Oaxaca is Mexico's most devastated landscape. Seventy percent of the once-arable land in Oaxaca has been ruined (Simon, 1997). Today, all that is left of the forests that the Mixteco Indians called Nudzaviñahu, or heavenly esteemed land, are a few stands of pines on the ridges (Simon, 1997). Erosion, deforestation,
desertification, and pollution threaten not only the land, but also the people whose lives depend on its health. The decline of agricultural productivity has brought on more intensive uses of the land such as logging and over-farming (Keen and Wasserman, 1988). As populations have increased, the story has been similar to many other places in the world; poor farmers inundate cities, colonize marginal lands, and the rural economy collapses (Keen and Wasserman, 1988). The environmental degradation has severe consequences in Mexico as it is the third most biologically diverse nation on the planet (Simon, 1997).

**Goals**

I first visited the state of Oaxaca in 1998 when coordinating and setting up a migratory bird education program called *Birds Beyond Borders* (BBB). I became interested in conducting my current research project there due to the rich biological diversity and the proximity of communities to habitats needing conservation.

Because research in environmental education in Central America views children, rather than adults, as the priority audience (Sutherland and Ham, 1992), I focused on elementary aged children. Children's attitudes about the environment are thought to be malleable and acquired at a very early age. Thus, the goals of this study were to:

1. Understand the children's attitudes about nature in communities that were economically dependent on the natural world;
2. Understand the needs of teachers and their perceptions of limitations to conducting environmental education programs outside of the classroom;
3. Use the information derived from 1 and 2 above as baseline data to make recommendations on environmental education programs that would be relevant to these communities.

Community Setting

In the winter of 1999, I conducted research in six schools in the towns of Las Negras, Aguaje del Zapote, Zapitolito and Puerto Escondido. These towns were located on the Pacific coast of the southern Mexican state of Oaxaca (figure 1.1). Three of these schools were in rural communities, and three of them were in towns of 50,000 or more people.

Rural Schools

The towns of Las Negras, Aguaje del Zapote and Zapitolito were small, with populations of 100 to 300 people. The majority of citizens earned their living by fishing and farming. Based on my observations, the economies of the towns were intimately connected to the land.

Las Negras and Aguaje del Zapote were adjacent to a biologically rich lagoon called Manialtepec, while Zapitolito was adjacent to a similar lagoon called Chacahua. The schools in which I worked were Lazaro Cardenas del Rio (Las Negras), Benito Juarez (Aguaje del Zapote), and Melchor Ocampo (Zapitolito). All of these schools were public institutions. There was no electricity or plumbing in any of them. In all of the rural towns, there was only one primary school and no secondary schools. The majority of the children, therefore, finished school after sixth grade (teacher, Juan Gama, personal...
communication). Most of the boys tend to become fishermen while the girls learn to take care of the home (teacher, Margarita Rosea, personal communication).

The three classes studied had 25 to 40 children per class and all teachers were responsible for teaching multi-age classrooms. Teachers made the most of minimal supplies and books; paper, pens and other teaching materials often were in short supply. Students attended school five days per week from 8:30 AM to 12:30 PM.

Town Schools

Puerto Escondido is a town of 50,000 people with a tourist-based economy. With the Sierra Madre Mountains to the east and the Pacific Ocean to the west, Puerto Escondido draws tourists from all over the world who come to explore the natural beauty of the beaches, coral reefs, and wildlife. The schools in this study were Las Luces, Benjamin Bloom, and Juan Rulfo.

Las Luces was a large, public elementary school with approximately 300 students. The campus consisted of four buildings built around a central, paved athletic court that overlooked the Pacific Ocean. Forty one students between the ages of 9 and 11 participated in the study.

Benjamin Bloom was a private elementary school run by a woman from the U.S.A. There was a fee for attendance. Twenty-five students, ages 9 and 10 participated in this study. The campus and the building were very clean and there was a playground with equipment, such as swings and a slide, not common at other schools. The building had two floors and was built around a central courtyard.
Juan Rulfo was a private elementary school run by a local woman. Classes were significantly smaller than in the other schools in this study (an average of 7 students per class). Twenty students, between the ages 8 to 11 participated in this study. Many parents sent their children here if they were falling behind in public schools (teacher, Jose Carrillo Valdobinos, personal communication).

Methodology

Data were collected from seven classes in the six elementary schools described above in January and February 1999. Six teachers and 168 students participated. Two types of data were collected; interviews and survey questionnaires. The use of two different strategies allowed self-reported data from interviews to be compared with data gathered through questionnaires.

Interviews

Five teachers, 34 students, and 2 community members, who worked in the ecological tourism industry, were interviewed face-to-face. All interviews were conducted in Spanish, tape recorded with permission, and lasted from 5 to 15 minutes. All questions were constructed to gain a deeper understanding of attitudes towards the environment, limitations in current teaching practices, and general interest in learning about nature. Additionally, the questions probed for richer knowledge of the lives of people in these areas. Interview questions are shown in Table 1.1.
Surveys

For the purpose of this study, a survey tool was developed with 28 items, focusing on attitudes towards the natural world (Table 1.2). Four general concepts were addressed to better perceive children's attitudes towards nature. The concepts addressed use of slingshots, comfort level in the natural world, feelings towards birds, and feelings towards insects. In Lazaro Cardenas del Rio School and Benito Juarez School, additional questions about Manialtepec Lagoon were asked. In the other four schools, several questions addressed attitudes about a local forest. Each concept was addressed with more than one question and stated in several different ways to look for consistency in student attitudes.

A five-step Likert scale was used with response choices ranging from strongly disagree (5) to strongly agree (1). Response 3 indicated that respondents were unsure or had no opinion. Survey data were analyzed by calculating the average and the standard error of the mean for each question. Values closer to one suggest a positive attitude while values closer to 5 suggest a negative attitude.

The problems of subtleties in translation to a different language, and careful attention to cultural differences in meaning were minimized with the aide of local translators. One survey was distributed to each participating child. They were instructed to circle a number from 1 to 5 for each question. Children were instructed to work alone, but to ask for help if they had any problems.
Results

Interviews

Results of student, teacher and community member interviews are summarized in Table 1.1. The table shows specific questions asked, the number of times certain answers were given, and the schools from which the answers came.

Children

Interviews with the children revealed that they all liked nature and loved learning about the natural world. Children at both rural and town schools often said that the reason they liked nature was “...because it was pretty.” The children at Juan Rulfo School said that they liked nature because “…trees give us oxygen and trees are a part of nature.” Many children said that they loved birds.

When asked if their towns had changed in their lifetimes, the majority of children said they had noticed change of some sort. Many of the children in the town schools said: “...there are fewer trees and more traffic,” and “...there is more trash on the streets.”

When asked if their town had changed, two nine year-old boys in rural schools said: “...the lagoon (Manialtepec) is drier now and there is more mud as well. Many birds have died.” They did not comment on how this made them feel.

All of the children in Lazaro Cardenas del Rio School and Benito Juarez School said that they liked Manialtepec Lagoon because it was pretty, they liked to fish on the lagoon, and they enjoyed spending some of their free time there. They also mentioned passing their free time doing homework, playing, and fishing. The children in the town schools mentioned spending their free time playing and going to the beach.
Teachers

Of the five teachers whose classes participated in the study, all stressed the environment as being an important theme in their teaching, although Margarita Rosea, a teacher at Benito Juarez School, said that math and language were the two most important themes for her.

Epifaunia Bautista, a teacher at Lazaro Cardenas del Rio School, said: "...All themes and subjects are important to me. Math, Spanish, science, history and geography are all important. It is very important to teach about nature and to teach children to protect it. It is hard for students to understand the importance of the natural world. It is important to go outside and learn to observe because even though they (the children) live here, they don't learn to observe. If my students learned to observe better, they would take care of nature and appreciate it more."

Juan Gama, another teacher at Lazaro Cardenas del Rio School said: "...Children need to find out the importance of the environment in which they live as it is the source of all life as well as their source of income and health...the ecosystem is part of society."

The teachers in the town schools said that they felt that it was good to teach about the environment and that local issues such as the burning of trash, needed to be addressed. All of the teachers mentioned needing more knowledge about environmental content and mentioned feeling insecure because they did not know enough about science. Based on the responses received, the teachers felt that taking their class outdoors to do scientific investigations would be a good idea.
Community Members

Two community members involved in the ecological tourism industry were interviewed. They felt that basic survival was very important to teach children. For example, Gina Machorro, a government tour-operator said: "...Teaching children to keep their hands clean is crucial as is caring for your water and preparing your food properly. Also, children will kill animals for the fun of it or out of boredom and they needed to be taught that wildlife is a finite resource."

Likewise, Anatolia Marquez, a nature tour operator felt: "...It is very important for children to learn about the natural world because there are many serious environmental problems that they need to study. The local economy is based so strongly on the environment that if it is not protected, the region will suffer."

Attitude Surveys

Responses to attitude surveys were consistent with answers received in interviews. Results are summarized in Table 1.3.

Trends in attitude responses revealed that students from both rural and town schools had positive attitudes towards the natural world. Responses to statements within a particular content category were relatively consistent. For example, students said that they liked nature and thought it was pretty. Similarly, they thought that the forest was pretty and peaceful.

Responses about insects generally were neutral, but not totally consistent. Students at Lazaro Cardenas del Rio School had strongly positive responses to questions regarding
the statement, “I like insects.” There was some uncertainty about whether or not insects were dangerous. When asked the question “Insects are dangerous,” the majority of children disagreed. However, when asked if insects would hurt them, students from three of the rural schools, and one of the town schools, agreed insects could hurt them.

