AN ABSTRACT OF THE THESIS OF

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This study involved the development of two bilingual and inquiry-based forest education programs within the Central Willamette Valley of Oregon. The first program used the participatory research (PR) process to engage 7th and 8th grade Latino students as participatory researchers to interview members of their community to learn their perspectives on forestry professions. Students developed a bilingual questionnaire and were trained in interview techniques. Results from the PR process indicated that Latinos had an interest in working in the forest to learn more about forest plants, animals, and ecology while being outdoors. These results informed the development of the second program, the Forest Field Program (FFP). The FFP lasted an academic year and enabled students to work collaboratively in designing and implementing their own observational study of the forest. Students were guided through the collaborative inquiry process to develop research questions and a hypothesis, design research methods and materials, conduct data collection and analysis, and present their findings. Participants also learned about four different forestry professions. The FFP was evaluated using pre/post questionnaires and tests as well as summative interviews with program completers as well as a small sub-sample of parents, teachers, program staff, and dropouts. Results from the FFP evaluation indicated that the program facilitated an overall significant (p=0.01) increase in students’ awareness of forestry professions and an improvement in
their inquiry skills. There was partial evidence from the evaluation to suggest that the FFP facilitated an increase in students’ collaboration skills as well as their self-efficacy of inquiry and collaboration skills. Meanwhile, little evidence suggested that the Forest Field Program increased students’ interest in forestry professions. Effective program components included hands on, inquiry-based, and collaborative activities. Future studies might examine strategies for lowering attrition rates and include an experimental control group in study design.
The Forest Field Program:  
A Case Study in Forest Education for Latino Youth

by
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I wish to express sincere thanks to Ed Jensen, my major professor, who enabled freedom and flexibility of study while providing necessary support and feedback. Many thanks to José Diéguez who was not only a willing but an enthusiastic partner during the process of program development and implementation. Generous partnership on behalf of Mr. Diéguez as the community liaison for Latinos in Forestry gave rise to project efforts and provided the necessary capacity to sustain them. Great appreciation goes to John Bliss who was instrumental in securing early funding for the participatory research process through the Community Forestry Research Fellowship, 2006-2007. Special thanks to Nam-Hwa Kang who encouraged me with great enthusiasm and helped shape early ideas of studying inquiry-based education for Latino youth, meanwhile providing thoughtful and timely insight throughout the course of the project. Additional thanks goes to the Friends of Paul Bunyan Foundation for providing the necessary financial support to cover the cost of transportation and staff time for the Forest Field Program. Thanks goes to all students, parents, and teachers who participated in this project. I thank God for inspiring all that is good and meaningful and for blessing me with wise and enthusiastic advisors, financial resources, and wonderful participants.
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INTRODUCTION

Hispanic or Latino American populations continue to grow and have implications in both natural resource management and science education in the United States. Currently, Latinos are underrepresented in natural resource professions and under perform in grade school science. To address concerns of the Hispanic workforce in natural resources and Latino youth in science education, the current study, following a participatory research-based needs assessment, implemented a youth forestry education and vocational program (intervention) for Latino students. The Forest Field Program (FFP) was aimed at addressing gaps in Latino awareness and education related to professional forestry opportunities while improving students’ collaborative inquiry skills among 7th and 8th grade Latino students from the Central Willamette Valley, Oregon. The FFP was implemented in partnership with the Latinos in Forestry Program at Oregon State University, extending its capacity for program work among middle school youth.

Hispanics comprise this country’s largest ethnic minority group and at current growth trajectories are predicted to become the major minority group through the first half of this century, which will have implications within the field of natural resources. In Oregon, 50% of the current immigrant population arrived during the 1990’s and many of these immigrants were from Latin America (Hutchins, 2006). This rapid increase of the Latino population can pose a challenge for natural resource agencies, which have engaged Latinos as stakeholders to a lesser extent than the majority culture, as they try to address their Hispanic audience (Chavez, 2005; Chavez, 2002; Allison, 1992; Valenzuela, 1995; Rideout, 1999; Virden & Walker, 1999; Heywood & Engelke, 1995). Without input and stakeholder involvement of Latinos, natural resource management agencies run the risk of becoming irrelevant to a rapidly growing segment of the U.S. population. In the words of Moote and others: “The diversity of both human and ecological communities requires that community-based ecosystem management processes be explicitly inclusive” (2001, p.99). Natural resource agencies may be faced with limited capacity to involve Latinos in stakeholder decision making processes. This
challenge can be addressed through efforts that increase Hispanic participation in such planning processes (Lopez et al., 2005). These efforts of inclusion can begin by using participatory research to develop a better understanding of why Hispanics are underrepresented in forestry professions.

In Oregon, the Central Willamette Valley is a strategic setting for undertaking participatory research related to natural resources within the Latino community. Geographically speaking, the Central Willamette Valley is situated east of the coast range, west of the Cascade mountain range, south of Portland and north of Corvallis, Oregon. Much of this land is productive farm land and central to the nation’s nursery industry. As a result, Hispanic workers have migrated to this area since the 1920s. Since the 1970’s, Mexicans have also found work in Oregon’s forest industry (Sarathy, 2006).

Most of the Hispanic migrant workers in Oregon have come from Central México. However, Hispanics in the Central Willamette Valley are emigrating increasingly from the states of Vera Crúz, Oaxaca, Guerrero, or from within the southwestern United States and California (Dash, 1996). Workers from the Central American countries of El Salvador and Honduras live in the Valley as well, although in smaller numbers. Over time, Latino migrant workers have established families and social networks within the Central Willamette Valley where a concentrated population of Hispanics exists today.

Despite more than three decades of laboring within the forest industry of Oregon, the degree to which Hispanics are represented professionally in forestry is lagging, especially in proportion to the numbers of Hispanics who occupy “low quality” forest jobs (Moseley, 2006, p.129). In Oregon, and in particular the Willamette Valley Hispanics account for much of the unskilled labor force in forestry (e.g tree nurseries, reforestation, and restoration), industries where unskilled workers have been subject to ongoing abuse (Melton, Debonis, & Krasilovsky, 2007; Knudson & Amezcua, 2005). Although Latino forest laborers are increasingly becoming contractors with substantial representation in this realm of forest management (Sarathy, 2006), the abuses of piñeros are systemic, persisting even under Latino contractors (Cassanova, 2006), suggesting that
Latinos in general are experiencing professional status in only the most hostile and disparaging of management environments. For example, forest management companies and agencies often hire through contractors who frequently replace workers with lower-wage immigrants recently recruited from México. This results in a glut in the available workforce, driving down wages (Dash, 1996). Furthermore, in an effort to cut costs and be highly competitive in securing forest management contracts, contractors have tended towards a core-periphery management style, “in which a small core of people enjoy benefits, high wages, stable employment, while a much larger periphery are in a highly competitive lowest-wage-possible pool of workers who have no effective rights or legal recourse” (Brown & Marín-Hernández, 2001). The H2B guest worker program in the U.S. would provide a steady stream of up to 66,000 workers per year (Bruno, 2006) for jobs that, in the sentiments of many including President Bush, “many Americans will not even consider” (United States Immigration Support, 2006). As these jobs have gone unwanted, the plight of migrant workers has gone virtually unnoticed among most Americans. In Oregon, more and more of these undesirable jobs are in forestry, a sector that has utilized the program in other regions of the U.S. more than any other sector for the last decade (McDaniel & Casanova, 2005).

While overrepresented in the poorest working conditions, Latinos are underrepresented in professional fields within forestry. Hispanic Americans are found infrequently among forestry related faculty positions and student bodies at universities as well as in the scientific workforce (Otero & Brown, 1996). They are also absent in disproportionate numbers from professional positions within the U.S. Forest Service, the largest single employer of forestry professionals in the United States (Kuhns et al., 2002). In light of the hazardous, exploitive, and unstable working conditions among Latino forest laborers- piñeros (Knudson & Amezcu, 2005) it may seem unsurprising that second generation Latinos have looked to other sectors for professional work. In addition to addressing concerns related to the Latino workforce in natural resources, the current study addressed science education concerns of Latino students.
As an appropriate setting for addressing underrepresentation of Hispanics in forestry professions, the Central Willamette Valley is also a strategic setting for addressing science education concerns pertaining to Latino American students. The political boundaries of the Central Willamette Valley include one main county and four primary cities where Hispanics reside in average or above average numbers compared with other cities throughout the state, but with below average levels of formal education compared with the rest of the population. The Central Valley, where Salem and Woodburn are located, is situated in Marion County. Within these two cities the total Hispanic population in 2000 was 30,061, roughly 19% of the total population, which was 6.5% higher than the national average and more than twice as high as Oregon’s overall Hispanic population. The percentage of Hispanics in Woodburn was especially high, (50.1% of the total population). Meanwhile, the percentage of Woodburn’s population with a high school diploma (58.1%) was exceptionally low. Only 10.8% of Woodburn’s residents have a bachelor’s degree or higher1 (U.S. Census Bureau, 2000).

These lower levels of formal education are consistent with the findings from other sources as well. According to the Oregon Progress Board (Conrad, 2002) the percentage of 8th grade Hispanics that met Oregon’s reading standards in the school year 2001-02 was lower than that of white non-Hispanics, African Americans, and Native Americans. Compared to Asian Americans, the rate was nearly half and was even lower for mathematics benchmarks. In a report for the American Association for the Advancement of Science, Triana and Rodriguez (1993) found a host of barriers to academic achievement for Hispanic students. In summary, Hispanic children were less likely to have early childhood education and more likely to be retained one or more grades. A specific finding on performance in scientific inquiry was that for grades eight through twelve, Hispanics scored particularly low in analyzing scientific procedures and data and integrating scientific information. Out of the Mathematics and Science for Hispanics (MASH) Summit in 1992, a key recommendation was that educators “Develop and employ mathematics and science curriculum that incorporates culturally relevant, real

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1 The respective education statistics for the U.S. aggregate are considerably higher: 80.4% have a high school degree and 24.4% have a bachelor’s degree or higher (U.S. Census Bureau 2000).
world contexts and that emphasizes experiential learning (Triana & Rodriguez, 1993, p.27).

Given these findings, a strong case can be made for seeking ways to improve Hispanic’s academic performance by exploring the role of a place based and natural resource education paradigm as a way to engage and empower Latino youth. The current research is predicated on the concept of a proverbial pipeline in which students are siphoned from high school into college, and then from college into the workforce. In the case of Latino students, the pipeline to universities often involves two year community colleges (Triana & Rodriguez, 1993). Although the pipeline may appear to begin in high school, students begin developing professional aspirations much earlier. This research also stems from the current context where Latinos are underrepresented in forestry professions.

Within this context, the current project seeks to learn whether young Latino Americans can expand their awareness of forestry professions, particularly careers requiring at least a college degree, while developing their science inquiry skills, which are required in many natural resource management professions, entry into higher education, and success in college. An additional focus on collaboration skills is based on the literature that suggests students learn best through active dialog and are often more engaged when working as part of a team for complex problem solving. The objectives of this research include creating increased interest in and awareness of forestry professions, improved self-efficacy of inquiry and collaboration abilities, and increased performance in science inquiry and collaboration skills among Latino middle school students. These outcomes will be measured both quantitatively and qualitatively. To measure the impact of this study’s Forest Field Program on achieving the aforementioned objective, this study posed the following six research questions related to Latino youth, their interest and awareness of forestry professions, inquiry abilities, and collaboration skills:
(1.1) **Research questions**

- **Question #1**: Will students who complete this program report more interest in forestry professions than when they began the program?
- **Question #2**: Will students who complete this program show greater awareness of forestry professions than when they began the program?
- **Question #3**: Will students who complete this program report greater self-efficacy in their inquiry skills than when they began the program?
- **Question #4**: Will students who complete this program demonstrate improved inquiry skills compared to when they began the program?
- **Question #5**: Will students who complete this program report greater self-efficacy in their collaboration skills than when they began the program?
- **Question #6**: Will students who complete this program demonstrate improved collaboration skills compared to when they began the program?

The hope of this study, although beyond its scope of measurement, is to one day increase performance among Latino students in science, promote entry into college, and increase Latino representation in forestry professions. While the short term objectives of this study are important in terms of program evaluation and are the focus of this thesis, the long term impacts of this study may have broader implications for society and workforce aspects of forest management.
(2) LITERATURE REVIEW

(2.1) Overview

The current study involves the design and evaluation of a Forest Field Program that addresses workplace and education concerns with respect to Latino student and within three integrated areas of focus: increasing students’ vocational interest and awareness of forestry professions, increasing self-efficacy of collaboration and inquiry skills, and improving science inquiry among middle school students. This study’s participatory research and forest field programs are rooted in pedagogical theory by Freire. To inform the design of the Forest Field Program according to best practices, I reviewed the literature on four areas of study that relate directly to my research objectives and research questions: vocational guidance, self-efficacy, collaboration skill development, inquiry skill development. To understand more specifically how I might use different pedagogies and learning theories to support program design around these four areas of study, I reviewed the literature on Participatory Research, Problem-based Learning, Place-based Education, Situated Cognition Theory, Project-based Learning, and Environment as an Integrating Context. I also reviewed literature on bilingual and bicultural education to meet the needs the program participants.

Despite recruitment efforts, Latino Americans are underrepresented in forestry professions at institutions like universities and agencies like the U.S.D.A Forest Service (Kuhns et al., 2002; Otero & Brown, 1996). Underrepresentation in forestry professions is not only a current issue but a looming problem when one considers that Hispanic youth comprise more than 18% of the U.S. population. By the year 2020, it is estimated that Hispanic youth will comprise 23% of all U.S. youth (U.S. Hispanic Chamber of Commerce, 2006). Meanwhile, as Latino students are not drawn toward forestry professions, in Oregon they continue to perform poorly in science academics (Conrad, 2002). Addressing the issue of underrepresentation of Latinos in forestry professions
and the underperformance of Latino students in science can be accomplished simultaneously through education programming.

(2.2) **Fundamental Theory and Research**

The literature review that follows examines the literature on Freire’s educational theory as well as studies that have explored research topics that are related directly to the hypotheses of this thesis. Freire’s theory is discussed first, followed by literature on vocational interest and awareness, self-efficacy, collaboration skills, inquiry skills, and collaborative inquiry.

(2.2.1) **Freire**

According to Paulo Freire (1970), the contents of traditional education tend to involve excess narration, where a teacher is responsible for doing most of the talking and students are responsible for doing most of the listening. Freire refers to this kind of education as the “banking concept of education, where knowledge is a gift bestowed by those who consider themselves knowledgeable upon those whom they consider to know nothing,” which in turn “negates education and knowledge as processes of inquiry” (p.58). Freire (1970) envisioned education reform as a shift from the classroom to more authentic contexts, which can be organized programmatically. For instance, instead of learning about a subject through lectures alone, students can learn about a subject experientially in settings more relevant to the subject at hand.

Freire’s theory on education reform is the basis of program design for the current study. Addressing the issue of underrepresentation among professional Latinos in forestry and the underperformance of Latino students in science can be done through inquiry-based programs where students are situated in a place of interest (i.e. their community, natural environment) and undertake a problem (or question) of study while acting as research participants, engaging collaboratively through bilingual dialogue. The
learners, instead of passive listeners, become “critical co-investigators in dialogue with the teacher” (Freire, 1970, p.68).

(2.2.2) Vocational Interest and Awareness

Arrington (2000) asserts that for students to think sufficiently about their career options they need a “foundation of career awareness and career exploration experiences” (p.104). To provide this foundation, she suggests that educators can integrate career competencies into an academic curriculum that includes cooperative learning. In holding minority students to high expectations, institutional support in the form of sensitive counseling is an important component (Lucas et al., 1990). Counselors need to recognize that students and their families may not be familiar with navigating the educational system (e.g. finding information about colleges and preparing applications). Counselors should involve the entire family in the process of advocating for students’ vocational and career decisions, focusing on the potential of the student with an awareness of expanding the possible pathways for the student to pursue. “Without evaluating access to their services, counselors will continue gatekeeping just as their well-intentioned predecessors did” (Hawks & Muha, 1991). Vocational services also need to be made accessible to students before it’s too late.

Career interventions must be timely. One survey of 500 parents (PGI Research, 1998) found that 54% of K-12 parents thought the most appropriate time for schools to introduce vocational information to students is in middle school, compared to high school (28%) and elementary school (19%). To increase the relevancy of vocational material presented to middle-school students, it can be integrated with academic curriculum. The Gaining Early Awareness and Readiness for Undergraduate Programs (GEAR-UP) integrate career education into middle school curriculum while utilizing community partnerships to increase students’ career awareness (Marcos, 2003).

Ethnicity should also be factored into career development programs. While students may aspire to attend college, cultural norms (e.g. staying close to home) may
influence a student’s decision on whether or where to attend post-secondary education (Sanchez, 2006).

“An ethnic group may be defined as a reference group called upon by people who share a common history and culture, who may be identifiable because they share similar physical features and values and who, through the process of interacting with each other and establishing boundaries with others, identify themselves as being a member of that group” (Smith, 1991, p.181).

Ethnic groups also serve as reference groups, which help shape an individual’s goals and perspectives; consequently, one’s ethnicity has implications for career aspiration (Arbona, 1989; Arbona, 1990; Arbona, 1995; Arbona & Novy, 1991; Bowman, 1993; Fouad(b), 1995; O’Brien et al., 1999; Gushue et al., 2006; Lauver & Jones, 1991; Church et al., 1992; Church & Reeves, 1990). For instance, a career that may be valued by one ethnic group might not be valued by another. Tapping into the vocational interests of a particular ethnic group involves understanding its culture and values.

As identity is an important part of career development (Vondracek, 1992), career intervention strategies for ethnic minorities should include both male and female role models of the same ethnicity while incorporating the students’ language and culture (Bowman, 1993). There is evidence that programs that are not designed for cultural appropriateness may not be effective for all students. Fouad (1995b) measured the effects of a year-long intervention at an urban, inner-city middle school in Wisconsin. The intervention was designed for eighth grade students and integrated math and science career awareness into curricula. The intervention (including a group field trip, guest speakers, and job shadowing) was assigned to one group of students and was withheld from a control group. Fouad found that the pre- and post-test results for the intervention group indicated an increase in knowledge about fields of occupations, attributes required in various occupations, and duties, but only for white students. O’Brien et al. (1999) developed a career awareness intervention that recognized and addressed cultural factors in career development with students (i.e. through discussions), however their study
stopped short of measuring the effects of the intervention on minority students versus non-minority students. Nonetheless, the authors recommended career interventions provide period contact with students throughout the year and aim towards understanding how ethnicity can interact with students’ career development.

Career awareness interventions specific to Latino/a populations should consider career decision-making factors specific to this population. Few studies have focused on these factors (Arbona, 1995; Fouad(a,b), 1995; Gushue, 2006). Arbona (1989) examined in which particular Holland work groups (these conceptual categories include Realistic, Investigative, Artistic, Social, Enterprising, and Conventional). By analyzing 1980 Census data, Arbona found that among Hispanics, 43% were employed in “Realistic” (i.e. systematic, hands on) jobs whereas only 5% were employed in both Investigative (i.e. abstract, systematic problem solving) and Artistic (i.e. aesthetic expression) categories, combined. She suggests the importance of Hispanic role models across occupations in Holland typologies. In a review of twenty years worth of literature regarding career counseling as it applies to Hispanics in the United States, Arbona (1990) found that family and cultural values influenced Hispanics’ career mobility.