Responses about birds were strongly positive from children at all schools. When asked if they liked birds in cages, the students in the urban schools strongly disagreed, while the students in the rural schools moderately disagreed. Students at all schools felt that birds were beautiful and felt that they were important in nature.

When asked about slingshots, responses indicated that students in all of the schools had some uncertainty about using them. Students in all schools felt that they were dangerous, yet some of the students reported using them.

In questions regarding studying nature, answers were very positive. Respondents disagreed with the statement “Going outside to study nature scares me”.

Students at Las Luces, Benjamin Bloom, Juan Rulfo and Melchor Ocampo were asked about their feelings towards the local forest. Responses were strongly positive from students’ at all four schools. Answers were consistent when asked similar questions in different ways. Responses agreed with the statements, “The forest is pretty,” and, “Trees are pretty,” and “It is important to protect forests”.

Students at Lazaro Cardenas del Rio School and Benito Juarez School were asked about Manialtepec Lagoon, a local resource. Students in both schools had positive attitudes about the lagoon. There was moderate disagreement with the statement,
"Manialtepec is clean," however students from both schools agreed that many animals lived in the lagoon.

**Discussion**

Developing countries need effective teaching strategies to develop conservation awareness so that processes such as deforestation may be averted (Padua and Jacobson, 1993). Results of this study indicate that students in Oaxaca, Mexico had positive attitudes towards the natural world, and that teachers had an interest in teaching their students about it by extending their classrooms to include the outdoors. These baseline data will be valuable to guide the development and implementation of environmental education programs in this region of Oaxaca.

**Children's Attitudes**

Overall, children in all participating schools had positive attitudes toward their natural surroundings. Although their attitudes were generally positive, there were some topics where they were less certain. For example, all students showed ambivalence toward the study and appreciation of insects. They questioned whether or not they really liked or feared insects. They did, however, say that they liked forests, birds, and nature. This may imply that their dislike or ambivalence about insects comes from a lack of understanding of the role insects' play in nature, or experience that some insects may bite or sting. Children may not have had the knowledge or understanding of basic ecological
concepts of ecosystem structure and function. In this regard, developing an understanding of the resources on which they depend is crucial.

There are several explanations for the positive attitudes, especially for the highly positive attitudes about birds. All of the students in this study had participated in a year long environmental education program called *Birds Beyond Borders*. Through study of migratory birds, children were linked with a pen pal in the United States with whom they corresponded. Classroom studies in Oaxaca revolved around topics such as over-wintering birds they could find in their community, and the breeding patterns of these birds in their sister school community. Though the extent to which each class participated and learned about birds was up to the individual teacher, all students had at least minimal exposure to the study of birds. Thus, previous studies of birds may have accounted for some of the highly positive attitudes observed. Exploring the impact of these programs deserves further study.

Another possible explanation for the positive attitudes towards the natural world was the lifestyles of the children in these communities. Families in rural areas tended to live lives that were economically tied to nature. Thus, children tended to experience the natural world first-hand via activities such as helping their families in the fields, or fishing. Spending large amounts of time in the forests, fields, and on the lagoon may have helped them to develop a strong sense of place, and awareness of their local environment. This might, in turn, have been translated into positive feelings about the natural world.

Children in the town schools also had the opportunity for many direct experiences with the natural world as they lived close to the ocean. At least 60% of the
population in Puerto Escondido earned a living in the tourism business. Many of these children may have family members that depended on the beauty of the environment to attract tourists, and therefore, to earn a living. In interviews, many of the children said that they loved to spend their free time at the beaches.

While there were many similarities between children in the rural and town schools, there also were notable differences. The students' standard of living in the rural communities was lower compared to the children in town. The majority of rural children finished school after the sixth grade because their families could not afford to send them into town for secondary school. Hence, it was common for rural children to follow the family tradition of fishing and farming (teacher, Margarita Rosea, personal communication).

Children in the town schools had more opportunities to pursue higher education and many did so (tourism guide, Anatolia Marquez, personal communication). After completing secondary school, town children often continued their education in technical schools or pursued a wider variety of career options as compared to rural children.

Despite the differences in the educational opportunities and economic status, children from all schools had positive attitudes about the natural world, demonstrated a similar level of enthusiasm and curiosity about their environment, and said that they would enjoy learning about it. The attitudes of these children imply that environmental education programs in these communities would be well received by students. Data indicate that children would be enthusiastic to have an opportunity to interact with, observe, and study their local environment.
**Teachers attitudes and needs**

All the teachers interviewed were willing to teach about the natural world and local environment to their students. Teachers reported that they believed that this was an important topic to teach, and felt that taking their students outside of the classroom would be one important way to help them learn about the natural world.

When asked about the program *Birds Beyond Borders*, teachers commented that it was a wonderful program that both they and their students were enjoying tremendously. However, they reported feeling unable to teach their students any more than what was found in the materials that were available to them. Though the natural science textbooks used by the teachers had lessons regarding the environment, the text was geared to indoor studies and experiments that were best implemented in classes that had sufficient resources and experimental materials available to them. Therefore, to continue with environmental and science education, teachers wished for additional training to feel confident with the content of the materials. This issue of teacher comfort is not unique to teachers from Mexico. Caton et al. (in press) reported similar concerns of American teachers considering new approaches to teaching science.

**Ideas for Nature Programs**

In the early 1980's, most environmental education programs in Latin America and Caribbean school systems were in their very early stages (Ham and Castillo, 1990). The first environmental education efforts were adopted from programs in developed countries, especially from the developed nations of the northern hemisphere. Often these
programs were not suited to local needs (Medina, 1990). Indeed, many researchers have since argued that it is not possible to simply transfer institutional models from developed to developing countries without substantial modification and adaptation (Ham and Castillo, 1990, and references within).

For many years, the justification for simply transferring materials from developed countries, such as the United States, for use in the developing world, was that past experiences and successes were capitalized upon (Norris and Jacobson, 1998). Moreover, this approach extended to teachers in developing countries the benefits of decades of development, testing, and improvement in environmental education curricula that had culminated in highly developed programs. It was also a strategy to provide educators in developing countries with resources they could not acquire otherwise and did not have the financial resources to develop locally (Ham and Castillo, 1990).

As noble as these efforts were, they were based on an underlying assumption that language differences constituted the only obstacle to effective implementation of these materials in other countries (Medina, 1990). Yet there are major differences between educational systems, teachers, students, and classrooms between developing and developed countries. Consequently, we now question whether translated materials originally intended for application in the United States or other developed countries can be as effective when applied in places with different cultures and resource bases. Ham and Castillo (1990) advocate providing alternative ways to provide needed assistance in international environmental education development.
A common weakness of translated materials transported to other countries is that the flora and fauna described are not local and therefore, have little relevance to the children and teachers using the materials (Ham and Castillo, 1990). If people are to manage their own biological resources, they need to know and work with the organisms in their backyards and regions. A Peace Corps volunteer in Honduras interviewed by Ham and Castillo remarked that "Children knew more about African and North American wildlife than they did about Honduran wildlife." This occurred, she said, because the only wildlife pictures children ever saw were from wildlife calendars and posters that gringos had given to them or their teachers.

Schools in developing countries often cannot afford the costs of producing and distributing wildlife posters, pictures, and magazines. There also are few picture books depicting native flora and fauna for many regions of the world. Children may come to believe that wildlife live in other places, but not where they live (Ham and Castillo, 1990). Furthermore, curriculum developers often take for granted access to electricity, blackboards, chalk, pens, paper, glue, crayons, and photocopying facilities, as well as the level of education of teachers, and the degree to which they understand the materials.

Because existing environmental education materials may not be as easily generalized as historically believed, we might question whether transplanted materials originally intended for application in developed countries are going to be as effective when applied under far different circumstances (Wood and Wood, 1987). It is important to consider alternative ways to provide assistance in international environmental
education development other than sending materials intended for use in Northern Hemisphere schools (Tangley, 1988).

One alternative is to develop environmental education strategies that tap into the natural curiosity of children and use local resources. The “schoolyard ecology” program advocates such an approach (Feinsinger et al. 1997). The schoolyard provides an ideal setting for ecology education (Hogan, 1994). Just outside the classroom door, teachers and students have the opportunity to discover a diversity of plants, animals, ecological interactions and human impact.

Concerns that many children do not have the same access to first hand experiences in natural environments has led many conservation groups to recommend using schoolyards to provide nature-based experiences for children (Rivkin, 1997). Many organizations in the United States view school grounds as a place to directly inform children about their natural heritage and engage in its preservation (Rivikin, 1997).

Whether in the schoolyard or elsewhere, effective nature education programs should involve active, hands-on and minds-on learning that has personal relevance. The best way to conduct active science learning is through the inquiry process (National Research Council, 1996). According to the National Research Council, “Inquiry into authentic questions generated from student experiences is the central strategy for teaching science.” The National Science Standards for the U.S.A encourage teachers to focus on inquiry as it relates to real-life experiences of students and to guide students to fashion their own investigations (Edwards, 1997). Young people are naturally excited when they
encounter something new and are doubly excited when they discover its relevance to their daily lives.

In its broadest sense, "scientific inquiry" is a strategy for asking and investigating questions first-hand, and then reflecting on the implications of the results to a wider universe (Feinsinger et al. 1997). To have bona fide inquiry experiences, students must formulate their own questions, create hypotheses, and design investigations that test the hypotheses and answer the questions (Edwards, 1997).