Meanwhile, Arbona also found studies of junior high and high school students to reveal that Mexican-Americans usually have high occupational and educational aspirations, but lower expectations of achieving these aspirations when compared to their white peers. These lower expectations are probably related to students’ career self-efficacy: their self-perceived ability to succeed in specific occupations (Church et al., 1992; Church & Reeves, 1990; Lauver & Jones, 1991; Clement, 1987), and, to some extent, the levels of education required for certain occupations (Bores-Rangel et al., 1990). In a subsequent meta-analysis, Arbona (1995) also found that both one’s interest and self-efficacy beliefs (one’s perceived capabilities) tend to predict one’s consideration of occupations. The author suggests that as a result of their minority status and more limited economic resources, many Hispanics have probably not had adequate experiences for their development of career self-efficacy through “performance accomplishment
regarding vocational and academic pursuits and exposure to successful role models” (p.57).

(2.2.3) Self-efficacy

Self-efficacy can be defined as one’s self-perceived ability to perform a skill or complete a task. “It is concerned not with the skills one has but with judgments of what one can do with whatever skills one possesses” (Bandura, 1986, p.391). One could consider self-efficacy to be the seed of performance insofar as one’s decisions and performance can depend on one’s self-efficacy. For instance, one who feels low self-efficacy for a skill will tend to avoid situations where this skill will be required. It also affects their persistence in a task, as those with lower self-efficacy will tend to give up more readily and dwell on their perceived deficiencies whereas those with higher levels of self-efficacy will “be spurred by obstacles to greater effort” (Bandura, 1986, p.394). Consequently, self-efficacy can also affect one’s motivation within the realm of task performance. Thus, one’s self-efficacy may influence one’s performance in a given subject and subsequent academic and career choices (Betz & Voyten 1997; Lent et al., 1991); a higher sense of self-efficacy in performing a skill encourages one to pursue related tasks in the future.

One way to measure a learner’s self-efficacy of a given academic or social task is to present a written description of the task and ask the learner to identify his or her ability to accomplish the task successfully (Bong & Skaalvik, 2003). In other words, ask the learner, “How confident are you that you CAN…?” This is commonly done using a Likert-type scale and evaluative statements. A highly specific self-efficacy measure is one that measures a student’s confidence in performing certain skills (Klassen, 2002). Well designed interventions focusing on developing a specific task or skill set can be successful in increasing the students’ self-efficacy in that area, while improved performance in other seemingly related areas may be negligible (Poynton et al., 2006).
Therefore, in designing self-efficacy measures to evaluate an intervention, it is important to be specific in measuring skills that are addressed by the intervention.

Bandura’s theory of self-efficacy states that there are primary factors that influence self-efficacy beliefs: 1) previous performance of a task, 2) exposure to models of efficacy, 3) identification with models of efficacy, 4) reinforcement/encouragement from others, and 5) emotional or physiological arousal while performing the task (Bandura, 1986). Of these factors associated with self-efficacy, Bandura found that for most students past performance is the greatest predictor when performance is based in an authentic context (1986). For Hispanic youth however, social persuasion, or “the expectations that parents, teachers, and peers communicate to the child” (Chin and Kameoka, 2002, p.454), is the greatest predictor of a students’ self-efficacy beliefs. Expectations can be informed by previous academic performance, indicating that establishing good performance may be particularly important for Hispanic students in maintaining self-efficacy. In addition to good performance and positive social persuasion, proximal goals can also lead to higher self-efficacy. Breaking up tasks and providing early feedback on skill performance can help students establish short-term goals and facilitate development of one’s self-efficacy (Schunk, 1984).

(2.2.4) Collaboration Skills

Collaborative learning enables students to work in a participatory setting as part of a team and can give students an opportunity to develop leadership qualities, which addresses an institutional recommendation from the Math and Science for Hispanics Summit (Triana & Rodriguez, 1993). Effective collaboration involves different behaviors of team members: 1) identifying objectives of a task, 2) mutually answering questions, 3) determining course of action including time frame and member roles, 4) exchanging and discussing ideas, and 5) integrating ideas (Rummel & Spada, 2005). Communication within collaborative contexts can be classified into three types: idea communication, idea negotiation, and idea consolidation (Jehng, 1997). Rummel and
Spada (2005) found that providing learners with a “cooperation script,” a guide for how to collaborate effectively, can improve subsequent collaborative efforts among individuals in a computer-mediated context.

Before embarking upon collaborative discussions, students can establish “ground rules for exploratory talk” (Dawes & Sams, 2004, p.98). Before establishing ground rules, students should be familiar with how to challenge each other’s ideas with respect, make rational arguments, and how to negotiate ideas (Dawes & Sams, 2004). Students should also know that when working as part of a group, challenging the ideas of others in a rational way is productive. All students should know that sharing their thoughts and knowledge is essential and all students should strive to describe the reasoning behind their ideas. Ground rules in exploratory talk within collaboration can be a pragmatic and effective means of facilitating group work while increasing individual reasoning performance (Wegerif, Mercer, & Dawes, 1999). Ground rules are effective when students generate them. Students can be prompted to generate ground rules by asking them what they think makes a good discussion. The following are some ground rules that were established using this exercise with 9-10 year olds (Wegerif, Mercer, & Dawes, 1999):

- “We will share what we know with each other.”
- “We will ask everyone to say what they think.”
- “Everyone should listen to others.”
- “We will think about what to do together.”
- “We will give reasons for what we say.”
- “We will decide what to do only when everyone has said all they want” (p.98).

Additional recommendations for successful collaboration include heterogeneous grouping, framing problems as group problems versus individual problems, modeling collaborative language and behavior, instructor feedback on group processing and rewarding positive behaviors (individually and collectively), and student self-assessment
Collaborative tasks can be worked on by students in small groups of three to four and students can be assigned functional roles within the group. Under these conditions, peer collaboration can support conceptual development among students who work in a group of peers with differing ideas about a given concept (Howe et al., 1995). Group roles are context specific, but can usually include a leader/manager/organizer, recorder, technician, questioner, reflective thinker, encourager, and reader/reporter (Lin, 2006).

The aforementioned modes of facilitating collaborative group work are centered on convergence. “It is proposed that the crux of collaboration is the problem of convergence: How can two (or more) people construct shared meanings for conversations, concepts, and experiences?” (Roschelle, 1992, p.235). It is relevant to examine students’ collaboration skills and self-efficacy of collaboration skills because collaborative activities among peers can improve students’ task performance (Forman & Larreamendy-Joerns, 1995). From a theoretical perspective, cognitive development occurs when there is dissonance among individual opinions and individuals seek resolution through cooperative interaction. Piaget’s perspective focuses more on the interaction among peers while Vygotsky’s theoretical perspective asserts additionally that cognitive development is more likely when a less advanced learner is paired with a more advanced one (Tudge, 1992). Tudge (1992) took a Vygotskian approach and studied performance results among pairs of children (ages 5-9) and found that students’ performance on a task was more likely to improve if the student was paired with another student who was more skilled in that task. These results of differential improvement through collaborative learning are consistent with the literature [citations]. In a discussion of a case study on convergence mechanisms of collaboration, Roschelle (1992) posits that social-cognitive process of convergence is perhaps complimentary to Piagetian and Vygotskian theoretical perspectives insofar as “[d]emocratic participation, intellectual progress, and gradual convergence are base attributes of social inquiry practices that enable scientists to undergo conceptual change” (p.272).
Studies support theory, suggesting that the process of collaboration can facilitate cognitive development. According to Kruger (1993) true collaboration involves discussing more than one solution from more than one perspective. Consequently, collaboration inherently involves both conflict and cooperation when an end result is derived as individuals co-construct understanding in the process of problem solving; “[Collaboration] is both dissection and creation” (p.179). Kruger found that when students dispute multiple perspectives, they develop cognitively and engage intellectually. Therefore, discourse is an important part of scientific reasoning or inquiry.

The more discourse that occurs within a peer group in problem solving, the higher complexity of reasoning within the group (Hogan, Nastasi & Pressley, 2000). Discussions are commonly used in problem solving and exploring different concepts (Brookfield, 1998). Brookfield suggests that guided discussion is an oxymoron, as the purpose of discussion is to explore different ideas, and recommends that facilitators of conversation refrain from entering group discussions with an agenda. Minimizing the role of facilitators in conversations may encourage learners to render more diverse perspectives on a given topic while “externaliz[ing] the assumptions underlying their values, beliefs, and actions” (Brookfield, 1998, p.174). The resulting conversation may therefore contain more elements of complexity and ambiguity, which are cornerstones of critical thinking and (Brookfield, 1998).

However, teacher guided discussions can reach similar levels of complexity but with less discourse, making them more “efficient” (Hogan et al., 2000, p.421) and perhaps more appropriate for younger learners who may become easily distracted in the presence of too much ambiguity. This efficiency occurs as a result of the teacher’s ability to initiate questions that can lead students to answers that can progress the group’s reasoning about the topic. This mode of questioning is known as the Socratic method of teaching: asking questions to guide students toward clarity of expression and resolution of different viewpoints (Paul, 1995). When using the Socratic method, the facilitator should allow enough time for student responses before interjecting. Brookfield (1998) points out that pauses can be often mistaken as a sign of disengaged learners, but that
quality conversations should be measured not by the number of comments made and absence of silence. Instead, a quality discussion usually includes room for thoughtful silences. While the Socratic method is a time honored pedagogy, it may be more effective with some students than others, as learner efficacy can interact with the effectiveness of Socratic dialogue. When Socratic dialogue was used as part of a web-based collaborative learning system (Web-Soc) for computer programming instruction, Chang et al. (1999) found that Web-Soc facilitated learning among lower achieving students but not among higher achieving students.

(2.2.5) Inquiry skills

Inquiry is commonly used in science and has been defined by the National Research Council (NRC, 2005): “Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations” (NRC, 2000, p.23). Inquiry-based instruction engages students in the investigative process to both provoke and satisfy curiosities, which includes “seeking an answer, solution, explanation, or decision” (Haury, 1993, p.3).

The process of inquiry can be described as a cycle. A general model of the inquiry cycle begins with a question, informed by some prior information or observation, and ends with a question (See Figure 2.1):
This cycle can be assessed using a reflective assessment on behalf of the student (White & Frederiksen, 1998). Students can be presented with criteria for judging scientific research, which can help students set goals for themselves and more effectively work towards standards. The following criteria for judging research was used by White and Frederiksen (1998) as a way to facilitate self-assessment, a metacognitive process they refer to as “reflective assessment.” Students in their study were asked to “[c]ircle the score that you think your work deserves” (p.26) for each of the following criteria:

- Understanding the science
- Understanding the processes of inquiry
- Making connections
- Being inventive
- Being systematic
- Using the tools of science
- Reasoning carefully
• Writing and communicating well
• Teamwork

According to the NRC (2000) inquiry in the classroom has defining characteristics: “Learners are engaged by scientifically oriented questions; learners give priority to evidence, which allows them to develop and evaluate explanations that address scientifically oriented questions; learners formulate explanations from evidence to address scientifically oriented questions; learners evaluate their explanations in light of alternative explanations; particularly those reflecting scientific understanding; learners communicate and justify their proposed explanations” (p.25). The focus on these “essential features of classroom inquiry” is on less direction from the teacher or material and more self-direction on behalf of the student.

Science education reform has promoted the use of science inquiry (Gibson, 1998) and approximately 25% of the National Assessment of Educational Progress (NAEP) items at the eighth grade level measure skills and comprehension of scientific inquiry (Neidorf et al., 2006). Although there is some evidence to suggest that inquiry-based approaches can facilitate learning among Mexican American students (Rodriguez & Bethel, 1983), Rodriguez (1997) cautions against this reform without a body of supporting empirical evidence that inquiry approaches will be effective across ethnic, socioeconomic, and gender groups. Rodriguez observes that ethnic minority groups are not addressed once in the entire 262 page report on the National Science Education Standards. In the words of Migdalia and Stalzer (2003): “Hispanics, for example, are a growing population with strong scientific potential if U.S. teachers consider the culture and interests of these students as motivational tools in preparing lessons” (p.64).

Considering the culture and interests of Hispanic students as while developing vocational awareness around forestry professions could be as simple as inviting students to identify a scientific topic of interest and integrating that topic into vocationally related activities. Nonetheless, gaps in science performance for Hispanic students when compared to Anglo and Asian American students persist. In addressing science performance, inquiry is an important place to start. White and Frederiksen (1998) found that “learning
inquiry improves students’ learning of science concepts, laws, and models as well as their ability to use them in analyzing new situations” (p.74) and that “learning inquiry is particularly effective in meeting the needs of educationally disadvantaged students” (p.75). Reform programs that promote inquiry education may find success with integrating collaborative settings.

(2.2.6) Collaborative Inquiry

Inquiry-based instruction and collaborative learning are often associated (Hsu, 2004; Gibson, 1998; Palinscar & Herrenkohl, 2002; Bilics & Lerch, 2001). Inquiry-based instruction, because of its frequent use of student collaboration, has been found to increase students’ social skills in the context of cooperation (Gibson, 1998). Johnson (1976) found that because inquiry-based learning often requires a cooperative learning atmosphere, inquiry-based instruction should include guided cooperative activities. Chang and Mao (1999) found that Taiwanese 9th grade students performed better while working in a cooperative learning setting (e.g. small group teamwork) with inquiry-based activities in learning earth science. Berger et al. (1999) found that self-efficacy of collaboration and inquiry skills increased over the long term as a result of a collaborative inquiry laboratory learning environment. Using both quantitative and qualitative methods in a study of forty high school freshmen, Hsu (2004) found that a Web-based learning environment could increase students’ inquiry skills while working collaboratively. The gains were especially apparent among students with lower baseline skills and that mixed groups of students with high and low skills increases the “weak learners’” motivation and participation. Inquiry, referred to as “science process skills,” were operationalized (based on Gagné, 1965) as basic and integrated skill sets. Basic skills included classification, communication, prediction, and inference. Integrated skills included identifying variables, constructing a table of data, creating a graph, describing relationships between variables, gathering and processing data, forming hypotheses, defining variables operationally, designing investigations, and experimentation. Chang et
al., (2003) proposed a four phase model, which includes “generating hypotheses, collecting data, interpreting evidence, and drawing conclusions” (p.56) for collaborative inquiry learning in a computer mediated context. I adapt this model for the current study, adding an additional phase of study design and modifying other phases (See Methods).

Cooperative inquiry allows participants to act creatively whereby “all those involved work together as co-researchers and as co-subjects. Everyone is involved in the design and management of the inquiry; everyone gets into the experience and action that is being explored; everyone is involved in making sense and drawing conclusions; thus everyone involved can take initiative and exert influence on the process (Heron and Reason, 2002, p.179). Heron and Reason (2002) have proposed a similar four phase model to the co-operative inquiry process:

Phase I: Exploration and development of a research plan
Phase II: Engagement in the plan
Phase III: Full engagement in the plan
Phase IV: Organization and presentation of data

With each subsequent phase the participants become increasingly cognizant of their experience within the inquiry process. Meanwhile, by phase III, participants may become so engaged in their experience that they have forgotten they are part of an inquiry process.

While many studies have demonstrated that inquiry-based instruction can encourage meaning construction and academic success, few studies have examined the effects of inquiry-based instruction within a culturally specific context (Von Secker, 2002). Von Secker found that despite student’s ethnicity, inquiry-based instruction was associated with student learning when teachers (1) elicited student interest and engagement, (2) used appropriate laboratory techniques, (3) encouraged problem solving, (4) emphasis on further study, and (5) scientific writing, especially among higher SES students. I have found no studies that have examined the effects of a bilingual inquiry-based program on inquiry-skills.
Inquiry-based interventions can be used to increase students’ interest in scientific careers, indicating long term effects. Moreover, students find hands-on inquiry learning to be more interesting than traditional classroom modes of instruction involving lectures and notetaking (Gibson, 1998; Gibson & Chase, 2002). In designing a career intervention program for seventh grade students, O’Brien et al. (1999) gave students opportunities to develop self-efficacy of academic and career-related science tasks.

Measuring inquiry skills can be challenging in large scale assessments (Neidorf et al., 2006). However, both the National Assessment of Educational Progress (NAEP) and Trends in International Mathematics and Science Study (TIMSS) assessments have included items that require students to “design and plan a scientific procedure” (Neidorf et al., 2006, p.34). Inquiry is usually central to the scientific process and is therefore commonly assessed by having students demonstrate their command of the scientific process.

(2.3) Supporting Pedagogies and Learning Theory

A number of learning theories and practices lend themselves to effective instruction using collaboration and inquiry as central modalities and vocational education as an integrated theme. Many of these pedagogies have theoretical underpinnings related to the work of Paolo Freire who launched his own model of education reform. Freire (1973) describes his project in the following way: “Instead of a teacher, we had a coordinator; instead of lectures, dialogue; instead of pupils, group participants; instead of alienating syllabi, compact programs that were ‘broken down’ and ‘codified’ into learning units” (p.42). Freire believed that education programs should enable learners to act as central creators rather than recipients of knowledge. These programs would then become an “act of creation, capable of releasing other creative acts” (Freire, 1973, p.43), tapping into what Freire considers people’s primary need to be creative. This also involves tapping into the knowledge that learners already possess, which requires trust in the learner’s ability to reason (Freire, 1970).
Activities within these programs would be concrete and applicable as opposed to abstract and disconnected from the learner’s own experience (Freire, 1973). Educators implementing such programs must therefore think of themselves as learners as well (Ada, 1993). Teachers help students realize the value of their existing knowledge (McCaleb, 1994). This type of education is different from mainstream education where students are typically passive in learning and where most knowledge is imposed on students and students are discouraged from asking questions (McCaleb, 1994). In contrast, McCaleb observes that the “central pedagogies of transformative or critical education are dialogue and problem posing” (p.13). These features of dialogue and problem posing are central to collaborative inquiry as described earlier, as well as participatory research, problem-based learning, place-based education, situated cognition theory, and project-based learning, especially when using the environment as an integrating context (EIC). Lastly, in working with bilingual students, a bilingual setting further facilitates learning.

(2.3.1) Participatory Research

Participatory research (PR), by design, has many goals. Rooted in a sense of place and purpose, participant research should be perceived as meaningful and beneficial to the participant researchers (Wilmsen, 2005; Torres, 1995). Through active involvement of community members as researchers, participant research seeks to accomplish the following:

- develop tools and skills for future problem solving within the community;
- foster an overall sense of empowerment for community members who would otherwise be disenfranchised from decision making processes;
- address the needs of the community as opposed to the needs of the researcher;
- develop institutional capacity through resource sharing, collaboration, and the development of human capital; and
- effect change.
“Participatory research is action-oriented research activity in which ordinary people [i.e. non-experts] address common needs arising in their daily lives and, in the process, generate knowledge” (Park, 2002, p.81). The research often focuses on issues central or relevant to poor or generally disenfranchised groups of people and has an aim towards justice and equality (Park, 1993) and has origins in Latin America within the context of adult education and in response to political regimes (Torres, 1995). The objectives of participatory research involve the processes of data collection and analysis, developing critical thinking skills and action oriented behavior, and developing community connections (Park, 1997). These processes are largely inquiry-based, with dialogue as a central mechanism (Park, 1993; Park, 2002). Participants in the research processes generate knowledge with their own “insider” (Park, 2002, p.82) or “indigenous” (Park 1993, 4) knowledge as a starting point and persistent reference. Researchers with technical backgrounds are involved in the investigative process as facilitators or coordinators. The PR process is often initiated by one such facilitator who, at the outset, needs to be familiar with and accepted by the community (Park, 1993). The facilitator helps the participants to define the problem or issue of investigation while suggesting methodological options and logistical considerations to the research team (Park, 1993). “It is easy to see from this that participatory research work is profoundly educational” (Park, 1993, p.3), and inquiry-based.