In the case of the rural schools in this study, an ecological study of the local lagoon would allow students to make discoveries, ask questions, create hypotheses, and design investigations about a habitat that was relevant to their lives. This might lead to a discussion on the health of the lagoon, to the health of the water that they drank, and to ways for purifying and having access to clean drinking water.

Observation is a central skill in the inquiry process (Harlen, 1988). Observation is the process through which we come to take notice, to become conscious of things and happenings (Harlen, 1988). Developing the ability to make observations and forming ideas go hand in hand. Some of the roles observation plays in learning include concept development, extending knowledge, stimulating investigations, and formulating conclusions from the investigations (Harlen, 1988). Each student’s existing conception can help to shape their observations and the questions they generate. This in turn shapes their inquiry.

Two children observing the same phenomenon may report quite different things about it. For example, two children at Aguaje del Zapote were observing the same tree.
One child knew that it was guarded by ants that lived in hollow thorns on the tree. She knew that if she touched the tree, the ants would rush to the tree's defense and sting her. The other child knew little about the tree, except that it had thorns. The depth of knowledge and experience of each of these students would likely lead to different questions, and therefore, different inquiries.

Using an inquiry-based approach to teaching and learning science, the possibilities for making observations and questions abound in the schoolyard. For example, what lives there? Where did the weeds come from? When inquiries take place in the outdoor settings people encounter in their daily lives, they will become more familiar with the natural history of their local biotic and abiotic environments. This is a crucial step in attaining ecological literacy (Orr, 1989). In addition, learners acquire skills in critical thinking and for posing questions about their surroundings. They become aware of the environmental consequences of human activities, and learn concepts of ecology and environmental science in a meaningful context (Feinsinger et al. 1997).

In a study conducted by the Vermont Elementary Science Project (1995), teachers and administrators observed behaviors of their students when they were participating in inquiry-based science. They found that, among other things, students looked forward to doing science, demonstrated a desire to learn, exhibited curiosity, accepted an invitation to learn, asked questions, and observed details. This was in contrast to just looking at a demonstration. The focus on the inquiry approach is on the inquiry, not just on transmitting numerous scientific concepts to students (Edwards, 1997). This may address teachers' concerns about not having sufficient background knowledge. The role
of the teacher in an inquiry lesson is to guide the learners to discover on their own, rather than providing all the answers.

Another way to address the concern teachers have regarding lack of content knowledge is for them to form partnerships with people in the community who do have this knowledge (Feinsinger et al. 1997; Caton et al. in press). In the communities in which this study took place, there were a number of people who had knowledge of the local environment. For example, Anatolia Marquez, an ecological tour operator specializing in wildlife, was working with teachers and classes to help implement the *Birds Beyond Borders* Program. Her expertise was of great help to the teachers who had questions and needed more information. Anatolia helped lead the classes on bird watching trips and provided specialized information to the classroom teachers.

Based on the interview and questionnaire data from this study, teachers and children in these communities could benefit from a program that uses local ecosystems to teach ecology. Creating a program which builds on a willingness to both teach and learn about the natural world, as well as the inquisitiveness and positive attitudes of children and teachers, may help local communities develop tools that they need to better understand, sustain, and protect their local ecosystems.
Table 1.1: Most frequently given responses to open-ended questions from interviews. LCR=Lazaro Cardenas del Rio, BJ=Benito Juarez, MC=Melchor Ocampo, LL=Las Luces, BB=Benjamin Bloom, JR=Juan Rulfo

<table>
<thead>
<tr>
<th>Questions and Responses</th>
<th>Schools</th>
<th># Times</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teachers (n=5)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What are your themes in teaching?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relate to science</td>
<td>LCR, BB</td>
<td>3</td>
</tr>
<tr>
<td>Relate to other themes</td>
<td>BJ</td>
<td>1</td>
</tr>
<tr>
<td>How long have you been teaching?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than five years</td>
<td>LCR</td>
<td>2</td>
</tr>
<tr>
<td>More than five years</td>
<td>BJ</td>
<td>1</td>
</tr>
<tr>
<td>Tell me about your school</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is a private school</td>
<td>BB, JR</td>
<td>2</td>
</tr>
<tr>
<td>It gives teachers many options</td>
<td>BB, JR</td>
<td>2</td>
</tr>
<tr>
<td>How important is it for you to teach about the environment?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very important</td>
<td>LCR</td>
<td>2</td>
</tr>
<tr>
<td>Not as important as other subjects</td>
<td>BJ</td>
<td>1</td>
</tr>
<tr>
<td>Burning trash needs to be addressed</td>
<td>JR</td>
<td>1</td>
</tr>
<tr>
<td>It is good to teach about ecology</td>
<td>BB, LCR</td>
<td>3</td>
</tr>
<tr>
<td>What are your thoughts on teaching kids science outside of the classroom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is something my students would like</td>
<td>LCR, BJ</td>
<td>3</td>
</tr>
<tr>
<td>It is an important class to teach</td>
<td>LCR</td>
<td>2</td>
</tr>
<tr>
<td>I would like to do this</td>
<td>LCR, BJ</td>
<td>3</td>
</tr>
<tr>
<td><strong>Students (n=34)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What are your thoughts on Manialtepec Lagoon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is pretty</td>
<td>LCR</td>
<td>7</td>
</tr>
<tr>
<td>I like to fish on the lagoon</td>
<td>LCR</td>
<td>5</td>
</tr>
<tr>
<td>I spend free time on the lagoon</td>
<td>LCR</td>
<td>7</td>
</tr>
<tr>
<td>It has changed in my lifetime</td>
<td>LCR</td>
<td>2</td>
</tr>
<tr>
<td>Tell me about your family.</td>
<td>My parents are fishermen</td>
<td>LCR</td>
</tr>
<tr>
<td>Do you like to study nature?</td>
<td>Yes, it is fun</td>
<td>LCR, BB, JR</td>
</tr>
</tbody>
</table>
Table 1.1 cont.

**Tell me your thoughts on nature**

<table>
<thead>
<tr>
<th>Thought</th>
<th>BB, LCR</th>
<th>BB, JR, LCR</th>
<th>BB, LCR</th>
<th>JR, LCR</th>
<th>JR</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is pretty</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I love nature</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I love looking at trees and water</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I love birds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trees give us oxygen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**How has your town changed in your lifetime?**

<table>
<thead>
<tr>
<th>Change</th>
<th>BB, JR</th>
<th>LCR</th>
<th>BB</th>
<th>BB, JR</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are fewer trees and more cars</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The lagoon is drier</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are less gardens</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is more trash on the streets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Do you use slingshots?**

<table>
<thead>
<tr>
<th>Use</th>
<th>LCR, BB, JR</th>
<th>BB, BB, JR</th>
<th>BB, BB, JR</th>
<th>BB, BB, JR</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, but not to kill animals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, to kill animals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**What do you do in your free time?**

<table>
<thead>
<tr>
<th>Activity</th>
<th>LCR</th>
<th>LCR</th>
<th>BB, BB, JR</th>
<th>BB, BB, JR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Play on the lagoon</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do homework</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Go to the beach</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Play sports</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Community Members (n=2)**

**What themes are important to teach kids?**

<table>
<thead>
<tr>
<th>Theme</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic survival skills</td>
<td>1</td>
</tr>
<tr>
<td>Wildlife is a finite resource</td>
<td>1</td>
</tr>
<tr>
<td>To protect the environment</td>
<td>2</td>
</tr>
</tbody>
</table>

**Is it important to teach kids about nature?**

<table>
<thead>
<tr>
<th>Answer</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>2</td>
</tr>
</tbody>
</table>

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Table 1.2: Attitude Survey Questionnaire.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Strongly Agree</th>
<th>Neither Agree or Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Playing outside is fun</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2) Insects are dangerous</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3) Manialtepec is a clean lagoon</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4) Slingshots are dangerous</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5) Birds are beautiful</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6) I like to learn about nature</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7) Many animals live in Manialtepec</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8) All forests are the same</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9) Birds have beautiful songs</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10) Nature is pretty</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>11) Insects will hurt me</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12) The forest is pretty</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>13) I never use slingshots</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>14) Manialtepec scares me</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>15) Forests are ugly</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>16) Manialtepec is pretty</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>17) Forests are peaceful</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>18) Birds are important in nature</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>19) Going outside to study nature</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>20) Forests are dangerous</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>21) I use slingshots when I am bored</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>22) I like insects</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>23) Birds are interesting</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>24) Trees are pretty</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>25) I like birds in cages</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>26) Slingshots are fun</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>27) Insects are pretty</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>28) It is important to protect forests</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

* Questions 3, 7, 14, 16 asked only in Lazaro Cardenas del Rio and Benito Juarez.
* Questions 8, 12, 15, 17, 20, 24 asked only in Benjamin Bloom, Juan Rulfo, Zapitolito and Las Luces.
Table 1.3: Attitudes of six schools regarding the natural world. Data are means ± standard error. Values closer to one suggest positive attitudes, while values closer to 5 suggest negative attitudes. LCR=Lazaro Cardenas del Rio, BJ=Benito Juarez, MC=Melchor Ocampo, BB=Benjamin Bloom, LL=Las Luces, JR=Juan Rulfo