(2.3.2) Problem-based Learning

Education based on posing problems embodies communication through authentic, contextual dialogue (Freire, 1970). Problem-based learning (PBL) can be used to increase students’ self-efficacy when students practice authentic problems, collaboration, and reflection during their skill building process (Dunlap, 2005). Problem-based learning involves a learner-centered approach where students are often engaged in processes of inquiry: analyzing a problem or question, formulating a related hypothesis, and testing that hypothesis. Students are then expected to evaluate the efficacy of their collaborative
activities in solving the problem or answering the question at hand. The emphasis in PBL is on the process and not necessarily the outcome, although students are encouraged to present their findings in the end (Cerezo, 2004).

Dunlap (2005) adapted Barrows’ (1985) four phases of PBL activity, describing them as 1) problem analysis, 2) solution design, 3) solution development, and 4) post development review. These four phases were applied in Dunlap’s study of adult software development professionals where general perceived self-efficacy scores nearly doubled following an intervention of PBL. (Data were triangulated using guided journal entries and a self-efficacy scale.)

(2.3.3) **Place-based Education**

Proponents of place-based education cite its capacity to engage students in meaningful, relevant, self-regulated and real world activities in an authentic context as its design strength. Place-based education with a focus on natural resources is often referred to as ecological place-based education (Gruenewald, 2003) and embodies inherent, distinctive characteristics: 1) It materializes from the specific attributes associated with a given place; 2) It is multidisciplinary; 3) It is experiential; 4) It connects the individual and the community via a sense of place; and 5) It focuses on ecological processes or natural resources as thematic content worthy of investigation. As a result, place-based learning is often perceived as relevant, experiential, intrinsically valuable to the student and extrinsically valuable to the community (Gruenewald, 2003; Loveland, 2003; Kannapel, 2000; Powers, 2004; Scott, 2002) and is an effective way to apprehend natural resource material.

Motivation is often cited as a main outcome of these design characteristics and can be associated with higher academic performance. Pintrich and DeGroot (1990) sought to understand how the motivational and self-regulated learning components are related to student performance on classroom academic tasks. They sampled 173 seventh-grade students from eight science and seven English classrooms in a small town in
Michigan with a predominantly white student population. Using the *Motivated Strategies for Learning Questionnaire*, a self-reporting questionnaire, the students were asked to respond to items on a seven-point Likert scale. The researchers found positive correlations between self-efficacy (i.e. self confidence to perform a task or skill) and intrinsic value as they related to cognitive engagement and performance. While intrinsic value did not have a direct influence on performance, it was clearly related to self-regulation and cognitive strategy use. Moreover, they found that “higher levels of cognitive strategy use and self-regulation were associated with higher levels of achievement on all assignments” (p.36).

(2.3.4) **Situated Cognition Theory**

Situated cognition theory, also known as situated learning, offers that knowledge is an integral part of the context and activity in which it is learned. Through “cognitive apprenticeships” (Griffin & Griffin, 1996, p.1) where activities are authentic, coherent, meaningful and purposeful, learners have the opportunity to access and use a body of knowledge as would applied practitioners. Griffin & Griffin (1996) sought to replicate an earlier study of Griffin (1995), who compared the effectiveness of instruction based on situated cognition versus traditional classroom based instruction. Their study included 45 participants from fourth grade who were learning map skills. In the situated cognition group, students learned map skills in the library in groups of five or six for an hour each instruction day (two days). Students were given an opportunity to practice way-finding skills as demonstrated by the instructor. The control group received the same amount of time of instruction but did not actually work in the environment that had been depicted in the map. Post-tests were administered one and two weeks as well as five months following the instruction sessions and compared with pre-tests, where they found no initial differences between the two group’s scores under covariate analysis. The tests included both written and performance tests.
Contrary to Griffin’s earlier study, the post-tests from the later study revealed no benefits to learning in the situated cognition group and better performance on the written test among the conventional group. The authors cite some possible explanations for the difference in results. For instance, in the later study, students were allowed to work in pairs during practice activities. This added element of collaboration, an element frequently found in place based education (Lewicki, 2005; Powers, 2004), might have more equally distributed increased performance among both groups. Another difference between the two studies was in the setting. The earlier study took place outdoors, a more authentic setting for map use skills, whereas the latter study did not. This increased degree of authentic setting, a setting frequently used in natural resource education, might have facilitated the improvement of skills among the situated cognition group. It is not entirely surprising, however, that students who have been given instruction in a traditional mode should perform well on a test that is given in the traditional mode of recall and writing. Since most students would not benefit later in life on a written way finding assignment, however, teaching map skills in a collaborative and authentic setting would be the most engaging and, therefore, efficacious approach. These findings can be aligned with the objectives of place based education: teach students using a modality in which they ought to be able to perform (Roth & McGinn, 1997).

(2.3.5) Project-based Learning

Project based learning is commonly a component of place based education. Recent literature (Thomas, Enloe & Newell, 2005) examines one school in particular that has been named “the coolest school in America” by Tom Vander Ark of the Bill and Melinda Gates Foundation. The school has also been selected as a model for replication across the country. The authors examine the case of the Minnesota New Country School (MNCS), which is implementing innovative teaching techniques and learning strategies that enable experiential learning through place based education. The school is without classrooms, bells or textbooks. The people who work at the school are not employed by
the school and the school building was not built with public school dollars. Students are allowed to work at their own pace and are not graded, yet graduation is awarded to students who demonstrate competence and performance through creating projects as well as meeting standards; students are responsible for determining when, where, and what they will study.

The results of this learning environment are reviewed favorably by educators and students alike. Lewicki (2005) notes that “teachers and students appreciate and value project learning because it serves purpose, makes a difference, is dynamic learning, and enables belonging. The four [factors], independent of each other, are powerful ingredients in learning. Together, they are quite a package.” (p.91) Self-reporting from MNCS graduate echo these positive attributes.

Johnson, Lonnquist & Enloe (2005), in collaboration with MNCS advisors, developed a survey protocol that could be used to interview the students about their experience at MNCS. Their survey focused on ascertaining the impact of the school on five specific skills sets among 2002 program graduates: project-based skills, individual responsibility, resilience/persistence skills, reflection skills, and relationship skills (p.107). Overall, the students reported that they felt the program had helped them to develop in these five skill sets. The students also reported their own reasons for favoring the mode of learning at MNCS. One MNCS student appreciated how natural resource, place based project learning enabled her to explore her interests in depth. “My absolute favorite project was my senior project; I wish I were still in high school to continue doing it…My senior project was on hypoxia in the Dead Zone in the Gulf of Mexico and I was tracing that all the way back to Sibley County because I wanted to relate this huge environmental problem to the people in the little-bitty county on the Mississippi River” (p.109).

Another study of project-based education focused more specifically on natural resources and also reported benefits to students through the program. Kucharski, Rust, and Ring (2005) examined the effectiveness of the Ecological, Futures, and Global (EFG) curriculum in an elementary school setting. The EFG curriculum is integrated with key
themes of ecology, thinking about the future, and global education. For example, “one EFG project may involve analyzing a local water supply...by measuring the purity of the water supply, graphing and reporting results, and investigating potential [local] effects” (3). The researchers compared the EFG group with a control group, who received traditional curriculum, on performance on the standardized achievement measure. They also evaluated students (n=461) for levels of academic satisfaction using a Student Satisfaction Survey and teachers (n=30) for their preferences in curriculum treatments. Both surveys were self-reporting and were found to have high internal validity. While the researchers expected to find academic and satisfaction gains in the EFG group over the control group, the results were mixed.

While third graders in the EFG group had higher gain scores over students learning with traditional curriculum, the fourth grade EFG group did not. The authors suggest, however, that these differences are consistent with the literature in that project design may need to take into account specific developmental stages among students. They also suggest that “the EFG curriculum may have long-term effects on academic learning, although they are not as strong as short-term effects” (p.6). The latter supposition has also been raised by Griffin (1996) in her analysis of student performance under situated cognition conditions. Overall, however, the mean scores for grades one, two and five showed higher student satisfaction scores. The TSS revealed also revealed significantly higher levels of satisfaction among teachers who used the EFG curriculum when compared to teachers who used the standard curriculum. Further studies with larger sample sizes and different curricula with a natural resource focus as well as demonstrating higher levels of student motivation (Bradford, 2005) could enable generalization of these results. The role of place based, natural resource education has been implicated in engaging students that might otherwise remain unengaged in learning: at-risk (Hodges, 2004), or vulnerable youth. The findings of The Rural School and Community Trust (RSCT, 2003) illuminate case studies across the country. One particular example involved students from Lubec, Maine, a rural community of approximately 1,800 people. This town has a historic natural resource based economy in
harvesting seafood. The youth in this case were defined as vulnerable because of their level of poverty, remoteness, lack of parent education, the absence of youth activities or social services, depressed economic conditions and removal from a sense of post-secondary education options. Through the RSCT, Lubec has “created and has sustained a vocational aquaculture program that shows promise for creating new economic options through student-led, entrepreneurial projects” (10) Educators and community members “All agree… that the aquaculture program in Lubec…[has] made a difference” and keeps students engaged who would have otherwise dropped out of school. The program teacher noted that especially rambunctious or truant students were engaged by the aquaculture program in their work and goals.

Thematic content and local exploration are natural components of place based, natural resource education. Smith (2002) profiles The Environmental Middle School in Portland, Oregon. The school enrolls approximately 200 students from grades six to eight and teaches a curriculum with thematic content centered on rivers, mountains, and forests—elements of western Oregon’s natural landscape. Academic lessons in social studies, science, language arts, and math are centered on these themes and students are encouraged to engage in an in-depth study that is also related to local natural landscapes. Students are able to make frequent trips to local rivers where they can monitor for water quality and observe wildlife.

(2.3.6) Environment as an Integrating Context

Environment as an integrating context for learning (EIC) is a framework for “interdisciplinary, collaborative, student-centered, hands-on, and engaged learning,” (Blank, Johnson, & Shah, 2003) using the school’s surroundings and community in the process. As an interdisciplinary framework, EIC utilizes team teaching and can help bridge the divide between school subjects, and the community. One example comes from Hollywood Elementary School, located in a rural agricultural part of Maryland. After several failed attempts within the community to start a recycling program, the fifth-grade
class at Hollywood Elementary School took matters into their own hands. The EIC framework enabled these students to turn their school campus into a neighborhood recycling center. Since then, students have transformed their elementary school into a living lab in their school with a nature trail, a butterfly garden, a forest habitat for migrating birds, and creating a natural wetland from what used to be a drainage pond. In 1997, fourth graders at the elementary school performed 27 percent higher than other schools in the county on the Maryland State Performance Assessment Program and 43 percent higher than the state average performance.

A study of an outdoor environmental program sampled Hispanic 6th graders, many of whom were English learners and found a number of benefits associated with the five-day program (McQuillan & Kennelly, 2005). Following the program, students improved their cooperation and conflict resolution skills, engaged in more positive environmental behaviors, and improved their science scores by an average of 27%. The curriculum for the program was designed to be hands on and inquiry based and program results were measured up to six weeks following the program. If an isolated five-day program such as this outdoor program can render positive results, what is the potential for a more long term program? Studies suggest that similar hands on (experiential) learning approaches can be effective with second language learners in a service learning context.

(2.3.7) Bilingual & Bicultural Considerations

The aforementioned pedagogical theory and practice can be drawn from and integrated into a bilingual education setting. While current opponents maintain that bilingual education is expensive and can even hinder the learning of English, proponents of bilingual programs assert that enabling students to use two languages while learning to master both can also assist in mastering comprehension of other subjects (Christian, 1994), like math and science. An evaluation (Lucas, Henze, & Donato, 1990) at the institutional level of six schools with programs for “language-minority” (LM) students found common features of high schools where the success of LM students is promoted.
The following five characteristics of those schools have particular relevance to the current study’s program design:

1. Value is placed on the students’ language and cultures;
2. High expectations of language-minority students are made concrete;
3. A [vocational] counseling program gives special attention to language-minority students;
4. Parents of language-minority students are encouraged to become involved in their children’s education; and
5. Staff members share a strong commitment to empower language minority students through education (324-325).

In summary, this literature review has provided the foundation and rationale for the design of two inquiry-based programs for Latino youth, which will be described in the following chapter. The first program was modeled after a participatory research design and served as an exploratory program as well as a needs assessment for the second program. The second program, the Forest Field Program, included a vocational component and focused on forest education through hands-on, inquiry-based activities.
(3) MATERIALS AND METHODS

(3.1) Exploratory Program: Participatory Research (PR)

“[I]nvestigators and the people who would normally be considered objects of that investigation should act as co-investigators.” The more active an attitude [people] take in regard to the exploration of their thematics, the more they deepen their critical awareness of reality and, in spelling out those thematics, take possession of that reality” (Freire, 1970, p.97).

(3.1.1) Overview

The current thesis consists of two projects: an exploratory participatory research (PR) program (or process) and a subsequent program of interest, the Forest Field Program (FFP). In partnership with the Community Forestry Research Fellowship Program and the Latinos in Forestry Program, I developed, implemented, and facilitated the exploratory PR program. The PR program acted as a non-traditional needs assessment for the FFP and was used to inform the overall design of the FFP. The PR program used participatory research to establish an understanding of the Latino community within the Central Willamette Valley while empowering Latino 7th and 8th grade students to act as participatory researchers.

(3.1.2) Participatory Research Program Design

With José Diéguez, my community partner from the Latinos in Forestry program at Oregon State University, and the Community Forestry Research Fellowship Program at the University of California- Berkeley, I began the current study with PR efforts during the summer of 2006. My community partner and I wanted to understand, through the PR process, why Latinos are not well represented in forestry professions. I guided the young participatory researchers in selecting an appropriate research method and creating a questionnaire that addressed our question of interest while emphasizing the students’
interest in what the Latino community thought about the forest. The students’ were also involved primarily in implementing the study, analyzing results, and presenting the results to the community as I acted as the facilitator.

Recruitment, enrollment, and implementation of the exploratory program all took place within about a 3 month time period. Recruitment and enrollment took place from June 5\textsuperscript{th} to June 24\textsuperscript{th} while program implementation, including the presentation of results to the community, took place from June 26\textsuperscript{th} to September 8\textsuperscript{th}. José Diéguez acted as a key informant and translator, providing me with contacts at schools and translating the details of the PR program to students and parents. With permission from school principals and other key leaders, we recruited students at Grant Community School in Salem, Talmadge Middle School in Independence, French Prairie Middle School in Woodburn and the Farmworker Housing Development Corporation (FHDC- Colonia Libertad) in Salem. Although our recruitment took place in three different cities, we were only successful in recruiting a total of ten students from Salem. We held the bilingual program in Salem, Oregon at Grant Middle School and Colonia Libertad. From start to finish, we worked with a small group (n=7) of students, all Mexican American, from different schools within Salem. We met once or twice per week for about eight weeks and followed a six step scientific process for social science as part of the PR process:

1. Review background information
2. Question formation
3. Methods design
4. Data collection
5. Data analysis
6. Results and presentation

Given the fixed and limited time (~8 weeks) to implement the program, I scheduled activities in advance using bilingual program calendars for participants and their parents to refer to (See Appendix A.). At the outset, students were given a general
idea of our topic of interest, but were encouraged and enabled to create the specific question we would address. I also guided students in creating a small, bilingual (English and Spanish) questionnaire consisting of 11 questions (See Appendix B.). As the facilitator, I was responsible for “training” (Park, 1993, p.13) the participants in how to interview others. Students were responsible for interviewing members of the community (n=58) according to Oregon State University Internal Review Board (IRB) Protocols and under qualified adult supervision according to IRB standards. Following data collection, students entered their data into a computer spreadsheet program and developed graphs, which they used to create a PowerPoint presentation. Participants used basic descriptive statistics (i.e. percentages) to analyze their data. Finally, students presented their findings to parents and other members of the community at a local community center. Although the participant researchers spent limited time drawing conclusions from the data, the results were well received by the Latinos in Forestry program and were sufficient to justify the need for an education program as a means to increase awareness of forestry professions among Latino youth.

The exploratory program acted as a needs assessment and helped inform the design and development of the subsequent bilingual Forest Field Program. The results from the PR process indicated a need for the subsequent FFP, which is the focus of the current study. Moreover, the exploratory program gave me an opportunity to develop my own experience working with Latino 7th and 8th grade youth. The PR process also set the stage for further program development designed for middle school Latino youth in the Central Willamette Valley by creating a network of students, parents, and teachers who would become involved in the FFP.

(3.2) Forest Field Program: Collaborative Inquiry

“The important thing, from the point of view of libertarian education, is for [learners] to come to feel like masters of their thinking by discussing the thinking and views of the world explicitly or implicitly manifest in their own suggestions and those of their comrades…[T]his view of
education starts with the conviction that it cannot present its own program but must search for this program with the people…” (Freire, 1970, p.118).

(3.2.1) Overview

In partnership with the Latinos in Forestry program, I developed, implemented, and evaluated the Forest Field Program (FFP), a forest education program for 7th and 8th grade Latino youth. The current study investigated the effects of the FFP. We recruited 34 students from five middle schools in Salem and Woodburn, Oregon. Of the ten students who completed the program, nine were Mexican American and one was Caucasian. As the primary participants in this study, students designed, conducted, and analyzed data from basic forest research (i.e. observational study) from late September, 2006 through early June, 2007. Program activities occurred either indoors or outdoors during a total of seven field trips, six meetings, and a presentation. The design of the FFP was informed by an exploratory participatory research program, described in the previous section. The objectives of the FFP were established to address programmatically the underrepresentation of Latinos in forest professions by addressing the underperformance of Latino students in science. The objectives of the FFP intervention were to increase participants,’ 1) interest in and awareness of forestry related professions, 2) self-efficacy and ability in their inquiry skills, and 3) self-efficacy and ability in their collaboration skills.

(3.2.2) Forest Field Program Design

The Forest Field Program consisted of an orientation, seven field trips, five meetings, and a final presentation. The program meetings lasted about two hours and generally took place after school at participating middle schools and community centers. Field trips generally took place on Friday afternoons and lasted about four to five hours, including transportation time. Students were usually picked up from school in the afternoon, driven to a local Weyerhaeuser forest or state park to conduct their field
activities, and dropped off at their home upon return. Meetings and field trips occurred once or twice per month from late September, 2006, through May, 2007. For details on program activities, see Table 3.1. The following list summarizes the program agendas (See Appendix C.):

(3.2.3) **Summary of Forest Field Program Agendas**

1. **Meeting #1 (Orientation):** Students are provided with an overview of the program; cover basic forest ecology in Western Oregon; students are given parental consent forms.

2. **Field trip #1:** Students explore the forest and make as many observations as they can about what they see.

3. **Field trip #2:** Students learn about research questions and hypotheses; students pose research questions based on further observations.

4. **Field trip #3:** Students select question of interest and pose group hypothesis; students design data collection sheet for using in proving hypothesis.

5. **Field trip #4:** Students review forest inventory methods and select preferred inventory method and practice using collecting data.

6. **Meeting #2:** Students learn about and practice data organization and analysis using computer spreadsheet.

7. **Meeting #3:** Students practice using PowerPoint and begin research on topic of interest (i.e. forest animals) to create a “field guide” for during data collection.

8. **Meeting #4:** Students finish field guide, finalize data collection sheet, and review data collection technique.

9. **Field trip #5:** Students begin data collection; administer professional awareness pre-test; students learn about 2 forest professions.

10. **Field trip #6 (Camping):** Students continue data collection; students practice forest plant and bird identification
11. **Field trip #7**: Students continue data collection; students learn about 2 more forest professions.

12. **Meeting #5**: Students enter data into spreadsheet program and create graphs.

13. **Meeting #6**: Students create PowerPoint presentation and integrate conclusions

14. **Presentation**: Students present findings to parents/community; administer all post-tests.

The FFP was designed for 7th and 8th grade students and was informed by the literature (See Literature Review), benchmark guidelines, as well as the exploratory PR program. Benchmark guidelines suggest that by eighth grade students are capable of a number of inquiry skills, including the following questioning, designing investigations, collecting information, organizing information, and drawing conclusions (NAAEE 2005). Following an overview of basic forest ecology and inventory (Wolftree, n.d.) during the program orientation (See Appendix F), students were encouraged to identify a topic of study related to what they wanted to investigate in the forest. Students were then guided through the process of designing a basic study. Students were also encouraged to use “A Guide to Oregon’s Forest Wildlife” (OFRI, 2005) for developing their hypothesis. In preparation for their data collection efforts, students searched the internet and found photos, which they used to create a field guide for their group. In this sense, “youth were the *creators* and not merely the *consumers* of the science curriculum” (Rahm 2002, 180); events were jointly constructed by facilitators and students (Case 1993). For the vocational component of the program, I developed four fact sheets using information from the Occupation Outlook Handbook (U.S. Department of Labor, 2006) (See Appendix D.), which were presented and discussed during the second half of the program. All materials presented to students were available in both Spanish and English and translated from English to Spanish by José Diéguez. To organize and identify FFP activities, objectives, and outcomes, I developed a table of stages within the program (See Table 3.1.).
Table 3.1 *Stages of collaborative inquiry process and corresponding learning activities, objectives, and outcomes (After Chang et al. 2003).*

<table>
<thead>
<tr>
<th>Stage</th>
<th>Learning activities</th>
<th>Learning goals and objectives</th>
<th>Learning outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I</strong></td>
<td>1. Individuals read basic material about the forest and methods for forest inventory</td>
<td>1. Students become familiar with basic concepts of forest ecology and inventory</td>
<td>1. Group hypothesis</td>
</tr>
<tr>
<td>Generating a hypothesis</td>
<td>2. Individuals think of questions they would like answer</td>
<td>2. Generating a hypothesis as a group</td>
<td>2. Concept maps</td>
</tr>
<tr>
<td></td>
<td>3. Group establishes ground rules for collaboration</td>
<td>3. Students understand connections between research question and hypothesis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Group determines group member roles</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Individuals share study question ideas and group narrows down list of ideas to top two</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Group learns about hypothesis building and generates a hypothesis for each question, or merges questions where appropriate</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. Group is introduced to concept maps</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. Small groups (2–4) create concept maps for how to field test the hypotheses</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9. Group decides which hypothesis is most feasible to test based on concept maps</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>II</strong></td>
<td>1. Review methods of forest inventory as group (refer to orientation handout and tools in the field)</td>
<td>1. Students work as part of a group to understand connection between research question, hypothesis, data collection, and study design.</td>
<td>1. Group’s final concept map of study design</td>
</tr>
<tr>
<td>Study design</td>
<td>2. Revise concept map (integrate concept maps where appropriate)</td>
<td>2. Group’s timeline/logistical model to complete study</td>
<td>2. Group’s timeline/logistical model to complete study</td>
</tr>
<tr>
<td></td>
<td>4. Break up into small groups to create data collection sheet; Regroup and merge templates</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| III  | Collecting data | 1. Group refers to member roles, concept map, and study design to implement study design  
2. Review how to record data in collection template  
3. Collect data in field | 1. Students experience group member roles to implement study.  
2. Students experience data collection process | 1. Field data on data collection sheets |
| IV  | Data management and analysis | 1. Group instruction on how to use computer software to organize and analyze data  
2. Enter field data  
3. Graphic analysis activity (creating graphs and charts) | 1. Students understand how to use spreadsheet software for data management and analysis  
2. Students learn how to create visual displays of data. | 1. Data spreadsheets with field data  
2. Graphic computer-generated representations of data |
| V  | Drawing conclusions and presenting results | 1. Group discussion on how to interpret the data  
2. Small groups practice questioning, negotiation, and compromise with regards to data interpretation; create concept map to illustrate interpretation  
3. Small groups share concept maps and converge interpretations  
4. Group discusses whether hypothesis was confirmed  
5. Group uses PowerPoint to present results to parents/community | 1. Students learn how to interpret data through group discussion.  
2. Students learn how to use concept maps to illustrate data interpretation.  
3. Students will confirm or disprove hypothesis.  
4. Students learn how to use PowerPoint to present findings. | 1. Concept maps that illustrate data interpretation  
2. Group PowerPoint presentation |
(3.3) **Forest Field Program Evaluation**

(3.3.1) **Forest Field Program Evaluation Overview**

I evaluated the Forest Field Program using pre-post instruments (See Figure 3.1.) as well as formative and summative interviews. The evaluation process consisted of nine stages (See Table 3.2.), beginning with focus group recruitment for the development of the pre-post instruments. Also known as a case study (Kolb, 1995), the current study is a single-case experiment, which involves the treatment of a small group with the results of their pre-tests and questionnaires serving as the control (Gall, Gall, & Borg, 2005). These gains were measured using a pre/post questionnaire and test, which was developed through a focus group meeting. Following the focus-group, I refined the evaluation instruments using pilot testing results. After completing the program, I compared the pre- and post-questionnaire and test results statistically (paired t-test, one-sided). Qualitative data were used to elucidate the quantitative findings. Differences in pre-post scores were not compared to outside control groups, which may not have provided an accurate comparison (Kolb, 1995), especially within the context of self-selecting participants. Instead, comparison of pre/post instrument scores was limited to program graduates.
### Figure 3.1 Pre/post questionnaire and tests

#### Professional Interest Questionnaire

<table>
<thead>
<tr>
<th>Name___________________________</th>
<th>Date__________</th>
</tr>
</thead>
</table>

**Instructions:** Please respond to the following statements by circling the words that best represent your feelings about the statement. **Please circle the first answer that comes to mind and try not to spend more than 30 seconds on each question. There is no right or wrong answer.**

1) One day I would like to work in a forest profession.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Tend to agree</th>
<th>Somewhat agree</th>
<th>Somewhat agree &amp; Somewhat disagree</th>
<th>Somewhat disagree</th>
<th>Tend to disagree</th>
<th>Strongly disagree</th>
<th>Don’t know</th>
</tr>
</thead>
</table>

2) I am not interested in working in a forest career.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Tend to agree</th>
<th>Somewhat agree</th>
<th>Somewhat agree &amp; Somewhat disagree</th>
<th>Somewhat disagree</th>
<th>Tend to disagree</th>
<th>Strongly disagree</th>
<th>Don’t know</th>
</tr>
</thead>
</table>

3) Forest science jobs are interesting to me.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Tend to agree</th>
<th>Somewhat agree</th>
<th>Somewhat agree &amp; Somewhat disagree</th>
<th>Somewhat disagree</th>
<th>Tend to disagree</th>
<th>Strongly disagree</th>
<th>Don’t know</th>
</tr>
</thead>
</table>
4) I am interested in going to college to study the forest.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Tend to agree</th>
<th>Somewhat agree</th>
<th>Somewhat agree &amp; Somewhat disagree</th>
<th>Somewhat disagree</th>
<th>Tend to disagree</th>
<th>Strongly disagree</th>
<th>Don’t know</th>
</tr>
</thead>
</table>

5) I have thought of working in a job related to the forest.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Tend to agree</th>
<th>Somewhat agree</th>
<th>Somewhat agree &amp; Somewhat disagree</th>
<th>Somewhat disagree</th>
<th>Tend to disagree</th>
<th>Strongly disagree</th>
<th>Don’t know</th>
</tr>
</thead>
</table>

6) One day I would like to manage the forest.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Tend to agree</th>
<th>Somewhat agree</th>
<th>Somewhat agree &amp; Somewhat disagree</th>
<th>Somewhat disagree</th>
<th>Tend to disagree</th>
<th>Strongly disagree</th>
<th>Don’t know</th>
</tr>
</thead>
</table>

7) I would like to learn more about jobs related to the forest.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Tend to agree</th>
<th>Somewhat agree</th>
<th>Somewhat agree &amp; Somewhat disagree</th>
<th>Somewhat disagree</th>
<th>Tend to disagree</th>
<th>Strongly disagree</th>
<th>Don’t know</th>
</tr>
</thead>
</table>
**Collaboration Self-efficacy Questionnaire**

8) When part of a group I don’t get a lot of work done.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Tend to agree</th>
<th>Somewhat agree</th>
<th>Somewhat agree &amp; Somewhat disagree</th>
<th>Somewhat disagree</th>
<th>Tend to disagree</th>
<th>Strongly disagree</th>
<th>Don’t know</th>
</tr>
</thead>
</table>

9) When part of a group I get a lot of work done.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Tend to agree</th>
<th>Somewhat agree</th>
<th>Somewhat agree &amp; Somewhat disagree</th>
<th>Somewhat disagree</th>
<th>Tend to disagree</th>
<th>Strongly disagree</th>
<th>Don’t know</th>
</tr>
</thead>
</table>

10) I feel comfortable pointing out what group members are doing well and what needs improvement.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Tend to agree</th>
<th>Somewhat agree</th>
<th>Somewhat agree &amp; Somewhat disagree</th>
<th>Somewhat disagree</th>
<th>Tend to disagree</th>
<th>Strongly disagree</th>
<th>Don’t know</th>
</tr>
</thead>
</table>

11) I feel comfortable hearing from others what I’m doing well and what needs improvement.

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Tend to agree</th>
<th>Somewhat agree</th>
<th>Somewhat agree &amp; Somewhat disagree</th>
<th>Somewhat disagree</th>
<th>Tend to disagree</th>
<th>Strongly disagree</th>
<th>Don’t know</th>
</tr>
</thead>
</table>
Now rate your ability to do the following tasks.

On a scale of 1-100:

0 = I can not do this task.
10 = Occasionally I can do this task but not with confidence.
40 = I can sometimes do this task but not with confidence.
60 = I can sometimes do this task with confidence.
90 = I can almost always do this task with confidence.
100 = I can always do this task with confidence.

12) Work well as part of a team:

0  10   20   30   40   50   60   70   80   90   100

13) Act in the role of a team leader:

0  10   20   30   40   50   60   70   80   90   100

14) Trust others to act as the team leader:

0  10   20   30   40   50   60   70   80   90   100

15) Respect my own ideas while working in a group:

0  10   20   30   40   50   60   70   80   90   100
### Inquiry Self-efficacy Questionnaire

16) Respect the ideas of others while working in a group:

| 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |

17) Propose a hypothesis based on an observation:

| 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |

18) Design an experiment to test a hypothesis in a subject that I am familiar with:

| 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |

19) Get information from different sources like the library, internet, and books:

| 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
20) Get information from different people like teachers, other adults, and classmates:

0  10  20  30  40  50  60  70  80  90  100

21) Interpret the information represented in graphs:

0  10  20  30  40  50  60  70  80  90  100

22) Organize information to help me reach a conclusion:

0  10  20  30  40  50  60  70  80  90  100

23) Make sense of information to help me reach a conclusion:

0  10  20  30  40  50  60  70  80  90  100
Inquiry Skills and Forestry Professions Awareness Pre/post-Test

Instructions: Please try to answer each question. If you can not answer a question, skip it and move on to the next question. Do not worry if you don’t know an answer. This test just helps us know what we need to teach. You have 30 minutes to work on this test.

[SCORING NOT INCLUDED ON STUDENT VERSION OF TEST]

1) This graph represents information about trees and shrubs found in the forest. Explain the graph by answer questions (a) and (b). Then list 3 more observations about the information represented by the graph.

![Graph of tree and shrub data](image)

a) How many plots have all four types of plants?_______[2 POINTS EACH_______

b) Which plots have just Douglas-fir and Salal? ____________________________

c) ___________________________________________________________________

d) ___________________________________________________________________

e) ___________________________________________________________________

3 more observations:

- Observation 1: ___________________________________________________________________
- Observation 2: ___________________________________________________________________
- Observation 3: ___________________________________________________________________
2) Look at the information below. Use the box to create a table that will organize all the information.

The following number of plants and trees were counted in 8 different parts of the forest (plots).

Shrubs per plot:

<table>
<thead>
<tr>
<th>Shrub Type</th>
<th>Plot 1</th>
<th>Plot 2</th>
<th>Plot 3</th>
<th>Plot 4</th>
<th>Plot 5</th>
<th>Plot 6</th>
<th>Plot 7</th>
<th>Plot 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salal</td>
<td>21</td>
<td>24</td>
<td>27</td>
<td>2</td>
<td>3</td>
<td>20</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Oregon grape</td>
<td>5</td>
<td>8</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Tree species per plot:

<table>
<thead>
<tr>
<th>Tree Type</th>
<th>Plot 1</th>
<th>Plot 2</th>
<th>Plot 3</th>
<th>Plot 4</th>
<th>Plot 5</th>
<th>Plot 6</th>
<th>Plot 7</th>
<th>Plot 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Douglas-fir</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Western redcedar</td>
<td>6</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>9</td>
<td>6</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

[10 POINTS TOTAL:
5 POINTS FOR ATTEMPT AT PARTIAL TABLE
10 POINTS FOR TABLE THAT INCLUDES ALL INFORMATION]
3) You are in the park one day and notice that all of the trees in one section of the park appear to be dying or unhealthy. You remember reading in the newspaper last year that attacks of a certain insect were harmful to particular tree species.

Form a hypothesis about what could be happening.

[5 POINTS TOTAL: 3 POINTS FOR HYPOTHESIS THAT MAY BE PARTIALLY RELEVANT; 5 POINTS FOR RELEVANT HYPOTHESIS]

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________

4) Now plan (design) an experiment that would allow you to test your hypothesis.

[20 POINTS TOTAL: 5 POINTS FOR VAGUE PLAN THAT RELATES TO HYPOTHESIS; 10-20 POINTS FOR PLAN THAT RELATES TO HYPOTHESIS (5 POINTS), WHICH INCLUDES SYSTEMATIC TREATMENT WITH CONTROL (5 POINTS), OBSERVATION (5 POINTS), AND/OR REPLICATION (5 POINTS)]

__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________
__________________________________________________________________


5) Name 3 forest related jobs. State 2 responsibilities that people in that job have.

a. (Job)____ [3 POINTS EACH]________

List 2 responsibilities

1. ______________________________________________________
2. _____________________________________________________

b. (Job)____________________________

List 2 responsibilities

1. ______________________________________________________
2. _____________________________________________________

c. (Job)____________________________

List 2 responsibilities

1. ______________________________________________________
2. _____________________________________________________
2) Now, please describe the working conditions of the 3 professions you listed above by checking the appropriate boxes.

[1 POINT PER CORRECT RESPONSE]

<table>
<thead>
<tr>
<th>Job</th>
<th>Pay</th>
<th>Work place</th>
<th>Level of education required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write the name of the 3 professions from above on lines a, b, and c below.</td>
<td>Less than $25,000 per year</td>
<td>Mostly Indoors</td>
<td>High school diploma</td>
</tr>
<tr>
<td>a)</td>
<td></td>
<td></td>
<td>At least 4 years of college (Bachelor’s degree)</td>
</tr>
<tr>
<td>b)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3.2 **Timeline of Forest Field Program evaluation activities**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Recruit for focus group and conduct focus group meeting for</td>
<td>July 28th – August 7th</td>
</tr>
<tr>
<td>development of pre/post questionnaire and tests (evaluation</td>
<td>2006</td>
</tr>
<tr>
<td>instruments).</td>
<td></td>
</tr>
<tr>
<td>II. Develop draft evaluation instruments, followed by IRB</td>
<td>August 8th – August 13th</td>
</tr>
<tr>
<td>review of instruments. Begin recruitment for pilot testing.</td>
<td>2006</td>
</tr>
<tr>
<td>III. Continue recruitment for and conduct pilot testing of</td>
<td>August 14th – September 24th</td>
</tr>
<tr>
<td>evaluation instruments. Finalize instruments and submit to IRB for</td>
<td>2006</td>
</tr>
<tr>
<td>review.</td>
<td></td>
</tr>
<tr>
<td>IV. Administer pre-questionnaire and inquiry skills pre-test.</td>
<td>September 25th – October 6th</td>
</tr>
<tr>
<td></td>
<td>2006</td>
</tr>
<tr>
<td>V. Conduct formative interviews with students and parents.</td>
<td>October - February</td>
</tr>
<tr>
<td>Develop in-depth interview questions.</td>
<td>2006 - 2007</td>
</tr>
<tr>
<td>VI. Administer professional awareness pre-test.</td>
<td>March</td>
</tr>
<tr>
<td>VII. Administer all post-questionnaire and tests.</td>
<td>June 9th – June 23rd</td>
</tr>
<tr>
<td></td>
<td>2007</td>
</tr>
<tr>
<td>VIII. Coordinate and conduct in-depth interviews with</td>
<td>June 9th – July 7th</td>
</tr>
<tr>
<td>students, teachers, and parents.</td>
<td>2007</td>
</tr>
<tr>
<td>IX. Analyze quantitative data. Transcribe, code, and analyze qualitative data.</td>
<td>July 7th – September 15th</td>
</tr>
<tr>
<td></td>
<td>2007</td>
</tr>
</tbody>
</table>

(3.3.2) **Forest Field Program Evaluation Design**

As an experimental design involving youth as subjects in a year-long intervention, the current study employed mixed-methods, with emphasis on triangulation and embedded design. Mixed methods research “focuses on collecting, analyzing, and mixing both quantitative and qualitative data in a single study or series of studies. Its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone” (Creswell & Plano Clark, 2007, p.5). Mixed methods research involves the use of quantitative and qualitative data.

Quantitative data may be analyzed objectively and often measure the magnitude of change in numerical values, such as test scores. Quantitative methods may be used for
practical evaluation of an education intervention. In the current study quantitative data were derived from pre/post instruments, namely questionnaires and tests, which were administered before and after the program. Qualitative data, derived from qualitative methods such as interviews, are more subjective in nature and require inference to understand. Qualitative methods are used widely in educational research to help researchers understand the contexts of students, parents, and teachers (Tierney & Dilley, 2002) while integrating “meaningful stories” from the research participants who act as “expert informants” (Auerbach & Silverstein, 2003, pp.23-26). The current study used triangulation design, which uses both quantitative and qualitative methods to prove/disprove hypotheses and interpret results.

This study used pre- and post-instruments to render quantitative data. To minimize possible effects of maturation, (i.e. changes in student awareness, interests, or abilities attributed to time and not the intervention) every effort was made to ensure timely administration of the instruments. The pre- and post-questionnaire, as well as the pre- and post-inquiry test, was administered within two to three weeks, respectively, of students’ commencement and completion of the program. Given the alternating schedule of the program and the erratic nature of students’ attendance it was not possible to administer the instruments to all students on the same days. The awareness of forestry professions pre/post test was administered at the beginning and end of the vocational awareness component of the program. The quantitative data were used to test five of six of this study’s hypotheses with respect to the forest field program intervention: 1) students’ interest in forestry professions will increase; 2) students’ awareness of forestry professions will increase; 3) students’ inquiry skills will increase; 4) students’ self-efficacy of inquiry skills will increase; and 5) students’ self-efficacy of collaboration skills will increase. The questions were mostly closed-ended. I scored the pre/post questionnaires using a Likert-type scale of 1-7 as well as 1-100 and scored pre/post tests using a standard grading scheme. Scores were derived from the instruments, converted to percentages, and analyzed using inferential statistics with a 95% confidence level to
detect gains. Given the small sample size and paired nature of the data, I used t-tools, which are robust to smaller sample sizes and enable paired sample analysis.