<table>
<thead>
<tr>
<th>Questions</th>
<th>LCR (n=29)</th>
<th>BJ (n=25)</th>
<th>MC (n=29)</th>
<th>BB (n=25)</th>
<th>LL (n=41)</th>
<th>JR (n=11)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insects are dangerous</td>
<td>3.6 (0.3)</td>
<td>3.3 (0.4)</td>
<td>3.9 (0.7)</td>
<td>3.7 (0.2)</td>
<td>2.9 (0.3)</td>
<td>2.3 (0.4)</td>
</tr>
<tr>
<td>Insects will hurt me</td>
<td>2.4 (0.3)</td>
<td>2.6 (0.4)</td>
<td>3.4 (0.3)</td>
<td>3.8 (0.2)</td>
<td>3.3 (0.3)</td>
<td>2.7 (0.4)</td>
</tr>
<tr>
<td>Insects are pretty</td>
<td>2.6 (0.3)</td>
<td>3.0 (0.3)</td>
<td>2.6 (0.4)</td>
<td>2.6 (0.3)</td>
<td>3.8 (0.3)</td>
<td></td>
</tr>
<tr>
<td>I like insects</td>
<td>1.1 (0.1)</td>
<td>3.6 (0.3)</td>
<td>2.3 (0.4)</td>
<td>2.5 (3.6)</td>
<td>3.6 (0.3)</td>
<td></td>
</tr>
<tr>
<td><strong>Birds</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birds are beautiful</td>
<td>1.0 (0.0)</td>
<td>1.2 (0.1)</td>
<td>1.1 (0.0)</td>
<td>1.0 (0.0)</td>
<td>1.1 (0.1)</td>
<td>1.2 (0.2)</td>
</tr>
<tr>
<td>Birds have beautiful songs</td>
<td>1.1 (0.1)</td>
<td>1.2 (0.1)</td>
<td>1.1 (0.1)</td>
<td>1.2 (0.1)</td>
<td>1.5 (0.2)</td>
<td>1.0 (0.0)</td>
</tr>
<tr>
<td>I like birds in cages</td>
<td>4.0 (0.3)</td>
<td>3.2 (0.4)</td>
<td>3.6 (0.4)</td>
<td>4.4 (0.3)</td>
<td>4.1 (0.3)</td>
<td>4.7 (0.2)</td>
</tr>
<tr>
<td>Birds are important in Nature</td>
<td>1.2 (0.2)</td>
<td>1.0 (0.0)</td>
<td>1.2 (0.2)</td>
<td>1.2 (0.2)</td>
<td>1.2 (0.2)</td>
<td></td>
</tr>
<tr>
<td>Birds are interesting</td>
<td>1.0 (0.0)</td>
<td>1.1 (0.3)</td>
<td>1.2 (0.2)</td>
<td>1.2 (0.1)</td>
<td>1.5 (0.2)</td>
<td></td>
</tr>
<tr>
<td><strong>Slingshots</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slingshots are dangerous</td>
<td>1.4 (0.2)</td>
<td>2.6 (0.4)</td>
<td>2.2 (0.3)</td>
<td>1.6 (0.0)</td>
<td>2.3 (0.3)</td>
<td>1.7 (0.5)</td>
</tr>
<tr>
<td>Slingshots are fun</td>
<td>4.6 (0.5)</td>
<td>3.0 (0.3)</td>
<td>3.3 (0.4)</td>
<td>4.3 (0.2)</td>
<td>3.7 (0.3)</td>
<td>3.6 (0.6)</td>
</tr>
<tr>
<td>I never use slingshots</td>
<td>2.9 (0.4)</td>
<td>3.2 (0.4)</td>
<td>3.8 (0.3)</td>
<td>4.1 (0.3)</td>
<td>3.4 (0.3)</td>
<td>3.3 (0.6)</td>
</tr>
<tr>
<td>I use slingshots when I am bored</td>
<td>4.1 (0.3)</td>
<td>3.6 (0.4)</td>
<td>4.2 (0.3)</td>
<td>4.8 (0.2)</td>
<td>4.2 (0.2)</td>
<td></td>
</tr>
<tr>
<td>Nature</td>
<td>1.1 (0.1)</td>
<td>1.7 (0.3)</td>
<td>1.1 (0.1)</td>
<td>1.0 (0.0)</td>
<td>2.1 (0.3)</td>
<td>1.0 (0.0)</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>Playing outside is fun</td>
<td>1.0 (0.0)</td>
<td>1.3 (0.2)</td>
<td>1.2 (0.2)</td>
<td>1.3 (0.1)</td>
<td>1.3 (0.2)</td>
<td>1.3 (0.2)</td>
</tr>
<tr>
<td>I like to learn about</td>
<td>1.0 (0.0)</td>
<td>1.2 (0.2)</td>
<td>1.2 (0.2)</td>
<td>1.2 (0.1)</td>
<td>1.0 (0.0)</td>
<td>1.0 (0.0)</td>
</tr>
<tr>
<td>nature</td>
<td>3.1 (0.4)</td>
<td>2.9 (0.4)</td>
<td>3.2 (0.4)</td>
<td>4.5 (0.2)</td>
<td>3.4 (0.3)</td>
<td></td>
</tr>
<tr>
<td>Nature is pretty</td>
<td>1.0 (0.0)</td>
<td>1.2 (0.2)</td>
<td>1.2 (0.2)</td>
<td>1.2 (0.1)</td>
<td>1.0 (0.0)</td>
<td>1.0 (0.0)</td>
</tr>
<tr>
<td>Going outside to study</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>nature scares me</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forests</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The forest is pretty</td>
<td>1.1 (0.1)</td>
<td>1.0 (0.0)</td>
<td>1.2 (0.1)</td>
<td>1.0 (0.0)</td>
<td>1.0 (0.0)</td>
<td></td>
</tr>
<tr>
<td>Forests are dangerous</td>
<td>3.8 (0.3)</td>
<td>4.5 (0.5)</td>
<td>3.5 (0.3)</td>
<td>4.0 (0.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is important to</td>
<td>1.1 (0.1)</td>
<td>1.0 (0.1)</td>
<td>1.2 (0.1)</td>
<td>1.3 (0.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>protect forests</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trees are pretty</td>
<td>1.0 (0.0)</td>
<td>1.2 (0.2)</td>
<td>1.1 (0.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forests are peaceful</td>
<td>1.4 (0.1)</td>
<td>1.9 (0.2)</td>
<td>1.5 (0.2)</td>
<td>1.5 (0.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forests are ugly</td>
<td>4.4 (0.2)</td>
<td>4.8 (0.1)</td>
<td>4.4 (0.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All forests are the same</td>
<td>3.3 (0.3)</td>
<td>3.6 (0.3)</td>
<td>4.2 (0.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manialtepec</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Many animals live in</td>
<td>1.8 (0.3)</td>
<td>2.0 (0.3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manialtepec</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manialtepec scares me</td>
<td>4.3 (0.3)</td>
<td>3.6 (0.3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manialtepec is pretty</td>
<td>1.5 (0.2)</td>
<td>1.8 (0.3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manialtepec is clean</td>
<td>1.1 (0.1)</td>
<td>1.6 (0.3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chapter 2

INQUIRY AND OBSERVATIONS IN THE SCHOOLYARD: A STUDY OF HABITATS

Introduction

The Problem

Protecting global biodiversity is an international conservation concern. Developing countries, especially those located in or near the tropics, contain an estimated 50% of the world's plant and animal species (Tangley, 1988). Recently in Mexico, 2.5 million acres of forest were being lost every year, (Simon, 1997). This environmental degradation has severe consequences as Mexico is the third most biologically diverse nation on the planet (Simon, 1997). By some reports, environmental degradation seems to be undermining the capacity of the land to support its people, and is gradually reducing the resource base upon which future Mexicans must depend.

The countryside of Oaxaca is Mexico's most devastated landscape. Seventy percent of the once-arable land in Oaxaca has been ruined (Simon, 1997). Today, all that is left of the forests that the Mixteco Indians called Nudzaviñuhu, or heavenly esteemed land, are a few stands of pines on the ridges (Simon, 1997). Erosion, deforestation, desertification, and pollution threaten not only the land, but also the people whose lives depend on its health.

Environmental education programs are a means of addressing issues of habitat loss and degradation of the environment. Environmental education can increase
ecological awareness, further favorable attitudes toward the environment, and promote
natural resource conservation (Jacobson, 1990, and references within). The schoolyard
provides an ideal setting for environmental education (Hogan, 1994). Just outside the
classroom door, teachers and students have the opportunity to discover a diversity of
plants, animals, ecological interactions and human impacts. Placing learning in the
context of the local environment allows children to develop a regionally relevant
understanding of organisms, and to think and care about their local environments as a
source of intrigue and ecological exploration (Hogan and Berkowitz, 1999, and
references within).

Developing keen observation skills and asking questions are important parts of
the inquiry process. Making observations is an important part of learning about local
ecosystems and habitats. According to Harlen (1988), observation is the process through
which one comes to take notice, and becomes conscious of things and happenings.
Developing critical observation skills is important because from their observations,
students can generate questions that stimulate thoughts and action. And there is nothing
like a good question to get students thinking critically about the world in which they live
(Chiapetta, 1997). Questions may encourage observation, analysis, speculation, and
further investigation (Cherif, 1993). Moreover, students’ questions may help them relate
what they have observed to their daily lives. Young people naturally are excited when
they encounter something new, and are doubly excited when they discover its relevance
to their daily lives (Cherif, 1993). For example, observations of an insect pollinating a plant might allow children to make discoveries and ask questions about the insect’s behavior. Teachers can build on these observations with their students to explore the various roles insects play in nature, e.g., and how insects pollinate the crops on family farms where children live.

Inquiry is multi-faceted and involves making observations, posing questions, planning investigations, gathering data, proposing answers, and communicating the results (NRC, 1996). According to the National Research Council (1996), “inquiry into authentic questions generated from student experiences is the central strategy for teaching science.” The National Science Standards for the U.S.A encourage teachers to focus on inquiry as it relates to real-life experiences of students, and to guide students to fashion their own questions.