The current study utilized an “embedded design” to develop quantitative research instruments (Creswell & Plano Clark, 2007), using focus groups and pilot tests. Embedded design is a mixed methods design where one data collection type is used to supplement another. The embedded experimental model is a variant of this design and can be used as either a one- or two-phase approach. For instance, the current study used the two-phased approach for the embedded experimental model where qualitative data were gathered before developing the final quantitative instruments as well as the final protocol for in-depth interviews. A focus group meeting and pilot tests preceded the creation of the final quantitative instruments while formative interviews (See Appendix E.) preceded the development of the final protocol for in-depth interviews (See Figure 3.2).

One focus group session and two pilot test sessions were conducted to gather data qualitative data that would be used to refine the quantitative instruments. The focus group included students, parents, and two co-investigators and was structured by the facilitator (one of the co-investigators). The focus group meeting had the following characteristics of a semi-structured focus group (Morgan, 2002, p.147):

- The goal was to answer the researchers’ questions regarding pre-post instrument validity
- Researchers’ interests were dominant
- Questions about the suitability of language used in instruments were asked; questions defined the discussion
- Facilitator directed discussion
- Participants addressed the facilitator

Meanwhile, the pilot test sessions were highly structured. During these sessions I administered to students a draft version of the pilot instruments in either Spanish or English, depending on the student’s preference. I encouraged students to let me know if
they had any questions during the test, especially if they were unsure of the meaning of a question or statement. After the first pilot test meeting, I modified the instruments to reflect students’ feedback and translated any changes. I administered the modified instruments at the second pilot test session, using student feedback to modify instruments further and create final versions of the questionnaire and tests in Spanish and English. For their participation in pilot tests, students were given $10 gift certificates to a local store.

Similar to the process of developing quantitative instruments, I solicited input for the development of my qualitative instrument. I used brief formative interviews with students and parents to advise my final evaluation interview protocol (See Figure 3.2.) and to gather mid-program feedback from a few students and parents. Formative interviews were conducted after making initial field observations (Eder & Fingerson 2002), which consisted of notes of students’ conversations within the first few weeks of the program. I used the notes to better understand each student and his or her role within the collaborative inquiry setting. The time spent in the field working with students and observing them also gave me a chance to develop rapport with them before embarking on interviews, which is important for enabling respondents to talk freely with the interviewer and improves validity of the data (Ryan, 2002). The formative interviews with parents were conducted in Spanish, with some language assistance from the students, and served as an opportunity to develop rapport with parents while soliciting feedback from them. The formative interviews with parents were also an opportunity to familiarize myself with cultural and contextual cues, both verbal and nonverbal, used commonly by respondents. Ryan (2002) suggests that body language for Latin cultures may be more meaningful than Anglo cultures and that fully understanding respondents from Latin cultures would require a familiarity of this body language.
Figure 3.2 Primary Forest Field Program summative evaluation questions

1. What was one thing you really liked about this program?
   a. Explain.

2. What was one thing you didn’t like about this program?
   a. Explain.

3. What’s one suggestion you have for improving this program?

4. Do you believe you have increased your awareness and/or interest in forestry professions as a result of this program? Why or why not?
   a. Explain.

5. Do you believe you have increased your self confidence in collaboration skills as a result of this program? Why or why not?
   a. Explain.

6. Do you believe you have improved your investigation skills as a result of this program? For instance, are you better at doing science now because of this program? Why or why not?
   a. Explain.

7. Was this program too challenging for you, too easy, or just right? Examples?

8. Do you have any other observations about your experience with this program that you would like to share?

Additional questions that may be appropriate:
   1. Why did you stick with this program?
      a. Were there challenges to staying with this program? If so, what were some of these challenges?

   2. Why did you leave this program early?
      a. What were some challenges to staying with this program?
The goal of triangulation design in the current study was to converge data. (Creswell & Plano Clark, 2007). In the convergence model, after quantitative and qualitative data are collected separately, the researcher converges the results. Convergence involves comparing and contrasting the results during interpretation of the data. “Researchers use this model when they want to compare results or to validate, confirm, or corroborate quantitative results with qualitative findings” (Creswell & Plano Clark, 2007, p.65). Within one month of the completion of the program I conducted interviews with students, teachers, parents, and program staff to gather qualitative data, which were used to address my research questions. The qualitative data were derived from interviews either individually or in small groups. Qualitative data were used to enhance understanding of quantitative data in the words of the participants (Johnson, 2002) and to corroborate the quantitative data in addressing the following six hypotheses: 1) students’ interest in forestry professions will increase; 2) students’ awareness of forestry professions will increase; 3) students’ inquiry skills will increase; 4) students’ self-efficacy of inquiry skills will increase; 5) students’ self-efficacy of collaboration skills will increase; and 6) students’ collaboration skills will increase. In-depth interviews were moderately structured and involved open-ended questions. As the interviewer, I used a protocol that explained the purpose of the interview followed by a request for permission to audio record the interviews, three icebreaker questions, transition questions, and about five to eight key questions (Johnson, 2002). To gain a sense of what aspects of the program worked well or needed improvement, I also asked participants (n=12), parents (n=5), teachers (n=2), and staff (n=1) to reveal what they liked about the program and what suggestions they might have for future program efforts. Respondents were allowed more than one response.

While this protocol was used to direct the interviews, I allowed each interview to take the form of a discussion as part of a guided conversation (Warren, 2002). In addition to recording the interviews, the interviewer also took “process notes” as a way to document the context of the interview (Johnson, 2002, p.112). I interviewed youth and adult respondents to understand their perspective on the program rather than rely solely
on researcher interpretation of the quantitative data (Eder & Fingerson, 2002). When interviewing youth it was important to consider power dynamics. To reduce the difference in power between researcher and student, the interviewer conducted all interviews in a natural setting where the student was surrounded by other students or family members (Eder & Fingerson, 2002). For instance, some interviews were embedded into field trip activities while others were conducted in the student's home. I also used group settings, whenever possible, as effective and natural settings for youth and used reciprocity (e.g. gift giving) in exchange for the final interviews (Eder & Fingerson, 2002).

Qualitative data were derived from in-depth, personal interviews with program participants, parents, staff and teachers. The student interviews included all program graduates (n=10) as well as a small convenience sample, respondents who were readily available and willing to be interviewed, of program dropouts (n=2). Program graduates either participated in the final components of the program, including data analysis and the presentation, or attended at least ten (out of 14) meetings. Of the program dropout sample, two of the three respondents were present for much of the program and were asked many of the same questions as program completers, so their responses are included in parts of the analysis. I used a small convenience sample of parent interviews (n=5) as well as teachers (n=2) and program staff (n=1). Respondents were allowed more than one response for open ended questions and the results are reported as a number of total responses and not respondents. Respondents who participated in the interviews were given a $10 gift certificate to a local store. As interviewees were viewed as “meaning makers” (Warren, 2002, p.83), respondents’ words from interviews were aggregated into thematic categories, which included “similar words or phrases to express the same idea” (Auerbach & Silverstein, 2003, p.37).

It is important to note the small sample size of program participants, which affects the scope of inference of this study. The small sample size limits our ability to generalize to the larger population and even other Mexican American students. Consequently, the small sample limits the external validity of this study. In addition to limiting our ability
to generalize, this study’s small sample size may also reduce the reliability of the results. Additionally, six of the ten students who completed the program were female and only four were male, which may have implications for the results of this study.
(4) RESULTS

“If the primary focus in co-operative inquiry is on action, on transformative practice that changes our way of being and doing and relating, and our world, then it follows that the primary outcome of an inquiry is just such a transformation, that is, our practical knowing, our transformative skills and the regenerated experiential encounters to which they give rise, together with the transformations of practice in the wider world with which the inquirers interact. The emphasis, with regard to research outcomes, shifts from the traditional emphasis on propositional knowledge and the written word to practical knowledge and the manifest deed” (Heron and Reason, 2002, p.184).

4.1 Results from the Participatory Research Process

Of particular interest to the Latinos in Forestry program was question four. Question four on the questionnaire was the only one not created by the students and was submitted by the Latinos in Forestry liaison:

- Question #4) In your opinion, what is the main reason why there aren’t more Latinos in leadership positions in forestry professions? (One response, please.)
  - a) Not enough education (27%)
  - b) Lack of interest (16%)
  - c) Not enough opportunities (43%)
  - d) Other (Unaware 14%)

More than half of the total responses to this question indicated that Latinos felt they lacked sufficient education, interest, or awareness to enter forestry professions. It is interesting to note that all of the open-ended responses for “other,” related to unawareness of opportunities in forestry professions. The Latino community’s responses to this question indicated sufficient need for creating a forest field program with an emphasis on providing science education to students while administering a vocational
component that focused developing students’ interest in and awareness of forestry professions.

Half of the 58 respondents interviewed expressed an interest in working in the forest. Those 24 respondents gave a variety of reasons for why they were interested in working in the forest (See Table 4.1.). Nearly a third of the responses related to learning about plants, animals, or ecology of the forest, followed closely by simple enjoyment of being in the forest. These responses indicated that while designing a program for Latino youth that would appeal to youth and parents alike, it would be important to anticipate requests to study plants, animals, or ecology and that these themes could be important components of bilingual program curriculum (See Appendix F.). These responses also offered valuable insight about what kinds of forestry professions to teach students. Consequently, the bilingual fact sheets we created for the Forestry Field Program were about forest botanists, wildlife biologists, forest ecologists, and forest engineers.

Table 4.1 Reasons why Latinos are interested in working in the forest

<table>
<thead>
<tr>
<th>Community responses</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>To learn about forest plants, animals, or ecology</td>
<td>9</td>
</tr>
<tr>
<td>I like to be in the forest</td>
<td>8</td>
</tr>
<tr>
<td>Because the jobs are good</td>
<td>3</td>
</tr>
<tr>
<td>I like the fresh air</td>
<td>3</td>
</tr>
<tr>
<td>Because I have my own land</td>
<td>2</td>
</tr>
<tr>
<td>To care for nature</td>
<td>2</td>
</tr>
<tr>
<td>Forests benefit everyone</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>28</strong></td>
</tr>
</tbody>
</table>

Within two weeks after the pilot program had ended, I interviewed a convenience sample (n=5) of the participant researchers as part of an informal evaluation. I asked them to describe their favorite aspects of the program as well as elements that could be improved. Participants seemed to enjoy the field trips (See Table 4.2.), which included an opportunity to interview others as well as a chance to visit the World Forestry Center in Portland, Oregon. Participants also enjoyed spending time with friends while meeting new people.
Table 4.2 **What students liked and didn’t like about the participatory research program** (number of responses equals one, unless otherwise noted)

<table>
<thead>
<tr>
<th>Favorite aspects of the program</th>
<th>Aspects of the program that could be improved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interviews/field trips (n=3)</td>
<td>Not enough participants</td>
</tr>
<tr>
<td>Being with friends (n=2)</td>
<td>Meet twice per week instead of only once</td>
</tr>
<tr>
<td>Meeting new people</td>
<td>Collaborate with the other group more often</td>
</tr>
<tr>
<td>Learning new things</td>
<td>Meet indoors when working with computer</td>
</tr>
<tr>
<td>Summer camp</td>
<td></td>
</tr>
<tr>
<td>Making graphs on the computer</td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td></td>
</tr>
<tr>
<td>Presentation</td>
<td></td>
</tr>
</tbody>
</table>

(4.2) **Results from the Forest Field Program Evaluation**

Data were triangulated using both quantitative and qualitative methods. All quantitative data were analyzed statistically using one-sided, paired t-tests within a 95% confidence interval. P-values of less than 0.05 were considered statistically significant. Quantitative data consisted of results from a pre- and post- questionnaire and tests, which were administered at the beginning and end of the program or program components (i.e. vocational component). The questionnaire was self-reporting and measured the participants’ interest in forestry professions, self-efficacy of inquiry skills, and self-efficacy of collaboration skills. All ten of the program graduates completed both the pre- and post-questionnaires. I used pre- and post-tests to assess knowledge and performance. A knowledge-based test measured the participants’ awareness of forestry professions and was taken by nine of the program graduates. To normalize this group of data for purposes of statistical analysis, 0.5 was added to all zero values and data were subsequently log-transformed before performing the paired t-test. The performance-based test, which measured inquiry skills, was also taken by nine of the ten program graduates. Students who were absent when a pre- or post-test was administered and were not available for timely follow-up testing were not included in the statistical analysis for
that particular test. Scores from all tests were converted to percentages for purposes of analysis.

Qualitative data were analyzed from in-depth, personal interviews with program participants, parents, staff and teachers. The student interviews included all program graduates (n=10) as well as a small convenience sample of program dropouts (n=3). Of the program dropout sample, two of the three participants were present for much of the program and were asked many of the same questions as program completers, so their responses are included in parts of the analysis. I used a small convenience sample of parent interviews (n=5) as well as teachers (n=2) and program staff (n=1). Respondents were allowed more than one response for open ended questions and the results are reported as a percentage of total responses and not respondents. As interviewees were viewed as “meaning makers” (Warren, 2002, p.83), respondents’ words from interviews were aggregated into thematic categories, which included “similar words or phrases to express the same idea” (Auerbach & Silverstein, 2003, p.37).

(4.2.1) Hypotheses 1-6

Using data triangulation, I evaluated the following hypotheses:

- Hypothesis #1: Students who complete this program will report more interest in forestry professions than when they began the program.

Results from the bilingual, self-reporting pre/post questionnaires did not indicate that students felt more interested in forestry professions after completing the program. Post-questionnaires scores for self-reported interest measures were not statistically higher than the pre-questionnaire values (p=0.49, See Table 4.3.).
Table 4.3 Forest Field Program evaluation results from statistical analysis of pre- and post-questionnaire and tests using one-sided, paired t-test

<table>
<thead>
<tr>
<th>Research question of interest</th>
<th>(n)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased professional interest? (Self-report questionnaire)</td>
<td>10</td>
<td>0.4846</td>
</tr>
<tr>
<td>Increased professional awareness? (Test)</td>
<td>9</td>
<td>0.0141***</td>
</tr>
<tr>
<td>Increased self-efficacy of inquiry skills? (Self-report questionnaire)</td>
<td>10</td>
<td>0.4977</td>
</tr>
<tr>
<td>Improved inquiry skills? (Test)</td>
<td>9</td>
<td>0.0105***</td>
</tr>
<tr>
<td>Increased self-efficacy of collaboration skills? (Self-report questionnaire)</td>
<td>10</td>
<td>0.6632</td>
</tr>
</tbody>
</table>

Results from the student interviews also suggest that students generally did not feel significantly interested in forestry professions. Only five of the twelve respondents reported a significant interest in forestry professions as a result of the program (See Table 4.4.). Students provided examples of ways in which they had increased their interest in forestry professions. Most of the students expressed some interest in a particular career, such as wildlife biologist.
Table 4.4 Students’ self-reported evidence of increased interest in forestry professions

<table>
<thead>
<tr>
<th>Student responses to question of whether they felt more interested in forestry professions as a result of participation in the FFP</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>5</td>
</tr>
<tr>
<td>Somewhat</td>
<td>4</td>
</tr>
<tr>
<td>No</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples of increased interest</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocational aspiration (i.e. wildlife biologist, timber cruising, engineer)</td>
<td>6</td>
</tr>
<tr>
<td>Interested in forest plants {subject}</td>
<td>1</td>
</tr>
<tr>
<td>&quot;I care about the forest more now than I did before&quot; {environmental/affective}</td>
<td>1</td>
</tr>
<tr>
<td>“I want to do what José [did]” (was a wildlife biologist) {identify with professional}</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>9</strong></td>
</tr>
</tbody>
</table>

Students also offered opinions about aspects of the program they felt contributed to their increased interest in forestry professions (See Table 4.5.). Many of the students recalled a specific anecdote, told in Spanish, which had been shared by one of the facilitators who had been a wildlife biologist in Peru. Students also reported a positive experience with data collection in the forest as something that had increased their interest in forestry professions.
Table 4.5 Students' experiences associated with increased interest in forestry professions as a result of participation in the Forest Field Program

<table>
<thead>
<tr>
<th>Student responses</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hearing about different jobs or Jose's experience as a wildlife biologist {anecdotal}</td>
<td>4</td>
</tr>
<tr>
<td>Data collection (i.e. both indoors and outdoors, similar to the jobs that were described) {experiential}</td>
<td>2</td>
</tr>
<tr>
<td>Seeing the different plants {experiential/observational}</td>
<td>1</td>
</tr>
<tr>
<td>Traveling to different forests to explore {experiential}</td>
<td>1</td>
</tr>
<tr>
<td>Hearing about the cougar near Silver Falls {anecdotal}</td>
<td>1</td>
</tr>
<tr>
<td>Learning about forest problems and how to care for the forest {environmental/affective}</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>

Parents, however, were not aware of any increased interest in forestry professions on behalf of their child. Four out the five parent responses to this question indicated that the child had not mentioned any interest in forest professions. The remaining response suggested that the program seemed to have served the function of increasing students’ interest in forestry professions. Program staff expressed similar uncertainty of any increased interest on behalf of the students.

- **Hypothesis #2**: Students who complete this program will show greater awareness of forestry professions than when they began the program.

There was strong statistical evidence to suggest that students who completed the program demonstrated greater awareness of forestry professions compared to when they began the program. The forestry awareness scores of post-tests were significantly higher (p=0.01) than the pre-test scores (See Table 4.3). Results from the student interviews corroborate this evidence. Nearly all of the students interviewed expressed a strong sense of increased awareness of forestry professions (See Table 4.6.). Program participants provided specific examples of how they had increased their awareness of forestry professions. Most expressed an expanded conceptual awareness of forestry professions.
Others reported an experiential awareness of forestry professions or proximal interest in the forest.

Table 4.6 Students’ self-reported evidence of increased awareness in forestry professions

<table>
<thead>
<tr>
<th>Student responses to question of whether they were more aware of forestry professions as a result of participation in the FFP</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>10</td>
</tr>
<tr>
<td>No* (includes a student who missed last portion of program)</td>
<td>1</td>
</tr>
<tr>
<td>Not sure</td>
<td>1</td>
</tr>
<tr>
<td>Total responses</td>
<td>12</td>
</tr>
</tbody>
</table>

Examples of increased awareness

<table>
<thead>
<tr>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has expanded awareness of forestry professions as career options {conceptual}</td>
</tr>
<tr>
<td>Knows more about doing research in the forest (i.e. tracking animals) {experiential, skills}</td>
</tr>
<tr>
<td>Has increased general awareness of forest {proximal interest}</td>
</tr>
<tr>
<td>Total responses</td>
</tr>
</tbody>
</table>

According to students there were three main aspects of the program that contributed to their increased awareness of forestry professions: studying forest wildlife, hearing an account of a professional experience, and learning about the forest in general (See Table 4.7.).

Table 4.7 Students' experiences associated with increased awareness of forestry professions as a result of participation in the Forest Field Program

<table>
<thead>
<tr>
<th>Student responses</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning more about the forest {proximal interest}</td>
<td>3</td>
</tr>
<tr>
<td>Studying forest wildlife (i.e. through reading and observation) {experiential}</td>
<td>2</td>
</tr>
<tr>
<td>Hearing José talk about his experiences as a wildlife biologist {anecdotal}</td>
<td>2</td>
</tr>
<tr>
<td>Total responses</td>
<td>7</td>
</tr>
</tbody>
</table>
Regardless of students’ expressed increased awareness, parents were unaware of this change. Similar to parents’ perception of students’ increased interest in forestry professions, four out of the five parent responses to this question indicated that the child had not mentioned any interest in forest professions. The remaining response suggested that the program facilitated an increase in students’ awareness in forestry professions. Meanwhile, staff seemed certain that students had increased their awareness of forestry professions.