For students and teachers new to this teaching and learning approach, a guided or semi-guided inquiry on observation is ideal for getting started. In guided and semi-guided inquiries, the teacher provides the theme or ecological concept to be studied, and helps the students learn an investigative approach (Feinsinger et al. 1997).

**Investigating Schoolyard Habitats**

An ecological inquiry was developed for elementary school children that took advantage of local resources at rural schools in Oaxaca, Mexico. This inquiry focused on teaching children how to make detailed observations of biological diversity in local habitats in their schoolyard. Children between the ages of 8 and 11 participated. 

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Cardenas del Rio Elementary School in Las Negras and Benito Juarez Elementary School in Aguaje del Zapote, were selected for implementation of the schoolyard inquiry. For children, the objectives were to gain an appreciation of the diversity of habitat types in their schoolyard, to observe the types of local habitats preferred by birds, and to learn through observing and recording information that habitats for organisms exist on large and small scales.

Two rural schools in towns with fewer than 500 people in Oaxaca, Mexico, (Figure 1.1) were selected to implement the schoolyard studies. The economies of the selected towns were intimately connected to the land, as the majority of people earned a living fishing or farming (tourism guide, Anatolia Marquez, personal communication). These communities, and their schools, were located near a biologically rich habitat called Manialtepec Lagoon. This lagoon provided critical habitat for many species of resident and migratory birds including osprey, herons, and trogons. Additionally, a myriad of fish and aquatic organisms supported a rich food chain and a local fishing economy.

The inquiry developed for the rural Oaxacan schools focused on nurturing observational skills. Rather than being given step by step directions, students participated in series of semi-guided activities during which they were asked to make careful observations of the living and nonliving parts of their school yard (see, for example, Clemens-Walatka, 1998).

During a series of investigations spanning four days over the course of several weeks, students worked together in groups of 5 to 7 to investigate habitats that could be
found in their school yard. The investigations were designed to integrate with a unit on migratory birds already underway.

**Checking Attitudes and Background Knowledge**

Initial attitudes were assessed by asking children to complete a questionnaire about five concepts related to the local environment (Table 1.2). The concepts addressed use of slingshots, comfort level in the natural world, feelings towards birds, feelings towards insects, and feelings towards the local Manialtepec Lagoon. Each concept was stated in several different ways to look for consistency in student attitudes. Student responses ranged from strongly disagree (5) to strongly agree (1). Response 3 indicated that respondents were unsure, or had no opinion.

Before beginning the outdoor investigation, we explored what children knew about local birds. Many children said that they commonly saw hummingbirds, especially near Bouganvillea, the bright red-flowering bushes growing prolifically around the schoolyard. After a discussion of what birds and other animals needed to survive, we were ready to explore the schoolyard!

**Map Makers**

The map making investigation started on a macro scale. Students were prompted to make a map of the entire schoolyard and school. They were instructed to pay careful attention to habitats for animals and plants. Maps are an effective tool for learning because, as Sobel (1998) says, "mapmaking is a valuable tool in assisting children in
developing a sense of connection to place and community.” Including map making focuses learners on building a relationship between the structure of the local landscape, and the shape of a person’s life (Sobel, 1998). Tony Kallet quoted in Sobel, 1998, (pages 3-4) says:

“It seems to me that one can think of mapmaking as a fundamental human activity, if not the fundamental human activity...Learning consists of looking at something new and beginning to see paths into it. You construct a map or a series of maps, each one an approximation and probably wrong in many details, but each one helping you to go further into territory... We all have hundreds, thousands of maps each of which represents a way we have learned to look at part of the world...There are music maps, language maps, maps of social relations, maps of physical environment...What they have in common is that all of them are models in our minds of what we think the world looks like and we can consult them to help predict what the world is going to be like, what the consequences of our actions are likely to be.”

Students were asked to represent the elements of the schoolyard that they felt were important places for plants and animals to live. Various strategies to draw or represent the school were discussed, but the final map design was left to individual student creativity. Once completed, each child shared their map with the class. Most of the maps were made as drawings that focused on a front view of the school. These drawings tended to include the school building, the athletic court, and the flowers and trees growing in front of the school. Fewer children represented birds in the bushes, or snakes on the ground, in their maps.
Children were asked if making a map helped them notice anything that they had not previously seen in their schoolyard. Some students noticed that there were several different types of trees growing in front of the school, and not just one type as they had previously assumed. The map making inquiry concluded with a walk around the entire school where students pointed out some of the different places where they thought animals might live. Many of these places had not been originally included on their maps.

**From Macro to Micro Habitats**

In this phase of the inquiry, the students were asked to focus in on a smaller scale as teams carefully mapped 10-15 ft$^2$ plots. Instead of looking at the big picture of the entire schoolyard, students carefully observed five small plots in, or near, the schoolyard. Plots were selected to include a variety of habitats. For example, one plot was on a hill, while another was in a patch of weeds. Working in groups, students had twenty minutes in each plot before moving on to the next area. Each child recorded their observations, including those made with magnifying lenses, on a data sheet (Figure 2.1). Children were encouraged to look for signs of animals, such as chewed leaves, galls, or cocoons.

With data sheets in hand, each group reported their observations back to their classmates. Class data were recorded on a large piece of chart paper. When something was reported more than once, a tally was made. Thus, the children could see which organisms were the most common in the schoolyard based on their observations. Later, we discussed which organisms were most commonly seen and why, especially focusing on similarities and differences between each study plot. Important factors included
sunlight, moisture, soils, and species composition. Students shared prize finds, such as a shed snake skin, and considered how shedding skin was an adaptation.

**Where Are The Birds?**

After mapping, students were introduced to the concept of a habitat. With this concept in mind, the children re-investigated the schoolyard and identify habitats needed by birds for survival. Students were asked to consider all the places they had observed in the schoolyard plots and identified on their maps. Examples of habitats they offered included flowering bushes, the rock pile behind the school, and a dead tree. Students made their own definition of habitat that included the food, water and shelter that an organism needs to survive.

A new map of the schoolyard with walking paths was used to guide students for a bird watching adventure. Along these paths, students re-explored the various habitats around the schoolyard to see if any birds lived in them. One group of students was assigned to each path. Like an actual ornithological study, different points were selected along the path where students could stop to record all the birds that they saw, and details of habitats where birds were found. One student in each group recorded group data, while the other students listened and watched for birds. An adult worked with each group. Students did not know the names of all the birds they saw. But, when in doubt, they simply recorded as much information about each bird as possible such as what color it was, what it was doing, and where it was seen.
The wrap-up discussion addressed the following points: types of habitats around the school; the variety of birds that these habitats supported; and the different roles birds played in nature. Students made a long list of all the possible food items for birds that they had found in their plots, as well as the elements of habitat they predicted the birds needed for survival.

The schoolyard investigation was concluded by reviewing the diversity of habitat types in the schoolyard. Students learned that a habitat could be as large as a lake, or as small as an ant hill. They talked about other types of habitats around their town and what would happen if these places changed, or ceased to exist. The children all agreed that it was important to make sure habitats were protected so that local animals and plants had space to live.

**Impact of the Schoolyard Study**

In this semi-guided inquiry, both teachers and students had different roles in the learning process. Teachers guided students in making discoveries, and creating personal understandings of their natural world. Mapping the schoolyard allowed children to expand their views of a familiar environment, and place their views in an ecological context. Plot studies focused the children’s observations on a much smaller scale. This allowed them to have direct, hands-on experiences that each individual found interesting. The bird walk provided an opportunity to discover connections between birds and habitats, and why habitat diversity is important.
The inquiry approach to hands-on, minds-on learning described here was new to the children and teachers in these rural schools. Through the inquiry process, it appeared that learners became quite comfortable asking questions and making observations. Moreover, at the same time science content was formally introduced (see for example, Feinsinger et al. 1997).

Teachers Voices

Teachers and students were interviewed face-to-face after the schoolyard inquiry. Interviews were conducted in Spanish, tape recorded with permission, and lasted from 5 to 15 minutes. Questions were constructed to gain a deeper understanding of teacher’s attitudes towards the environment and how they felt about this unit.

The three partner teachers in rural Oaxaca schools reported that teaching science in the outdoors was a good idea, and they all demonstrated enthusiasm for teaching about the environment. All of the teachers said that they would like to do this type of study again on their own. Frequently reported comments during the interviews (Table 2.1) suggest that teachers appreciated that their students enjoyed the investigations, and that it was very important to teach children about nature. Based on the responses received, the teachers felt that the class was highly successful.

After the four-day unit, Juan Gama, a teacher at Lazaro Cardenas del Rio School, said: “... These experiences were new for my students. I believe that my students already had strong feelings about what we are studying and really like the theme of nature. I feel
that it is necessary to teach these classes outside of the classroom. In the future I would like to take my children more into the countryside for observations."

All three teachers stressed the environment as being an important theme in their teaching, although Margarita Rosea, a teacher at Benito Juarez School, said that math and language were the two most important themes for her. Regarding the schoolyard lessons, she said: "...There are no limitations in taking the children outside to do this type of thing, except time. I know that they enjoyed it."

Epifaunia Bautista, the other teacher at Lazaro Cardenas del Rio School, felt:
"...This class was very helpful to my students. It helped them to learn about where they live and about the organisms that live there. They enjoyed what they learned and it is important to teach them about the environment using both books and the outdoors."