- **Hypothesis #3:** Students who complete this program will report greater self-efficacy in their inquiry skills than when they began the program.

Students did not report significantly greater self-efficacy in their inquiry skills following the Forest Field Program (p=0.50, See Table 4.3.). Nonetheless, interviews with students indicate otherwise. Most of the students interviewed who had completed the entire program felt they had improved their ability to investigate scientifically (See Table 4.8.).

Table 4.8 Evidence of students’ increased self-efficacy of inquiry skills

<table>
<thead>
<tr>
<th>Student responses to question of whether they felt more confident in their ability to “do science” or investigate as a result of participation in the FFP</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>9</td>
</tr>
<tr>
<td>No* (includes student who missed 1st half of program)</td>
<td>2</td>
</tr>
<tr>
<td>Somewhat</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

- **Hypothesis #4:** Students who complete this program will demonstrate improved inquiry skills compared to when they began the program.

Students demonstrated improved inquiry skills in their post-test scores. There is strong statistical evidence (p=0.01) to suggest that students who completed the program
scored significantly higher on their inquiry skills post-test when compared to their pre-test score (See Table 4.3.). Interviews with students (See Table 4.9.) support this quantitative data. Half of the students’ responses related to their improved ability to use specific parts of the scientific process, such as generating a hypothesis or collecting data to support a hypothesis. Students also reported improved ability using science technology, making scientific observations, gaining scientific knowledge, and improved performance in science class as a result of the program.

Table 4.9 Students’ self-reported evidence of improved inquiry skills as a result of participation in the Forest Field Program

<table>
<thead>
<tr>
<th>Examples of inquiry skills</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improvement using the scientific process (i.e. better at coming up with hypothesis, collecting data, searching for information, data analysis, drawing conclusions, presenting findings)</td>
<td>11</td>
</tr>
<tr>
<td>Better at searching for animal tracks or scat {observational}</td>
<td>3</td>
</tr>
<tr>
<td>Learn more about plants and animals, ID and/or ecology {cognitive}</td>
<td>3</td>
</tr>
<tr>
<td>Better performance in science class (i.e. grades; turning in homework) {behavioral}</td>
<td>3</td>
</tr>
<tr>
<td>Learned how to make graph on computer from data {technological}</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>22</strong></td>
</tr>
</tbody>
</table>

According to the program participants, there were specific experiences they felt facilitated improved inquiry skills (See Table 4.10.). The most common experience associated with improved scientific investigation was practice using the scientific process, such as data collection in the forest.
Table 4.10 Students’ experiences associated with improved inquiry as a result of participation in the Forest Field Program

<table>
<thead>
<tr>
<th>Student responses</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practicing collaboration (i.e. achieving consensus) {activities}</td>
<td>2</td>
</tr>
<tr>
<td>The program was interesting {content}</td>
<td>1</td>
</tr>
<tr>
<td>Outdoor learning {setting}</td>
<td>1</td>
</tr>
<tr>
<td>Using scientific process (i.e. data collection in forest) {activities}</td>
<td>1</td>
</tr>
<tr>
<td>Students feeling encouraged to challenge themselves and do their school work {social atmosphere}</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>

Interviews with parents also revealed strong evidence that students had increased their inquiry skills as a result of the program. All of the parents interviewed expressed at least some belief that their child had improved his or her inquiry skills (See Table 4.11.). Parents also offered a variety of examples of how their child has improved their inquiry skills, such as improved performance and interest in science.

Table 4.11 Evidence of improved inquiry of students according to parents

<table>
<thead>
<tr>
<th>Parent responses to question of whether they perceived improved investigation or “science” skills in their child as a result of the FFP</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>4</td>
</tr>
<tr>
<td>A little</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>5</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples of improved inquiry in child</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gets better grades in science class {behavioral}</td>
<td>4</td>
</tr>
<tr>
<td>Is more interested in science {motivational}</td>
<td>2</td>
</tr>
<tr>
<td>Spends more time studying science now {behavioral}</td>
<td>1</td>
</tr>
<tr>
<td>Understands more in science {cognitive}</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>

While one science teacher expressed uncertainty about whether the program alone had increased his students’ inquiry skills, another teacher commented specifically about improved skills of one of his students in the program. Meanwhile, program staff felt the students had improved their inquiry skills somewhat. Nonetheless, teachers and staff all
agreed that practice using the scientific process during the program could be associated with any gains in inquiry skills.

- **Hypothesis #5**: *Students who complete this program will report greater self-efficacy in their collaboration skills than when they began the program.*

According to data from the pre- and post-questionnaires, students who completed the program did not report greater self-efficacy in their collaboration skills after completing the program (p=0.66, See Table 4.3.). However, interviews with the students who participated in the program revealed that they did perceive an increase in their self-efficacy of collaboration skills. All but one of the students interviewed on this topic felt they had experienced at least some gains in their ability to work as part of a team (See Table 4.12.).

| Table 4.12 Students’ self-reported evidence of increased self-efficacy in team work/collaboration skills |
|-------------------------------------------------|-------------------------------------------------|
| Student responses to question of whether they felt more confident in their ability to work as part of a team as a result of participation in the FFP | # of responses |
| Yes | 10 |
| No | 1 |
| Somewhat | 1 |
| **Total responses** | **12** |

- **Hypothesis #6**: *Students who complete this program will demonstrate improved collaboration skills compared to when they began the program.*

Students provided significant examples of how they had improved at collaborating (See Table 4.13.). The most improvement appeared in their willingness to communicate with others, followed by spending more time with peers in groups and making new friends.
Table 4.13 **Students’ self-reported evidence of improved collaboration skills as a result of participation in the Forest Field Program**

<table>
<thead>
<tr>
<th>Student responses</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talks more in groups/class now {communication}</td>
<td>4</td>
</tr>
<tr>
<td>Spends more time with peers in groups/makes new friends {social}</td>
<td>3</td>
</tr>
<tr>
<td>Each group member had a role during the presentation {team work}</td>
<td>1</td>
</tr>
<tr>
<td>Collaborates more in groups {team work}</td>
<td>1</td>
</tr>
<tr>
<td>Participates more in school and science class {participation}</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total responses</strong> (Question was asked only of students who completed the program.)</td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>

Program participants identified specific aspects of the program they felt facilitated the increase in their collaboration skills (See Table 4.14.). The most common response was time spent sharing and generating ideas. Meeting new people and developing trust, collaborating on their presentation, and working with others during data collection were the second most common responses.

Table 4.14 **Students' experiences associated with improved collaboration skills as a result of participation in the Forest Field Program**

<table>
<thead>
<tr>
<th>Student responses</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharing and generating ideas together {activities}</td>
<td>5</td>
</tr>
<tr>
<td>Collaborating on PowerPoint presentation {activities}</td>
<td>4</td>
</tr>
<tr>
<td>Working in groups or partners/data collection {activities}</td>
<td>4</td>
</tr>
<tr>
<td>Meeting new people and developing trust {social}</td>
<td>4</td>
</tr>
<tr>
<td>Practicing collaboration {activities}</td>
<td>1</td>
</tr>
<tr>
<td>Less pressure than school/no grading {social atmosphere}</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>19</strong></td>
</tr>
</tbody>
</table>

Interviews with parents revealed perceived improvement among students, especially among particular students. Most of the parents expressed (4 out of 5), with remarkable certainty, that their child had improved his or her collaboration skills as result of participation in this program. The remaining parent expressed uncertainty about whether their child had improved collaboration skills as a result of the program. Parents also perceived their child’s improvement in specific areas related to collaboration skills.
Most of the parents observed their child was more likely to participate in extracurricular activities, indicating a willingness to collaborate with others. Parents also noted how their child was more willing to communicate with others, making an effort to be more sociable.

Table 4.15 Evidence of improved collaboration skills among students, according to parents & teachers, as a result of student participation in the Forest Field Program

<table>
<thead>
<tr>
<th>Parent and teacher responses</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participates in extracurricular activities now {social}</td>
<td>3</td>
</tr>
<tr>
<td>Challenges herself more to talk with others/less shy {social}</td>
<td>2</td>
</tr>
<tr>
<td>Gets along better with others/ made new friends {social}</td>
<td>2</td>
</tr>
<tr>
<td>Trusts herself more {self-efficacy}</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>

Of the teachers interviewed, one felt he had seen significant improvement in collaboration among his students while the other did not express observed changes among his students in this area. Both teachers and parents expressed opinions about which aspects of the program they felt probably contributed to students’ improved collaboration skills (See Table 4.16.). The most common response offered was that the program was fun, which facilitated participation in all aspects. There is no data from program staff on this question.

Table 4.16 Experiences associated with improved collaboration skills among students, according to parents & teachers, as a result of student participation in the Forest Field Program

<table>
<thead>
<tr>
<th>Parent and teacher responses</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fun to participate in everything {activities/social atmosphere}</td>
<td>2</td>
</tr>
<tr>
<td>Learning new things in the forest with a team {team work}</td>
<td>1</td>
</tr>
<tr>
<td>Students felt secure {social atmosphere}</td>
<td>1</td>
</tr>
<tr>
<td>Trust in other students/ can depend on group {social/social atmosphere}</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>5</strong></td>
</tr>
</tbody>
</table>
In addition to evaluating six hypotheses for this study, I felt it was relevant to gain a sense of what aspects of the program worked well and what could be done better next time. Students (n=13), parents (n=5), teachers (n=2), and staff (n=1) were all asked to reveal what they liked about the program and what suggestions they might have for future program efforts. Respondents were allowed more than one response. Their responses are reported below. Most of the positive feedback from students related to program activities (See Table 4.17.). Students enjoyed going to the forest to see plants and animals, especially within the context of data collection. For most students, this was the first activity that came to mind when asked what they liked about the program. Associated with this activity was “being outside/field trips,” which was the second most common response.

Table 4.17 What students liked about the Forest Field Program

<table>
<thead>
<tr>
<th>Student responses</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field trips/going to forest and finding out what animals and/or plants lived in the forest/seeing wildlife (i.e. data collection) {activities}</td>
<td>13</td>
</tr>
<tr>
<td>Learning about the forest, plants, and animals {content}</td>
<td>2</td>
</tr>
<tr>
<td>Spending time with friends/getting to know people {social}</td>
<td>2</td>
</tr>
<tr>
<td>Camping {activities}</td>
<td>1</td>
</tr>
<tr>
<td>Data analysis {activities}</td>
<td>1</td>
</tr>
<tr>
<td>Meeting regularly and throughout year {logistics}</td>
<td>1</td>
</tr>
<tr>
<td>Knowledgeable staff {staff}</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>21</strong></td>
</tr>
</tbody>
</table>

Parents shared their child’s enthusiasm for field activities, with more than half of the parents interviewed citing this as something they liked about the program (See Table 4.18.). Parents also appreciated the content of the program with a focus on the forest.
Table 4.18 What parents liked about the Forest Field Program

<table>
<thead>
<tr>
<th>Parent responses</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning about animals and identification/field trips to search for animals</td>
<td>3</td>
</tr>
<tr>
<td>Focus on the forest</td>
<td>2</td>
</tr>
<tr>
<td>The presentation</td>
<td>1</td>
</tr>
<tr>
<td>Good social experience</td>
<td>1</td>
</tr>
<tr>
<td>Child learned about caring for the land</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>

Staff gave a favorable report of team-work dynamics among other program staff, availability and application of technical knowledge among staff, and the opportunity to work with middle school students and their parents. The staff member interviewed felt it was especially important that parents be involved in program efforts if students are to assimilate what’s being taught. Teachers appreciated that students were doing science in “real world” settings, as opposed to in the classroom.

Students gave a variety of responses about how the program could be improved (See Table 4.19.). The most common response from students was they would like to go to a forest (or forests) that would not be closed unexpectedly at times due to road closure and gate closure. Students also wanted more students in the program and to visit places where we would see more wildlife.
Table 4.19 **Students’ suggestions for improvement of the Forest Field Program**

<table>
<thead>
<tr>
<th>Student responses</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go to a different forest/ compare forests/ go to forest that won’t be closed</td>
<td>5</td>
</tr>
<tr>
<td>{logistics}</td>
<td></td>
</tr>
<tr>
<td>Have more students in program {social}</td>
<td>2</td>
</tr>
<tr>
<td>Use various forms of communication {communication}</td>
<td>2</td>
</tr>
<tr>
<td>More detailed info/Identify more organisms at the species level {content}</td>
<td>1</td>
</tr>
<tr>
<td>Students translate fewer graphs next time {activities}</td>
<td>1</td>
</tr>
<tr>
<td>Learn about specific study areas beforehand {activities}</td>
<td>1</td>
</tr>
<tr>
<td>Go on field trips every week {logistics}</td>
<td>1</td>
</tr>
<tr>
<td>Go to places with more wildlife {setting}</td>
<td>1</td>
</tr>
<tr>
<td>None</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>

Parents’ suggestions related mostly to program content (See Table 4.20.). One parent revealed that communication of program details could have been more thorough and periodic. Another parent expressed concern about providing transportation for their child at all points within the program.

Table 4.20 **Parent suggestions for improvement of the Forest Field Program**

<table>
<thead>
<tr>
<th>Parent responses</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhanced content (i.e. more detailed info/Identify more organisms at the species level; learn about forest health issues) {content}</td>
<td>2</td>
</tr>
<tr>
<td>More information about the program/periodic updates {communication}</td>
<td>1</td>
</tr>
<tr>
<td>Provide transportation to and from home {logistics}</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>4</strong></td>
</tr>
</tbody>
</table>

Staff suggested that there be additional staff (i.e. facilitators) to lower the adult/student ratio and to allow for more one-on-one time with students. Additionally, staff felt working with fewer groups per term but more intensively and over a shorter duration (i.e. 3 months) would provide a more coherent structure with more continuity for both students and staff. Although teachers did not feel familiar enough with the program
to provide much constructive feedback, one of the teachers suggested that any program such as this one should always be “authentic, interesting, and have outside importance.”

Finally, it is worth noting the high rates of attrition for the Forest Field Program. Of the 34 total students that were recruited and went to at least one program meeting, only 18 continued on to attend up to four meetings and, of those 18 students, only ten completed the program. Four meetings seemed to be the final threshold for participation when most of the remaining 18 students would either drop out of the program or go on to become program completers. Students cited a wide variety of reasons for either missing program meetings or dropping out of the program (See Table 4.21.). Most of these reasons were socially related, such as family obligations, interpersonal conflict with other program participants, and other extracurricular commitments. However, one of the students who dropped out of the program was simply lost to contact.
Table 4.21 **Student challenges to attending or reasons for dropping the Forest Field Program**

<table>
<thead>
<tr>
<th>Student responses</th>
<th># of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other extracurricular activities</td>
<td>7</td>
</tr>
<tr>
<td>Doctor's appointments or sick</td>
<td>4</td>
</tr>
<tr>
<td>Family obligations</td>
<td>3</td>
</tr>
<tr>
<td>Interpersonal conflicts with other students in program</td>
<td>2</td>
</tr>
<tr>
<td>Disciplined by teacher or parents</td>
<td>2</td>
</tr>
<tr>
<td>Friend couldn't go</td>
<td>1</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Lost to contact</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>23</strong></td>
</tr>
</tbody>
</table>

In summary, the results of the current study provided valuable insight into program design in addition to information about student gains. Through the PR process, we learned that a forest education program that would be valuable to the Latino community should include opportunities to learn about forest ecology while spending time in the forest. Through the FFP evaluation, we learned that students, parents, and teachers alike appreciated program opportunities to visit and investigate the forest through hands on, authentic, inquiry-based activities. In addition to insight on program design, the current study determined whether students made gains with respect to program objectives (See Table 4.22.).
Table 4.22 Summary of Forest Field Program evaluation results

<table>
<thead>
<tr>
<th>Student gains with respect to hypotheses</th>
<th>Quantitative (statistical) support?</th>
<th>Qualitative (interviews) support?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased interest in forestry professions (H:1)</td>
<td>No</td>
<td>Weak</td>
</tr>
<tr>
<td>Increased awareness of forestry professions (H:2)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Increased self-efficacy of inquiry skills (H:3)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Increased performance of inquiry skills (H:4)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Increased self-efficacy of collaboration skills (H:5)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Increased performance of collaboration skills (H:6)</td>
<td>N/A</td>
<td>Yes</td>
</tr>
</tbody>
</table>
(5) DISCUSSION

“In the absence of youth leadership, programs, organizations, and communities fail to reflect young people’s needs and aspirations, and development processes lose young people’s energy and knowledge. Young people’s needs are often indicators of the most critical issues facing the community at large” (London, Zimmerman, & Erbstein, 2003, p.35).

(5.1) Participatory Research Program

Results from the participatory research exploratory program indicated the need for a forest education and vocational awareness program for Latino youth within the Central Willamette Valley. Responses from Latino community members, including youth and adults, revealed an interest in forestry professions, but also indicated awareness and education among Latinos was too limited to take advantage of professional opportunities within the field of forestry. This lack of awareness of opportunities might reflect a difference in forest economies across México and the United States. For instance, most of México’s forests are not managed commercially or by the government (Brown, Leal-Mariño, Mellveen, & Tan, 2004). Many of the Mexican immigrants in the Central Willamette Valley have come from southern states in México like Michoacan, Oaxaca, and Chiapas; these states generally consist of poor forest communities when compared to northern Mexican states (and the U.S.A.) (Brown et al., 2004), which could also have implications for one’s expectation to find well paid work in forestry. Given the lower levels of formal education among Hispanics (U.S. Census Bureau, 2004), it is not surprising that the Latino community felt that lack of formal education, too, was in part to blame for the low numbers of Latinos in professional forestry positions.

Results from the PR process also indicated Latinos’ interest in visiting the forest and learning about the plants and animals found there. Feedback from students following the PR process suggested that a subsequent inquiry-based program in the forest could be well received given more students and larger collaborative-inquiry groups.
(5.2) Forest Field Program

Results from the Forest Field Program evaluation, although inconsistent, provide evidence for overall efficacy of the program. Evaluation of the FFP rendered mixed results, which occur commonly with mixed-methods study design (Mathison, 1988). Qualitative analysis revealed efficacy of the program with respect to all objectives. While the results of the in-depth interviews supported the results of the pre/post tests, they did not corroborate the results of the self-report questionnaires, with the exception of the first hypothesis. The self-report questionnaires did not uncover any statistically significant evidence to support hypotheses one, three, and five, suggesting the program did not increase significantly students’ interest in forestry professions or their self-perceived inquiry and collaboration skills. Meanwhile, the in-depth interviews supported hypotheses three and five. How can this inconsistency in results be explained?

There are at least a few possible explanations for inconsistency in the results: lack of instrument reliability, differences in student levels of reflection depending on the mode of evaluation, and the lack of self-efficacy’s predictive power for complex tasks, such as inquiry and collaboration. The concern of instrument reliability relates to the internal validity of the study. Although the bilingual self-report questionnaire was informed by the literature and designed using a focus group and pilot testing, it’s possible that some of the items on the questionnaire did not fully capture, in the minds of Latino students, what it means to be interested in forestry professions and feel confident in inquiry or collaboration skills. For instance, “One day I would like to manage the forest,” item 6 on the questionnaire may not have been an accurate indicator of students’ interest in forestry professions. However, while some of the items on the questionnaire may not have been accurate indicators of students’ perceptions, the number of items (n=23) on the questionnaire should have minimized this potential problem. It is also unlikely that this was a significant issue across all sections of the questionnaire.