The school superintendent from Puerto Escondido visited during the schoolyard investigation and was pleased with what he saw the students doing. He talked about how much the town had grown and changed. He said: "...I feel that it is very important for students to have this opportunity to study the natural world. Children need to learn to take care of nature."

Anatolia Marquez, a nature-tour operator who had helped with the outdoor investigation, felt that the unit was very successful, stating: "...It is very important for children to learn about the natural world because there are many serious environmental problems that they need to study. The local economy is based so strongly on the environment that, if it is not protected, the region would suffer."
Students Voices and Attitudes

In interviews, students said that they liked nature "...because it was pretty." They also said that they liked learning about the natural world. Regarding the investigations, many children said: "...I love going outside and looking for birds and animals."

During the explorations, many children commented: "...what we are doing is fun! I always come to these places, but looking for birds makes it more fun!" One child said: "...I like to go swimming and be near the water. Sometimes I look at the plants and animals around the water. This makes me want to look at them more."

Attitude scores were produced by calculating the mean response ranging from highly positive (1) to strongly negative (5). Results from the pre- and post-surveys on attitudes suggest that, after the investigations, students' attitudes were positive (Table 2.2), and improved on some topics. For example, student responses toward insects at Benito Juarez School improved dramatically, changing from slightly negative to highly positive. They had greater appreciation for insects and were more confident that insects would not hurt them.

Answers given towards birds remained very positive. Students at Benito Juarez School felt that birds were beautiful and had beautiful songs. At both schools, students had shift in feelings towards birds in cages. Students disagreed more strongly with the statement, "I like birds in cages."
Especially at Benito Juarez School, feelings towards learning about nature were more positive overall. Children had less fear about going outside to study nature, and were more positive about their learning. Feelings about Manialtepec Lagoon were generally more positive after the nature investigation. Students at each school felt more strongly that Manialtepec was clean and safe. Additionally, they learned that many animals lived in the lagoon.

**Why the change in attitudes?**

Overall children at the two rural schools in Oaxaca showed improved attitudes towards the natural world after the schoolyard investigations. Like children everywhere, their interests and curiosities were engaged as they explored local habitats. Allowing students to have hands-on interactions with their local environment was an important factor leading to positive attitudes in the learners in these schools. Relying on familiar local resources to teach environmental education and science has not traditionally been the approach in developing nations. Instead, environmental education methods have often been transported from developed nations (Ham and Castillo, 1990). A weakness of using adopted materials is that the flora and fauna described are not local and, therefore, have little relevance to the children and teachers using the materials (Ham and Castillo, 1990). It is little wonder that children and teachers do not use such materials widely. If people are to appreciate and manage their local biological resources, they need to know what organisms are in their backyards and regions.
The strength in using the local environment to learn about nature was illustrated by the change in attitude towards insects by the children at Benito Juarez School. During the plot studies, many of the children’s observations were focused on insects and spiders. The children loved catching grasshoppers and beetles, and observing them with magnifying lenses. These up-close interactions gave children the opportunity to understand that not all insects are dangerous, and, more important, that they were exciting to observe.

Furthermore, every time a student shared their newly discovered insects, or reported on their observations, new questions emerged. These became “teachable moments.” This illustrates a crucial aspect of the inquiry process: when students observe personally interesting phenomena, they are inclined to want to know more. Moreover, if what they observe has local relevance and meaning in their life, they will be more excited about learning (Cherif, 1993). Teachers can help turn this excitement to feelings of pride regarding the local environment.

During the schoolyard investigations, students were eager to share every interesting observation witnessed in the world around them. They relished the chance to show shed skins of snakes, intricately colored grasshoppers, or flowering bushes visited by hummingbirds. These observations were delivered with an enthusiastic story or information about what the object of wonder was, and how it was found. The process of making authentic observations plays a role in developing positive attitudes in children. At both rural schools, children became confident in their observation skills and asking questions. And they thoroughly enjoyed the process!
An example of the enthusiasm for observation was illustrated by a child at Benito Juarez School. While watching intently a butterfly that had caught her eye, a young observer discovered a nearby caterpillar on the branch. When she realized that the butterfly had once been a caterpillar, she wanted to know how it had gotten its wings. The conversation flowed to other topics such as metamorphosis, where butterflies lived, what they ate, the role they played in nature, and plants around the schoolyard that may provide food. The little girl was very excited about what she had learned, and later shared her findings with her classmates.

In a similar way, a boy at Lazaro Cardenas del Rio School was thrilled to find an intricately camouflaged grasshopper. He questioned why the grasshopper was the color of the grass, leading to a small group discussion about camouflage and predator-prey relationships. Observations and questions similar to these examples are common in authentic investigations.

The inquiry process at rural schools in Oaxaca allowed children to focus on what they found interesting. Their enthusiasm for learning was obvious— they applauded at every opportunity for a schoolyard investigation!

In an inquiry classroom, follow-up investigations may go into greater depth of content and involve children in longer studies. Additionally, scientific information and process skills can be integrated with social and personal values (Caton et al. 1998). For example, issues that lead to habitat degradation in the local community, and ways of preventing this from occurring can be explored.
Adapting and Extending the Schoolyard Ecology Approach

As children report on their observations, there are many opportunities to discuss the impact the environment has on their daily lives, and the impact their daily lives have on the environment. For example, children's attitudes towards slingshots may be directly addressed in a follow-up discussion to an inquiry that examines threats to biodiversity and local extinction. Discussions can address how killing animals with slingshots affects population sizes, especially of rare species. Furthermore, as children become increasingly comfortable with their observation skills, they can turn their observations and questions into hypotheses, conduct experiments, and come up with conclusions. Over time, this may lead to more in-depth knowledge of local ecosystems.

Teachers can extend their classes explorations beyond the immediate vicinity of the schoolyard, into the rest of the community. They might have their students compare degraded habitats with those in better condition. Interviews with family members could be conducted to learn about the changes that have taken place in the environment over time. Children can provide useful data to their community as they survey environmental conditions and document changes over time.

The approach described here and elsewhere to develop (e.g., Feinsinger et al. 1997, Berkowitz and Hogan, 1999) to schoolyard-based investigations can most likely be adapted to other schools in Mexico, as well as to other countries, and serve as a model for future projects. Observations and inquiries can be carried out in any setting as teachers design activities to take advantage of the local habitats. For example, in urban settings,
teachers might focus on diversity by exploring patches of bare ground compared to grassy areas with their students. The inquiry process can be applied to studies of, for example, spider webs, ants, seed dispersal, and erosion. Potential environmental investigations are virtually endless. And best of all, in economically disadvantaged schools, there is no need for expensive equipment or transportation to distant field trip sites. Teachers who feel insecure about having adequate scientific knowledge can draw on local environmental experts in the community, and form community partnerships for education (Caton et al. 1997, 1998, 2000; Snetsinger et al. 1999).

As teachers develop new instructional practices, they should "think big and start small." This means that a foundation for change can be laid that provides experiences in the practice of ecological science through field work in familiar settings, and through working communally on various ways to translate these experiences into practice with children (Hogan and Berkowitz, 1999, and references within).

Summary

A significant part of Central America is rural. Thus, environmental education development in these areas promises to reach a significant portion of the population that have traditionally had few opportunities to participate in environmental education activities (Ham and Castillo, 1990). In addition to outside global influences, many of the environmental problems in Central America and Mexico are caused by rapidly growing rural populations inhabiting lands containing natural resources, and by demands for these
natural resources in developed countries. As children in these regions grow up, they
develop lifelong perceptions, values, and behaviors toward nature and natural resources.
Therefore, rural school and community nature education programs represent an important
strategy for mitigating environmental problems and improving the future of the
environment in Central America and Mexico (Ham and Castillo, 1990). By helping
children explore relationships between the quality of their environments and the quality
of their lives, nature education encourages them to live in greater harmony with their
natural surroundings (Sutherland and Ham, 1992).
Table 2.1: Most frequently given responses by teachers and one community member to open-ended questions from interviews. LCR=Lazaro Cardenas Del Rio School, BJ=Benito Juarez School.

<table>
<thead>
<tr>
<th>Questions and Responses</th>
<th>Schools</th>
<th># Times Response Given</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teachers (n=3)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What are your themes in teaching?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relate to science</td>
<td>LCR</td>
<td>2</td>
</tr>
<tr>
<td>Relate to other themes</td>
<td>BJ</td>
<td>1</td>
</tr>
<tr>
<td>How important is it for you to teach about the environment?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very important</td>
<td>LCR</td>
<td>2</td>
</tr>
<tr>
<td>Not as important as other subjects</td>
<td>BJ</td>
<td>1</td>
</tr>
<tr>
<td>What were your thoughts on the unit?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It was something my students liked</td>
<td>LCR, BJ</td>
<td>3</td>
</tr>
<tr>
<td>It was an important class to teach</td>
<td>LCR</td>
<td>2</td>
</tr>
<tr>
<td>I would like to continue it on my own</td>
<td>LCR</td>
<td>2</td>
</tr>
<tr>
<td>I like teaching the class outdoors</td>
<td>LCR, BJ</td>
<td>2</td>
</tr>
<tr>
<td>It is good as long as it doesn’t involve many supplies.</td>
<td>BJ</td>
<td>1</td>
</tr>
<tr>
<td><strong>Community Members (n=1)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What themes are important to teach children?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic survival skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wildlife is a finite resource</td>
<td></td>
<td></td>
</tr>
<tr>
<td>To protect the environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is important to teach children about nature</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2.2: Attitudes towards the natural world before and after ecology unit. Data are means and ± standard error. The scale ranged from 1 (strongly agree) to 5 (strongly disagree). LCR=Lazaro Cardenas del Rio School, BJ=Benito Juarez School

<table>
<thead>
<tr>
<th>Question</th>
<th>Responses before instruction</th>
<th>Responses after instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LCR (n=25)</td>
<td>BJ (n=29)</td>
</tr>
<tr>
<td><strong>Insects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insects are dangerous</td>
<td>3.6 (0.3)</td>
<td>3.3 (0.4)</td>
</tr>
<tr>
<td>Insects will hurt me</td>
<td>2.4 (0.3)</td>
<td>2.6 (0.4)</td>
</tr>
<tr>
<td>Insects are pretty</td>
<td>2.6 (0.3)</td>
<td>3.0 (0.3)</td>
</tr>
<tr>
<td>I like insects</td>
<td>1.1 (0.1)</td>
<td>3.6 (0.3)</td>
</tr>
<tr>
<td><strong>Birds</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birds are beautiful</td>
<td>1.0 (0.0)</td>
<td>1.2 (0.1)</td>
</tr>
<tr>
<td>Birds have beautiful songs</td>
<td>1.1 (0.1)</td>
<td>1.2 (0.1)</td>
</tr>
<tr>
<td>I like birds in cages</td>
<td>4.0 (0.3)</td>
<td>3.2 (0.4)</td>
</tr>
<tr>
<td>Birds are important in nature</td>
<td>1.2 (0.2)</td>
<td>1.0 (0.0)</td>
</tr>
<tr>
<td>Birds are interesting</td>
<td>1.0 (0.0)</td>
<td>1.1 (0.0)</td>
</tr>
<tr>
<td><strong>Slingshots</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slingshots are dangerous</td>
<td>1.4 (0.2)</td>
<td>2.6 (0.4)</td>
</tr>
<tr>
<td>Slingshots are fun</td>
<td>4.6 (0.5)</td>
<td>3.0 (0.3)</td>
</tr>
<tr>
<td>I never use slingshots</td>
<td>2.9 (0.4)</td>
<td>3.2 (0.4)</td>
</tr>
<tr>
<td>I use slingshots when I am bored</td>
<td>4.1 (0.3)</td>
<td>3.6 (0.4)</td>
</tr>
<tr>
<td><strong>Nature</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Playing outside is fun</td>
<td>1.1 (0.1)</td>
<td>1.7 (0.3)</td>
</tr>
<tr>
<td>I like to learn about nature</td>
<td>1.0 (0.0)</td>
<td>1.3 (0.2)</td>
</tr>
<tr>
<td>Nature is pretty</td>
<td>1.0 (0.0)</td>
<td>1.2 (0.2)</td>
</tr>
<tr>
<td>Going outside to study nature</td>
<td>3.1 (0.4)</td>
<td>2.9 (0.4)</td>
</tr>
<tr>
<td>Manialtepec scares me</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manialtepec is clean</td>
<td>2.4 (0.3)</td>
<td>2.8 (0.4)</td>
</tr>
<tr>
<td>Many animals live in Manialtepec</td>
<td>1.8 (0.3)</td>
<td>2.0 (0.3)</td>
</tr>
<tr>
<td>Manialtepec scares me</td>
<td>4.3 (0.3)</td>
<td>3.6 (0.3)</td>
</tr>
<tr>
<td>Manialtepec is pretty</td>
<td>1.5 (0.2)</td>
<td>1.8 (0.3)</td>
</tr>
</tbody>
</table>

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Figure 2.1 Sample form for plot study activity.

<table>
<thead>
<tr>
<th>School Yard Habitat One</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date___________________</td>
</tr>
<tr>
<td>Weather Conditions_______</td>
</tr>
<tr>
<td>Time___________________</td>
</tr>
<tr>
<td>General Description of Area__________________________</td>
</tr>
</tbody>
</table>

We will be comparing five different habitats. Look around carefully in each one for signs of animals and plants.

*Please list everything that you find!*
Chapter Three

Executive Summary

The Big Picture

Overall, the data reported in my study from attitude surveys, interviews, and the schoolyard investigations demonstrated that children in both rural and town communities in Oaxaca, Mexico, are interested in learning about the natural world. Furthermore, though teachers voiced concerns that they do not have sufficient scientific knowledge, they would like to incorporate schoolyard inquiries as a way of teaching their students about nature.

Taking advantage of local resources found in the schoolyard proved to be a successful strategy for implementing environmental education in these rural Oaxacan Schools. Children and teachers were enthusiastic about the investigations and eager to learn more about their local environment. Given the positive attitudes of children and teachers toward nature, and the success of the schoolyard inquiries, I recommend continuing and extending this approach in these communities.

To continue this approach, teachers need to be trained to feel comfortable with inquiry-based methods. One way to address this need is through the inclusion of inquiry-based strategies in formal teacher training colleges and universities. Additionally, setting up schoolyard inquiry workshops for teachers, administrators, and community members could provide a solid introduction to the methodology, and a support network for teachers. Including administrators is important because school leaders who attend
workshops will feel more comfortable with new teaching methodologies, and their understanding of these new strategies may provide a support system for teachers when back in their classrooms. This in turn may help solidify the implementation of this new approach. Moreover, they may be more willing to allow simple modifications to the schoolyard to enhance its value as an educational resource.

Involving community members in workshops will provide training to people that know about local resources and want to form educational partnerships with teachers, but do not have any formal educational background. There is tremendous possibility for these types of educational partnerships. For example, in the rural towns in this study, fishermen, people involved in parks and conservation, tourism guides, foresters and local researchers all had in-depth knowledge of local resources and can contribute meaningfully to local explorations. Furthermore, as teachers discuss class investigations with parents, family members may become interested in participating in investigations. For example, when parents at Lazaro Cardenas del Rio school learned about the bird watching investigation, many of them came along. This may extend lessons learned in the classroom into the rest of the community.

Science education researchers can help to facilitate the process of implementing schoolyard based inquiry workshops by forming relationships and training local people on schoolyard inquires. These people can then conduct workshops in a number of different schoolyard settings representing the full spectrum of the rural-urban gradient (Feinsinger et al. 1997).
In upper grades, investigations may be designed that are related to local environmental problems, and ways of addressing them. For example, a class may investigate an area they think is being polluted or degraded. Students could collaborate with local community members to plant trees, pick up litter, set up interpretive signs, or provide educational materials for use in the rest of the community about the importance of a particular habitat.

**Limitations**

Care should be used when generalizing these results to other communities in Mexico and beyond. For example, the positive attitudes of children toward the natural world reported here might be different for children in other communities, particularly if they have had little opportunity to study nature before. Because children in this study were already participating in the *Birds Beyond Borders* program, their positive attitudes may have been influenced by what they had learned already. Furthermore in major metropolitan areas, such as Mexico City, where children have fewer opportunity to interact with nature, their attitudes may be less positive toward the environment (Medina, 1990).

Attitudes also may have been biased by the presentation of the attitude questionnaire survey by an outsider. In this study, Gina Machorro, a government sponsored tourism operator, said that children may tell outsiders what "they want to hear." Children in other communities may have different reactions to foreigners coming into their schools and may feel uncomfortable telling an outsider their feelings. With this possibility in
mind, every effort should be made to have a local member of the community distribute
the questionnaires to children.

Teachers in other regions throughout Mexico and the rest of Latin America may
have different reactions to using inquiry methods, as compared to the teachers in this
study who felt that inquiry was something they enjoyed. Different reactions may be due
to training, level of education, and comfort with classroom management. Implementation
may, therefore, require more in-depth teacher training, and there may be different
obstacles to overcome toward using inquiries in other regions.

There are a few models that have been developed and may help in overcoming these
obstacles. Feinsinger and his colleagues (1997) described an approach for conducting
workshops on schoolyard inquiry in Bariloche, Argentina. In these workshops, teachers
and ecologists work together and participate in a series of investigations that introduce
the possibilities for using the schoolyard to conduct science and inquiry methodologies in
instruction. Feinsinger et al. 1997, presented a scheme for general ecological concepts
appropriate for the schoolyard. Other workshop models have been developed for
connecting teachers with partners to collaborate in schoolyard investigations (see, for
example, Caton et al. in press; Caton et al. 1997).

Training courses and workshops should have teachers and their partners work
together in different investigations that start with a guided inquiry approach and later
evolve into the use of an open inquiry. This would allow workshop participants to
become more comfortable working together, and with using the different instructional
strategies.
Future Research

This project may have benefited from using an attitude survey questionnaire that was more descriptive and asked students to explain their responses for each question. Having children justify in writing their rationale for their answers would help them to more closely examine and reflect on how they feel. Additionally, it may help the person assessing the information to understand how the children's attitudes are being formed and if they understand the questions that are being asked of them.

This study also would have benefited from the inclusion of control schools that were not involved in a formal environmental education program. This would have allowed determination of whether or not changes in attitude were due to the program, or other factors. As children in all the schools had been studying migratory birds, it is possible that their attitudes may have been influenced by these studies, and that they would not otherwise have had such positive attitudes toward nature.

Finally, in the future, it would be useful to assess the relationship between children’s attitudes and knowledge toward nature. (See Kinsey, 1980, for a tool which has been developed for this form of assessment). This would provide educators with an understanding of any misinformation or naïve conceptions that students may have that contribute to their attitudes. Furthermore, it would help educators design appropriate investigations to address any gaps in knowledge.
Final Recommendations

In conclusion, to integrate schoolyard ecology into schools, teachers need training on the use of inquiry instructional strategies in their classrooms. A local should conduct workshops on the use of the schoolyard for teaching science. Finally, partnerships between teachers and community members who know about local resources are vital to support teachers as they bring nature investigations to students in their classrooms.