Another explanation for the inconsistency in results is the difference in levels of student reflection depending on the mode of evaluation. More reflection is required and
enabled during interviews than while responding to closed-ended questions on a questionnaire. In contrast to the interviews where students were prompted to give thoughtful examples to substantiate their responses, students were encouraged to respond to the questionnaire using their first impression, not dwelling too much on any one response. As a result, students spent more time reflecting on their experiences during interviews, where they were provided with open-ended questions and conversational prompts, than when given a questionnaire with closed-ended statements. Similarly, students demonstrated significant gains on both post-tests, where open-ended questions and prompts were used.

A third explanation for inconsistency of the triangulated results involves the lack of self-efficacy’s predictive power for complex tasks such as inquiry and collaboration. Lane and Lane (2001) found that self-efficacy has only partial predictive power when it comes to academic performance. Inquiry, which requires systematic reasoning, and collaboration, which requires sophisticated interpersonal skills, are both complex tasks. Consequently, the ability to predict (or associate) one’s performance in these tasks with one’s self-efficacy is limited, or challenging- at best. Furthermore, the program activities involving reflection, a necessary step in the process of developing one’s self-efficacy, were limited. Students were unaware of their gains on the post-test and consequently may not have perceived overall gains in their ability to investigate.

Nonetheless, students demonstrated significant gains in areas of professional awareness and inquiry skills while reporting gains in all areas, with respect to program objectives. Students not only spoke of an increased awareness of forestry professions and improved inquiry skills but demonstrated gains in these areas as well. Students reported having a greater awareness of career options within forestry, often citing tasks associated with specific professions discussed in the program. Students also reported evidence of how they had improved in their inquiry skills as a result of the program. Half of the students’ responses to whether they had improved their inquiry skills related directly to how they had developed their ability to use the scientific process, such as coming up with a hypothesis and collecting data. Students spent multiple meetings practicing these skills,
so it is not surprising that they felt improvement in this area. Pre- and post-tests corroborated these findings, with significant improvement in both awareness of forestry professions and inquiry skills (p=0.01). Students reported an increased interest in and awareness of forestry professions, which they attributed in part to a program leader’s personal account of his professional experiences in the forest. Students recalled this account vividly during interviews. Meanwhile, a few students, parents, and one teacher commented on what an impact the program had on the collaboration efforts among particular students, citing unprecedented involvement in an extracurricular activity. These gains, while not reported for all students, were remarkably significant among a select few. According to students and parents, the success of the program may be attributed its activities.

At least half of the responses from students and parents revealed that activities were the most popular aspect of the program. The most popular type of activity, unsurprisingly, was field trips. Both youth and parents appreciated the opportunity for students to visit the forest or “el campo” (the country) and learn about plants and wildlife. Their responses are aligned with results from the participatory research pilot program where, when asked why they would be interested in working in the forest, more than half of the responses from the Latino community indicated a desire to learn about plants and animals or to spend time in the forest. Interviews with students and parents, many of who came from rural parts of México, revealed a fondness or even deep appreciation of nature and “the country.” These results support findings by Dwyer and Barro (2001) where Hispanics were found to place high value on outdoor activities.

In both the exploratory and the Forest Field Programs, students particularly enjoyed field trips, which involved activities like collecting data. Students revealed in interviews that they appreciated the hands-on nature and setting associated with data collection. Students also revealed an appreciation for the social nature of activities. In light of the students’ collaborative inquiry gains, paired and group activities like forming hypotheses, collecting data, and data analysis were highly aligned and probably very effective.
Meanwhile, parents appreciated the students’ final presentation of their investigation findings. The students decided to present their findings in English and Spanish so that their parents, who spoke primarily Spanish, could fully appreciate their child’s efforts. Parents not only appreciated their children’s efforts, but expressed an interest in the content as well. Following the presentation, parents were encouraged to ask questions about the presentation, which they did. It is important to emphasize that although I (as the facilitator) would have had more to contribute conversationally had the presentation been conducted solely in English, parents would have had less to contribute. Given that the level of parents’ appreciation for and interaction with the presentation probably depended on the language in which it was presented, it is recommended that similar future programs also enable students to choose their preferred language throughout the program. While the interviews with students and parents revealed what worked in the program, interviews also revealed what areas of the FFP could be improved.

Suggestions for program improvement cited by students and parents concentrated on three main areas: content, communication, and logistics. Both students and parents expressed an interest in exploring species and forest related information at more depth. Students and parents also expressed an interest in more in-depth communication between them and program facilitators. For instance, one student suggested the use of a program calendar with activity dates while a parent suggested periodic updates about the program’s progress would be useful. Students and parents also made suggestions for improved logistics. For instance, one student requested more frequent field trips while one parent expressed concern about providing transportation to and from all activities. A number of the students’ concerns about logistics related to forest access, as we were unable to access the Weyerhaeuser forest on more than one occasion due to unexpected road or gate closure. A future program including the favored aspects of the program while integrating improvements based on student and parent feedback would likely render even better outcomes and student retention.
(5.3) **Research Contributions and Scope of Inference**

This study is the first of its kind with respect to program population, content, and design. While existing studies, both quantitative and qualitative, have examined the effects of inquiry-based or experiential type programs on participants, none have examine such programs where content involved vocational and science education among Latino youth, in particular. Moreover, few studies that have examined vocational or inquiry-based programs have used triangulation methods in their evaluation. More commonly, the evaluation involves either quantitative or qualitative methods, but not both. The results of this case study indicate that similar, student-centered programs may be worth developing and evaluating.

Although the findings of this study suggest a degree of program transferability and that a similar program may be used to render similar results, there are limitations to the scope of inference. As only one of the students included in the final analysis and only two of all original participants did not share Mexican American ethnicity, this study’s scope of inference is limited to self-selecting 7th and 8th grade Mexican American youth with language skills in both English and Spanish. Although this project sought to involve Latino students of different ethnicities, only Mexican American students volunteered to participate in the FFP, perhaps reflecting the higher percentage of Mexican American families residing in the Central Willamette Valley. Forestry, as a relevant topic and professional field in Oregon, may also have its limitations as a vocational emphasis in similar programs outside of Oregon. Nonetheless, Mexican American communities where forests are available as a setting for student investigation may find a similar program useful for at least developing collaborative inquiry skills of students.

While these results are encouraging, there are additional limitations to this case study, which may also affect the scope of inference. First, the small sample size of program participants limits our ability to generalize to the larger population and even other Mexican American students. Consequently, the small sample limits the external validity of this study. In addition to limiting our ability to generalize, this study’s small
sample size may also reduce the reliability of the results. The small sample size reflects the challenge of sustaining a larger population for a long-term program of considerable commitment. Of the 34 total students who were recruited and went to at least one program meeting only ten completed the program and only one student reported no challenges to staying in the program. Most of the challenges faced by students in sticking with the program were socially related, perhaps reflecting the busy lives of many students today and the significance of peer relationships among middle school students. Regardless of the reasons for attrition, a small sample size of ten participants limits the scope of inference of this case study to other small studies with a similar population.

Secondly, program participants were self-selecting and not evaluated in light of an experimental control group. Self-selecting students, or students who enroll in educational programs voluntarily, may have unique aptitudes, perhaps on account of their predisposed interest in the program content. Consequently, the self-selected nature of program participants, while realistic, may limit the scope of inference in this study to similar programs or interventions where students are also self-selecting. Similarly, without a control group, it is difficult to determine whether the effects shown with the FFP participants would appear in control group students who had been selected randomly. Finally, most of the program completers were female. Six of the ten students who completed the program were female, which may have implications for the results of this study. It is possible that given a different gender balance, program preferences and evaluation results in general might have been different.

(5.4) Suggestions for Future Study

The single most challenging aspect of managing this case study was dealing with program attrition and attendance in general, which may be remedied with future study. Program attrition made it difficult to plan on how many students would be attending any given field trip. Logistically, this meant not knowing in advance what would be the optimal number of vans to use, how much food to bring, and how many materials to
prepare. The small number of program completers also reduced the scope of inference of this study. While not the sole focus of this study, future studies might examine how to solve this problem of attrition and/or irregular attendance. One approach for understanding why students leave the program early or do not attend regularly might be to look at how students are admitted to the program. Other than being in 7th or 8th grade, there were no other entry or selection criteria for this program (although the program was promoted as a “Latino” program). While opening the program to all who were interested may have been the most inclusive approach, it also enabled the entry of students who may not have been committed to complete the program. Future efforts might implement selection criteria for program entry. Asking students to write an essay or create a poster for program entry, for example, would be a simple exercise for recruiting program participants who demonstrate a significant level of interest. In addition to dealing with a small sample size for purposes of analysis, the current study did not have access to an outside control group with which to compare results.

Although pre/post measures are sufficient as a control for small case studies, further study and subsequent design of a program similar to the FFP might create an experimental control group by offering the program in quarterly segments, as suggested by staff. This would create a ready pool of self-selecting participants that could act a control group prior to participation in the program. Reducing the duration of the program could also reduce the likelihood of temporal effects (i.e. maturation) on students’ post-program performance measures. Additionally, condensing the program into a shorter period of time, such as two or three months could reduce attrition rates by reducing the required commitment. However, future studies that employ this design would need to address the question of whether a change in the intensity of the program (by condensing it) would affect its efficacy with respect to student outcomes and program objectives.

Future studies might also examine the effectiveness of a student-centered, inquiry-based approach in programs where there is more emphasis on student comprehension of content. The student-centered approach to program design, which encourages students to engage collaboratively in the inquiry process, may be useful
among high school and college students who are mastering course content. In contrast, high school and university class instructors typically employ testing as a means to encourage students to master material. Future studies might examine how a student-centered, collaborative inquiry approach may be integrated effectively through meaningful, authentic, and engaging activities.

Lastly, future studies might spend more time on the development of bilingual evaluation instruments. This case study was unique in its approach by offering evaluation instruments in both Spanish and English. While these instruments were developed using a focus group of Latino students and parents as well as two pilot tests, the final instruments were not tested with statistical measures to determine validity. Future studies that focus on developing valid bilingual assessment tools for inquiry-based programs, for example, could contribute greatly to the literature and the body of resources available in the field.
CONCLUSION

Overall, the quantitative and qualitative results of this study provide strong evidence to indicate that the Forest Field Program was successful in developing students’ awareness of forestry professions while improving their collaborative inquiry skills. Results from the FFP evaluation indicated that the program facilitated an overall significant (p=0.01) increase in students’ awareness of forestry professions and an improvement in their inquiry skills. There was partial evidence from the evaluation to suggest that the FFP facilitated an increase in students’ collaboration skills as well as their self-efficacy of inquiry and collaboration skills. Meanwhile, little evidence suggested that the Forest Field Program significantly increased students’ interest in forestry professions. While the results of this study are inconsistent, they are not incongruent.

Results from this study indicate that it would be worthwhile for educators to explore the efficacy and use of similar programs for educational, social, and vocational exploration purposes among ethnic minority students. The student-centered approach to program design enabled students to engage more authentically in the inquiry process. Although a student-centered approach requires the facilitator to have a broad knowledge base in a subject such as forestry, for instance, this approach enables students to have a sense of ownership of their investigation. In addition to acting as a student-centered context for scientific inquiry and vocational exploration, the Forest Field Program could also be considered as an entrée for students and their families into the world of higher education, expanding the capacity of middle and high school counseling programs, which are currently under-serving minority students, as well as college recruitment programs.

While universities throughout the U.S. move towards dismantling affirmative action in admissions after 30 years of debate, universities have made little progress toward student bodies that are ethnically and racially representative (Lewin, 2007). For university programs where it is a priority to develop a diverse student body, the role of a
college recruiter can be more than a salesperson, recruitment programs a community investment rather than solicitation. Instead, the role of the college recruiter could be expanded to act as a vocational counseling liaison and educator within the community and among parents (Triana & Rodriguez, 1993), according to community needs and in partnership with schools and colleges. Expanding the role of a university recruiter to one as an educator might seem superfluous, but is entirely relevant within the context of increasing minority representation at the university level. In the words of Triana and Rodriguez (1993), “Without an education Hispanics will always be underrepresented in math and science-related fields, or for that matter, in any field” (p.36). As well as playing a role in educating minority students, a program designed after the FFP can orient students toward college.

Middle-school is an important age for students as they develop an orientation toward college. If students are bound by a greater sense of direction, they may be more likely to succeed in high school and take the steps required for entry into higher education, especially if those steps are clearly defined for the students following the program and during their high school career. If students who complete a program similar to the FFP develop rapport with program facilitators, these facilitators may act as trusted sources of information about college bound options. A program designed after the FFP but with more vocational guidance and counseling capacity could ultimately be a very worthwhile approach.

In closing, there is no panacea for addressing ethnic underrepresentation in certain professional fields and underperformance in certain academic areas. Student-centered programs that integrate vocational and collaborative inquiry elements may, however, be beneficial for Mexican American students. What is essential is that such programs are relevant to not only students but to their parents and community as well. The participatory research process that preceded the current study served as both an unconventional needs assessment and exploratory program that enabled youth leadership and allowed researchers to discern the needs of Latino youth within their community. It
would not only be valuable for academia but would benefit youth if programs modeled after the FFP use a student-centered approach in every step of design.
BIBLIOGRAPHY


Oregon Forest Resources Institute (OFRI). *A guide to Oregon’s forest wildlife*. Portland, OR: OFRI.


## Appendix A  Bilingual participatory research program calendars

### JULY

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<td>15) (Field Trip) Colonia Libertad: 2:00-4:00 Conduct Interviews</td>
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<td>18) Colonia Libertad: 2:00-4:00 Técnicas de Análisis de datos</td>
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<td>29) Colonia Libertad: 2:00-4:00 Escribir sobre resultados</td>
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<td>31) Colonia Libertad: 2:00-4:00 Escribir sobre resultados</td>
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<td>9 ¡Celebración! Presentar los resultados</td>
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Hello, my name is ______________ and I’m with the Social Research in Forestry Program from Oregon State University. We want to learn about what people think about the forest. Do you have about 10 minutes for an interview? What language do you prefer: English or Spanish?

1. How long have you lived in Oregon? ________

2. Have you ever worked in a job related to the forest?
   a. Yes or No
   b. What was your profession and what did you do?
      ________________________________
      ________________________________
      ________________________________

3. Are you interested in working in the forest?
   a. Yes or No
   b. If yes, why?
      ________________________________
      ________________________________
      ________________________________
   c. If no, why not?
      ________________________________
      ________________________________
4. In your opinion, what is the main reason why aren't there more Latinos in leadership positions in forestry professions? \textit{(One response, please.)}
   a) Not enough education
   b) Lack of interest
   c) Not enough opportunities
   d) other

5. What do you think about the forest?
   a. It's good
   b. It's bad

6. Do you think the forest is important or unimportant?
   a. (If important) Explain:
      __________________________________________________________
      __________________________________________________________
      __________________________________________________________
      __________________________________________________________
   b. (If unimportant) Explain:
      __________________________________________________________
      __________________________________________________________
7. What do you like the most about the forest?
______________________________________
______________________________________

What do you like the least?
______________________________________
______________________________________

8. How interested in the forest are you?
   a. Really interested
   b. Somewhat interested
   c. Not interested at all

9. Have you been to a forest?
   a. Yes or No (If no, end of questionnaire)
   b. If yes, how many times in the last year have you gone to the forest? _____________

10. If you go to the forest where do you usually go?
________________________________________
________________________________________

11. If you have been to a forest, what did you do there? (You can choose more than one.)
   a. Camping
   b. Picnic
   c. Hiking
   d. Family time
   e. Other___________
Hola, mi nombre es_____________ y estoy con el programa de investigación social del bosque de oregon state university. Queremos aprender lo que piensan la comunidad del bosque. ¿Tiene acera de 10 minutos para una entrevista? ¿Que lenguaje prefiere: ingles o español?

1. ¿Hace cuánto tiempo que vives en Oregon?
________

2. ¿Tuviste alguna vez algún trabajo/a relacionado con el bosque?
   a. Sí o No
   b. ("Sí"), ¿Cuál era tu profesión y que cosa hacías en el trabajo?
      __________________________________________________________
      __________________________________________________________
      __________________________________________________________

3. ¿Estás interesado en trabajar en el bosque o en el área forestal?
   a. Sí o No
   b. ("Sí"), ¿Por qué sí?
      __________________________________________________________
      __________________________________________________________
      __________________________________________________________
c. ("No"), ¿Por qué No?

________________________________

________________________________

4. ¿En tu opinión, cuál es la razón principal por qué no hay más Latinos en posiciones de la dirección en profesiones del bosque? (Una respuesta, por favor)
   a. No tienen bastante educación.
   b. Porque a Los Latinos no les interesa.
   c. No hay bastantes oportunidades.
   d. la otra razón

________________________________

________________________________

5. ¿Que piensas acerca del bosque?
   a. Es bueno que exista el bosque o
   b. Es malo que exista el bosque

6. ¿Tu crees que el bosque es importante o no es importante?
   a. (Es importante) Por favor explica tu respuesta:

________________________________

________________________________

________________________________

________________________________
b. (No es importante) Por favor explica tu respuesta:

__________________________________
__________________________________
__________________________________

7. ¿Qué es lo que más te gusta del bosque.

__________________________________
__________________________________
__________________________________

¿Qué es lo que menos te gusta?

__________________________________
__________________________________
__________________________________

8. ¿Tan interesado/a estás en el bosque?
   a. Realmente interesado.
   b. Más o menos interesado.
   c. No tiene ningún interés en el bosque.
9. ¿Has estado alguna vez en el bosque?
   a. Sí o No (Si no, final de la entrevista)
   b. ("Sí"), ¿cuántas veces has ido al bosque en este último año? __________

10. ¿Si vas al bosque, a que lugar vas generalmente?
    ___________________________________________________________________
    ___________________________________________________________________
    ___________________________________________________________________

11. ¿Si tú has estado en el bosque, que actividad hiciste allí? (Puedes elegir más de una respuesta.)
    a. Campar
    b. Picnic
    c. Caminata
    d. Compartiendo tiempo con la familia.
    e. Otra actividad__________
Appendix C  Forest Field Program agendas

Meeting #1 Agenda (Orientation)

1. Provide overview of program.
   a. Question and answer

2. Administer pre-tests.

3. Hand out orientation curriculum.
   b. Read and discuss.

4. Gather students’ contact information.
Field Trip #1 Agenda

**On the way to Molalla**
1. Check for student consent forms (required for each student!)
2. Give each student a binder and pencil.
3. Introductions
4. Give students a copy of the pretest questionnaire.
5. Collect questionnaires from students once completed.
6. Talk to students about safety.

**Meet with Weyerhaeuser**
1. Visit each site.
2. Talk about the differences and similarities between each site.
3. Encourage students to make observations and write them down. Ask them:
   a. What do you see?
   b. How many different species can you see?
   c. How different is what you see from one site to another?
4. Before getting back in the vans, gather all students to establish ground rules for collaboration.
   a. Guidelines for speaking and listening\(^2\):
      i. Challenge with respect; make rational arguments, work through ideas.
      ii. Establish ground rules for collaboration by having students identify what makes a good discussion. One student will write these down; instructor collects at the end.
   b. One student can write down the answers.