The schoolyard is an under-utilized resource which teachers can take advantage of to teach science and about the environment. By identifying the natural features in and around their schoolyards, teachers can provide their students with meaningful nature experiences that are locally relevant. Furthermore, forming partnerships with people that are experts on local resources in their communities can help teachers utilize local outdoor resources to their fullest extent.
Bibliography


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Appendix
Notes and Summaries of Interviews in Oaxaca, Mexico

Juan Rulfo School
Teacher

Tell me about this school.

The teacher said that this school was private and had small classrooms. Many children came to this school because they were falling behind in public school. Many children only attended the school for one year or so, and then went back to the public schools. She said that children were mandated to go to school until junior high (which is 9th grade) and then 50% went on to higher education. Many went to trade schools. The teachers had many options open to them at this school, as it was private. For example, at other schools when there were week-long strikes, which happened frequently, and the teachers were not in class teaching, this school still had class in session.

What are your thoughts about teaching about the environment?

She felt that the burning of trash was a main problem and that the best way to reach the public was through broadcasting and also through advertising.

Children

Tell me your thoughts on nature.

All the children said that they loved nature and especially loved birds. Some also mentioned liking the forest and all animals and the trees. Approximately half of the children said that trees give us oxygen and that trees are important homes for animals.
Has your town changed in your lifetime?

The children all agreed that Puerto Escondido had changed and that they could remember how it had been when they were younger. Five children identified the fact that there were less trees and more stop lights and cars. Some children said this said they were not happy with these changes. Three children said that there was more trash on the streets and that they knew this was bad for their health and for habitat.

What do you like to do in your free time?

Every child said that they liked to go to the beaches on their free time. At least half said that they liked to watch TV and play sports.

Do you like learning about nature?

They all said that they loved learning about nature.

Do you use slingshots?

Three boys said that they used slingshots. One boy said he liked to kill iguanas and that he left them where he found them after he killed them.

Benjamin Bloom School,
Head Teacher

A brief interview was conducted with the head teacher. She was very enthusiastic about her students participating in any kind of environmental education.
Tell me about this school

She said that this was a private school and that the children needed to get permission slips to do anything outside of the classroom and it was logistically difficult to therefore conduct field trips or leave the classroom.

What are your thoughts on teaching about the environment?

She said that she thought that it is very important to teach about the environment and that she liked the idea of her classes participating in learning about ecology.

Children

Tell me your thoughts on nature

The children all said that they loved nature and two girls explained how pretty they thought it was. They said that they liked looking at trees and at water and at the plants and animals.

Do you use slingshots?

Half of the boys said that they used slingshots, but stressed that it was not to kill birds.
Has your town changed in your lifetime?

All the children said that the town had changed in their lifetime and that there were less trees and more traffic. One girl said that she was very sad because her neighborhood had changed and that there were not gardens anymore.

Lazaro Cardenas del Rio School

Teachers

Juan Gama

Juan Gama was the director of the school at Las Negras and also the 3-4th grade teacher.

How long have you been a teacher?

Juan Gama had taught for 3 years at Lazaro Cardenas del Rio and for 1 year in a different school. In order to become a teacher, he had to attend 6 years of primary school, 3 years of secondary, a preparatory school for teachers for 3 years, and finally a teacher school for 4 years. During this study, he taught grades 3 and 4 and had 25 kids in his classroom.

Do you think it is important to teach about the environment?

Juan Gama believed that children needed to find out the importance of the environment in which they lived, as it was the source of all life, as well as their source of income and health. He said that it was important to put life in context and that the
ecosystem was a part of society. Mr. Gama said that children needed to be taught to be careful with the environment.

*What themes are important to you in your teaching?*

The environment was a theme that he taught in geography and also in the natural sciences that he felt was very important. He used mostly books to teach this theme, but felt that outside observations were very important.

*What are your thoughts on the activities and lessons that we did this week?*

He believed that these experiences were new for his students. He believed that his students already had strong feelings about what we were studying and really liked the theme of nature. He felt that it is necessary to teach these classes outside of the classroom. In the future he would like to take his students more in to the countryside for observations because this helps spark curiosity for the natural world. He felt that the activities were fun and also taught the students to be careful with the environment.

**Epifania Cruz Bautista**

Ms. Bautista was a teacher for grades 5 and 6.

*How long have you been a teacher?*

Epifania Bautista had been a teacher for 2 years, but had only taught at Lazaro Cardenas del Rio for one month. She had attended school for 14 years to become a teacher.
What themes are important to you in your teaching?

All themes and subjects were important to her. She named math, Spanish, science, history and geography as important. She specifically said that it was very important to teach about nature and to teach children to protect it. She felt it was hard for students to understand the importance of the natural world. She thought it is important to go outside and learn to observe because even though they live here, the children don't learn to observe. She felt that if her students learned to observe better, they would take care of nature and it appreciate it more.

What are your thoughts about the activities that we did this week?

She liked the activities because she felt that they helped the students learn about the place where they lived and about all the organisms that lived there too. She would have liked time to investigate the lagoon. She said that the unit was very helpful to her students. They enjoyed what they learned and she felt that it was important to teach them about the environment using both books and the outdoors.

School Superintendent

Although I did not interview the superintendent, he came by to see what I was doing and to ask me a few questions. Much of the time he spoke with Juan Gama and I had a difficult time understanding what was said, as he spoke a native dialect that I did not understand. However, I was able to ask him what he thought of the program and he was very pleased. He felt that it was very important for students to have this opportunity
to study the natural world. He talked about how much the town had grown and changed
and his belief that children needed to learn to take care of nature.

Children

Tell me about Manialtepec Lagoon.

All seven children liked the lagoon very much because they said it was pretty. They all said that they liked to fish on the lagoon and all spent a lot of their time there.

Tell me about your families.

All seven children told me that their families were fishermen and campesinos. An 8 year old girl told me that her parents worked in the countryside moving trees and farming.

What do you like to do in your free time?

All the children told me that they liked to spend time on the lagoon in their free time. They also mentioned passing their free time doing homework, playing and fishing.

Do you use slingshots?

They all said that they did not use slingshots.
Has Manialtepec changed in your lifetime?

Two of the nine year old boys told me that the lagoon was drier now and that there was more mud as well. They knew that many birds had died, but did not offer their opinion on the situation when asked.

Do you like to study nature?

All the kids said they very much liked to study and learn about nature. They said that it was pretty. They said that looking for birds and animals was fun and that this made going to the same places more fun. One boy said that he liked to go swimming and be near the water. He said that sometimes he looked at the plants and animals around the water. This (the schoolyard inquiry) makes me want to look at them more.

Aguaje del Zapote

Teacher

Margarita Rosea

Margarita Rosea was the teacher of grades 4 to 6.

How long have you been a teacher?

Ms. Rosea had been a teacher for seven years. She had taught for 2 years in this school and attended teacher training for 4 years.
What are your thoughts on teaching about the environment?

She felt that it was very important to teach about the environment since the children lived in a place where there is so much nature and they didn't have much knowledge of it. She believed that it was important to help the children learn to appreciate the natural world.

Do you teach about this topic now, and if so, how?

She said science text-book supported teaching about the environment by using drawings and experiments. She acknowledged that it is very hard for these children to buy or order supplies in the area because there is nothing. In order to get supplies, they had to go to Puerto Escondido and they can't because the economic base was so low.

What do you think of studying nature outside of the classroom?

She thought that this was a very good idea, but that it wouldn't be good if it involved having to buy things. She said there was so much nature in the area that it could support outside studies. She felt that her students had enjoyed the lessons.

Are there restrictions to doing this type of outdoor teaching?

She said that there were no restrictions, except time.

What themes are important to you in your teaching?

Although she said all themes were important to her, Spanish and math were the most important, and everything else less so. She said that most of her students graduated and finished school after sixth grade and had to know how to read and do basic math.
Community Members

Gina Machorro

Gina was familiar with the town of Puerto Escondido, as this was where she worked. However, she also knew a lot about the region and its people, as she has been a local resident for many years.

How do the majority of people make a living?

(In Puerto Escondido) Sixty percent of the people earned a living off of tourism. The majority of the people outside of the city earned a living growing peanuts, papayas, sesame, limes and mangoes.

Do you think tourism is a good option for your town and the people?

Gina felt tourism was an option, not better or worse, however she felt that it could improve the lives of many people. She felt that outsiders helped influenced the growing desire to keep the city clean.

What themes do you think are important to teach the children?

Gina felt that basic survival was very important. For example, teaching children to keep their hands clean. She felt that children killed animals for the fun of it or out of boredom and that they needed to be taught that wildlife was a finite resource.
Anatolia Marquez

Anatolia Marquez was a local woman who had grown up on the Oaxacan Coast and knew a tremendous amount about the people and the community. She was a wildlife tour operator specializing in birds. She helped teach classes in this study.

_Do you think it is important for the kids to learn about nature?_

Ana felt that it was very important for children to learn about the natural world and that there were many serious environmental problems that the children needed to study. She felt that the local economy was based so strongly on the environment that if it were not protected, the region would suffer.

_Are there limitations to teaching these things?_

Ana felt that the biggest limitation was that most teachers did not know enough about the natural world to teach about it and that there were not enough materials from which they could study.

_What themes are important to teach the children?_

Ana felt that teaching children about the natural world was a very important skill as were the basics of math and language.