**On the way back from Molalla**
1. Review ground rules for collaboration (you can quiz the students).
2. Get the students talking about what they would like to study. You may need to help them stay on the right track in terms of studying something FEASIBLE.
3. Have one student write down these ideas; meanwhile, pass around a contact information sheet.
   a. Have students narrow ideas down their two favorite ideas.
   b. Collect these ideas. We will come back to these ideas on the next field trip, determine the favorite, and determine methodology.

\(^2\) From Dawes and Sam (2004): Developing the Capacity to Collaborate
Field Trip #2 Agenda

On the way to Molalla:
1. Activities
   a. Group determines group member roles (example: leader, recorder, artist, questioner/skeptic, encourager)
   b. Group learns about hypothesis building and generates a hypothesis for each question, or merges questions where appropriate
   c. Group is introduced to concept maps
   d. Small groups (2-4) create concept maps for how to field test the hypotheses (can be one hypothesis per group or same hypothesis for both groups)

In Molalla
1. Work with compasses
2. Refine concept maps; Explore field options for testing the hypotheses

On the way back from Molalla
1. Group decides which hypothesis is most feasible to test (discussion: remember ground rules)

Outcomes
1. Hypothesis
2. Concept maps
Field Trip #3 Agenda

Learning Activities

On the way to Molalla (1 hour)
1. Review group roles and ground rules
2. Review hypothesis and concept map so far
3. Group reviews methods of how to study animals in the forest (refer to orientation handout- Emily will bring extra copies!)
   a. Student(s) can read this out loud
4. Group adds to their concept map

In Molalla (1.5 hours)
1. Lead students through different transect and plot methods.
2. Group decides which method is best for their study.
   a. They need to give you a rationale! You can guide them through this with Q & A.
3. Regroup and create final plan for study design. Students (or leader, recorder, etc.) can list out the items from their concept map in step-by-step order.
4. Students practice with the chosen field data collection method.
5. Students determine how to create data collection sheet. The artist and the recorder will play a central part in this activity!

On the ride home (1 hour)
1. Students create a timeline for getting their work done. (They have 5 more field trips and 3 more class sessions after school.)
2. Remind students that they need to bring their binders next time because they will be collecting data.
Field Trip #4 Agenda
First day of data collection

On the way to Molalla
1. Show students their data sheet. Get them to discuss how they will use it, who will collect the data sheets at the end of the day, etc.

In Molalla (1.5 hours)
2. Students collect data.
   a. Set up and label transects.
   b. Record data.

On the way back from Molalla
1. Students share what they found in the field for the day. Get them to talk about whether they’re on the right track or if there are any issues they need to address
Meeting # 2 Agenda

1. Review what we’ve done so far. Ask students:
   a. How did we begin this study? What were the first steps we took? For example, can you describe what we did at the first meeting, second meeting, etc.?
   b. Remind students that this is part of the scientific process. They’re acting like scientists.

2. Ask students what they think we’ll do next. What is the next step? What are we going to do once we have collected information for our data sheet? (Each student should get a copy of the data collection sheet.)

3. Has anyone ever used Microsoft Excel on the computer?

4. Has anyone ever created charts and graphs using Excel?

5. Encourage the students who have some experience with these programs to open the program and walk through it with you on the computer. We can use the little data we have from the fall to practice data entry and graph making.

6. Now encourage each of the other students to practice filling out the data collection sheets with mock data and then enter into the computer.
   a. This is also a good time to reexamine the data collection sheet and discuss its usefulness.
      i. How useful is this data collection sheet going to be? Have the students convene in a small group to consider the following questions for about 5 minutes:
         1. Are all the categories on here necessary?
         2. Are there any categories that we’re forgetting?
Meetings #3 & 4 Agenda

1. Finish working with Excel
   a. Making graphs that make sense from our data
   b. Interpreting those graphs and labeling them
   c. Trying different graphs

2. Explore PowerPoint
   a. Ask if anyone’s worked with PP before. If so, let that person stand at the computer first to begin navigating.
   b. Look at how to create different color schemes, layouts. Get students thinking about different ways to design, like incorporating pictures.

3. Research on the animal(s) of interest.
   a. Get students to jump on the computers and begin search through Google.
   b. For students studying different animals, give them the OFRI booklet. Maybe break students up into different groups to search through the sections of booklet (i.e. all stands, young stands, middle-aged stands, older stands).
      i. Get them thinking about which age group our stand would fit into.
         1. Focus on section for that age class.
            a. Google for more information online about scat ID and tracks ID in particular, as well as nesting sites, burrows, etc.
Field Trip #5 Agenda

On the way to Molalla
1. Hand out clipboards with students’ data sheets and field guides; hand out pencils
2. Administer pre-post career test in van ride to Molalla (15 min)

In Molalla
1. Students collect data in field (about 3 hours with 5 minute break every 30 minutes) in pairs. Students can take turns: one student can count steps while other student records data
   a. Dinner break: meet at top of hill open forest area at 5:15.
      i. Kyrria talks about her experience in Forest Engineering and introduces Forest Engineering fact sheet (IN SPANISH)
      ii. Jose talks about wildlife biologist experience and fact sheet (IN SPANISH)
2. Collect data sheets in binder and gather equipment

On the ride home
1. Free time and drop students off at home
Silver Falls Camping Agenda (Field Trip #6)

Thursday
1. Arrive at Silver Falls around 5:30

2. Cook dinner as group and set up beds; unpack vans; clean up

3. Get students working on Excel to begin data entry; graphs

4. Fun activity?

5. Lights out 10:00pm (Quite hours required 10:00pm to 7:00am)

Friday
1. Wake up at 7:00

2. Pack vans, get dressed and breakfast until 8:30

3. Begin bird sound ID activity- go until about 9:30 and award prizes

4. Begin plant ID activity- go for an hour and award prizes

5. Check out the waterfalls and maybe go for a little hike?

6. Lunch around 12/12:30- go until 1:30

7. Begin data collection activities and go until about 5:00.

8. Go home.
Field Trip #7 Agenda

On the way to Silver Falls
1. Hand out clipboards with students’ data sheets, field guides, and fact sheets; hand out pencils
2. Administer pre-post career test in van ride to Waldo students (15 min)
3. Students read over the two new fact sheets aloud (can take turns)

At Silver Falls
1. Students collect data in field (about 3 hours with 5 minute break every 30 minutes) in pairs. Students can take turns: one student can count steps while other student records data
   b. Dinner break: TBA.
2. Collect data sheets in binder and gather equipment

On the way home
1. Quiz students on data sheets on ride home (you can choose a leader to do the quizzing so that you can concentrate on driving!) and drop students off at home
Meetings 5, 6, & 7 (presentation)

1. Students enter data into Excel and make graphs.

2. Students begin PowerPoint presentation and include graphs from Excel files.
   a. Interpret graphs

3. Students present PowerPoint to parents at Colonia Libertad
   a. Begin with practice session 11:00 – 12:00
   b. Lunch 12:00 – 1:00
   c. Presentation 1:00 – 2:00
      i. Questions and answers
Appendix D  Bilingual Forest Field Program forest professions fact sheets

Forest Ecologists

Forest ecologists study mainly the relationship between many living things in the forest. For example, they are responsible for looking at both plants and animals and making notes (known as collecting data) about how well different plants and animals are living together. They could also study how environmental changes can affect different plants and animals. Additionally, they may be responsible for making sense of their data (known as analysis) by entering it into the computer.

Education required:

- Most forest ecologists who work in the forest and natural areas have at least a 4 year college degree (Bachelors in Science degree).
- Higher paying and more permanent careers often go to forest ecologists with a Master’s degree (about 6 years of college).
- Forest ecologists with a Ph.D. (about 8-9 years of college) can conduct their own research and may teach at a university. They are usually paid the most.

Working conditions:

- After a few years of experience, forest ecologists can expect to spend about the same amount of time working outdoor and indoor.

- Forest ecologists in the forest may work in the forest during a particular season to collect data about plants and animals, including where different plants and animals are living, how many different plants and animals there are, and healthy those plant and animals populations are. This requires going on field trips that can involve a lot of hiking and camping in possibly all kinds of weather.

- During the rest of the year they may analyze the data collected using computers and other technology.

- Forest ecologists may work alone for many hours collecting data or as part of a team.

How much forest ecologists earn:

- Starting salaries (earnings per year) usually begin around $35,000.
- With more experience and/or more education, median (middle range) salaries for forest ecologists are around $50,000.
ECOLOGO FORESTAL

Los ecólogos forestales estudian las relaciones entre los elementos vivos del bosque. Por ejemplo, ellos son responsables de observar las plantas y los animales y tomar notas (conocido como colección de información o colección de datos) acerca de cómo las diferentes plantas y animales viven juntos en el mismo medioambiente. Ellos también pueden estudiar cómo los cambios del medioambiente afectan a las diferentes plantas y animales. Adicionalmente, ellos también pueden ser responsables de la interpretación de sus datos (conocido como análisis) poniendo estos datos en la computadora.

Educación requerida:

- La mayoría de los ecólogos forestales que trabajan en el bosque y en las áreas naturales tienen al menos 4 años de estudios universitarios y un Grado de Esoanodo de Estudios de Ciencias (BS)

- Para ganar más dinero y más oportunidades en la carrera, generalmente hay que obtener una Maestría (MS) (aproximadamente 6 años de estudios universitarios)

- Los ecólogos forestales que tienen un Doctorado (Ph.D) (aproximadamente 8-9 años de estudios universitarios) pueden conducir sus propias investigaciones y enseñar en la universidad. Estos son generalmente los mejores pagados.

Condiciones de trabajo:

- Después de algunos años de experiencia, los ecólogos forestales pueden esperar pasar la misma cantidad de tiempo de trabajo en el campo y en la oficina.

- El ecólogo forestal puede trabajar en el bosque durante una estación determinada para recolectar datos acerca de plantas y animales, realizando las pruebas donde las diferentes plantas y animales están viviendo, cuantas clases diferentes de plantas y animales hay en ese lugar, y cuán salubres están esos poblaciones de plantas y animales. Esto requiere salidas al campo con muchas caminatas y campamentos en diferentes claves de climas.

- Durante el resto del año, el botánico puede analizar la información en la oficina usando computadoras y otras clases de tecnologías.

- Ellos pueden trabajar solo durante muchas horas, o como parte de un grupo de trabajo, colectando datos.

**Cuanto gana un ecólogo forestal**

- El salario del que viene comienza es alrededor de $30,000 Dólares por año.

- Con más experiencia o más educación el salario del ecólogo forestal es alrededor de $50,000 Dólares por año.
Botanists in the Forest

Botanists can study plants in the forest. They are responsible for looking at different plants, including trees, and making notes (known as collecting data) about the condition of these plants. They may also be responsible for making sense of their data (known as analysis) by entering it into the computer.

Education required:

- Most botanists who work in the forest and natural areas have at least a 4-year college degree (Bachelor's in Science degree).
- Higher paying and more permanent careers often go to botanists with a Master's degree (about 6 years of college).
- Botanists with a Ph.D. (about 8-9 years of college) can conduct their own research and may teach at a university. They are usually paid the most.

Working conditions:

- After a few years of experience, botanists can expect to spend about the same amount of time working outdoors and indoors.
- Botanists in the forest may work in the forest during a particular season to collect data about plants, including where different plants are growing, their size, and how many there are. This requires going on field trips that can involve a lot of hiking and camping in possibly all kinds of weather.
- During the rest of the year, they may analyze data indoors using computers and other technology.
- They may work alone for many hours collecting data or as part of a team.

How much botanists earn:

- Starting salaries (earnings per year) usually begin around $30,000.
- With more experience and/or more education, median (middle range) salaries for botanists in the forest are around $50,000.
Los Botánicos en el Bosque

BOTÁNICO
Los Botánicos pueden estudiar las plantas en el bosque. Ellos son los responsables de buscar las diferentes plantas, incluyendo los árboles y tomar apuntes (también conocido como colección de datos) acerca de las condiciones de esa planta en el bosque. Ellos también pueden ser responsables de la interpretación de los datos (Conocido como análisis) poniendo estos datos en la computadora.

Educación requerida:
- La mayoría de los botánicos que trabajan en el bosque y en las estaciones naturales tienen al menos 4 años de estudios universitarios y un Grado de Académico de Bachiller en Científica (BS)
- Para ganar más dinero y más oportunidades en la carrera generalmente hay que estudiar una Maestría (MS) (aproximadamente 6 años de estudios universitarios)
- Los Botánicos con un Doctorado (Ph.D) (Aproximadamente 8-9 años de estudios universitarios) pueden conducir sus propias investigaciones y enseñar en la universidad. Ellos son generalmente los mejor pagados.

Condiciones de trabajo:
- Después de algunos años de experiencia, los botánicos pueden esperar pasar la misma cantidad de tiempo de trabajo en el campo y en la oficina.
- Los botánicos pueden trabajar en el bosque durante una estación determinada para colectar datos acerca de plantas, incluyendo los lugares donde las diferentes plantas crecen, sus tamaño y la cantidad de plantas presentes en el lugar. Esto requiere salidas al campo con mucho caminar y campamentos en diferentes clases de clima
- Durante el resto del año, el botánico puede analizar la información en la oficina usando computadoras y otras clases de tecnologías.
- Ellos pueden trabajar solos durante muchas horas, o como parte de un grupo de trabajo colectando datos.

Cuanto puede ganar un botánico:
- Salario del Botánico que acaba comienza es alrededor de $40,000 Dólares por año.
- Con más experiencia o más educación el salario del botánico forestal es alrededor de $50,000 Dólares por año.
Forest Engineers

Forest engineers use their knowledge of engineering to find better ways to operate machinery and build roads in the forest. They are responsible for designing ways for people to make use of the forest with the least amount of damage possible to the forest. They are also responsible for understanding the impact to the forest from possible construction projects.

Education required:

- Most forest and environmental engineers have at least a 4-year college degree (Bachelor's in Science degree).
- Higher paying careers often go to forest engineers with a Master's degree (about 6 years of college).
- Forest engineers with a Ph.D. (about 8-9 years of college) can conduct their own research and may teach at a university or work independently for hire. They are usually paid the most.

Working conditions:

- Forest engineers may work in the forest and in the office. Most of their time is spent in the office working on designing plans.
- Field trips to the forest can involve some hiking all kinds of weather. There may be noise from loud machinery at logging or construction sites.

How much forest engineers earn:

- Starting salaries (earnings per year) with a Bachelor's of Science degree are high and usually begin around $45,000.
- With more experience and/or more education, median (middle range) salaries for forest engineers are around $55,000.
Ingeniero Forestal

INGENIERO FORESTAL

Los ingenieros forestales usan sus conocimientos de ingeniería para encontrar las mejores formas de operar las máquinas y conservar los bosques. Ellos son los responsables de diseñar las fajas para que la gente haga uso del bosque sin causar el menor daño posible. Ellos también son responsables de comprender el impacto al bosque debido a los proyectos de construcción.

Educación requerida

- La mayoría de los ingenieros forestales y de medioambiente tienen al menos 4 años de estudios universitarios y un Grado de Bachiller en Ciencias (BS).
- Las carreras mejor pagadas en la Ingeniería forestal se consiguen con frecuencia con un Grado de Maestría (aproximadamente 6 años de estudios universitarios).
- Los ingenieros Forestales con un Doctorado (Ph.D.) (aproximadamente 8-9 años de estudios universitarios) pueden conducir sus propias investigaciones y enseñar en la universidad. Ellos son generalmente los mejor pagados.

Condiciones de trabajo

- Los ingenieros Forestales pueden trabajar en el bosque y en la oficina. La mayoría de su tiempo trabajan en la oficina diseñando los planes de manejo del bosque.
- Las salidas al bosque pueden tener caminatas en diferentes tipos de climas. Puede haber mucho uso de maquinaria de cosecha forestal a de sitios de construcción.

¿Cuánto ganan los ingenieros forestales?

- El salario del Ingeniero Forestal con un grado de Bachiller en Ciencias y que recién comienza es está en, redondeado de unos $46,000 dólares por año.
- Con más experiencia y/o más educación (rango medio) el salario del Ingeniero Forestal es alrededor de $55,000 dólares por año.
Wildlife Biologists in the Forest

Wildlife Biologists often study animals in the forest. They are responsible for watching animal behavior and making notes (known as collecting data) on that behavior. They may also be responsible for making sense of their data (known as analysis) by entering it into the computer.

Education required:

- Most wildlife biologists who work in the forest and natural areas have at least a 4 year college degree (Bachelor's in Science degree).
- Higher paying and more permanent careers often go to wildlife biologists with a Master's degree (about 6 years of college).
- Wildlife biologists with a Ph.D. (about 8-9 years of college) can conduct their own research and may teach at a university. They are usually paid the most.

Working conditions:

- After a few years of experience, wildlife biologists can expect to spend about the same amount of time working outdoors and indoors.
- Wildlife biologists in the forest may work in the forest during a particular season to collect data about wildlife, including where they can be found and what their populations are. This requires going on field trips that can involve a lot of hiking and camping in possibly all kinds of weather.
- During the rest of the year they may analyze that data indoors using computers and other technology.
- They may work alone for many hours collecting data or as part of a team.

How much wildlife biologists earn:

- Starting salaries (earnings per year) usually begin around $30,000.
- With more experience and/or more education, median (middle range) salaries for wildlife biologists in the forest are around $50,000.
Biologos de Vida Silvestre

BIOLOGOS DE VIDA SILVESTRE

El Biólogo de Vida Silvestre son frecuentemente estudiosos de los animales en el bosque. Ellos son responsables de observar y recoger datos sobre el comportamiento, la reproducción y las necesidades de los animales. Además, deben organizar y mantener registros de datos, tomar notas y una amplia gama de información. Deben interpretar esta información y buscar nuevas vías para mejorar la vida silvestre. Estos profesionales pueden trabajar en parques nacionales, refugios de vida silvestre y otras áreas protegidas.

Educación Requerida:

- Los Biólogos de Vida Silvestre que trabajan en el campo y en los parques nacionales tienen al menos 4 años de estudios universitarios y un Grado de Bachelor en Ciencias (BS).
- Para ganar más dinero y más oportunidades en la carrera esta biólogo generalmente tiene que estudiar una Maestría (MS) (aproximadamente 6 años de estudios universitarios).
- El Biólogo con un Doctorado (Ph.D.) (aproximadamente 8-9 años de estudios universitarios) pueden conducta sus propias investigaciones y enseñar en la universidad. Ellos son generalmente los mejor pagados.

Condiciones de Trabajo:

- Después de algunos años de experiencia, el biólogo de vida silvestre pueden esperar para la misma cantidad de tiempo de trabajo en el campo y en la oficina.
- El Biólogo de vida silvestre pueden trabajar en el campo durante una estación determinada para colectar datos acerca de los animales salvajes, incluyendo los lugares donde se encuentran y las condiciones de la población, como clases de edad, tamaño de la población, salud, peligros, etc. Esto requiere salidas al campo con muchas caminatas y campamentos en diferentes clases de clima.
- Durante el resto del año, ellos pueden analizar la información en la oficina usando computadoras y otras formas de tecnología.
- Ellos pueden trabajar solos durante muchas horas, o como parte de un grupo de trabajo colectando datos.

Cuanto puede ganar un Biólogo de Vida Silvestre:

- Salario del biólogo que recientemente es alrededor de $30,000 Dólares por año.
- Con una experiencia o más educación, el salario promedio del biólogo es alrededor de $50,000 Dólares por año.
Appendix E  Formative interview protocol (Forest Field Program)

Primary questions for students and parents

1. What aspects of the program do you like so far? Why?
2. Is there anything you would like for us to cover in the program that we have not yet covered?
3. Have you (or your child) participated in after school programs before?
4. Why did you enroll in this program?
5. What is your interest (or your child’s interest) in science?
6. [For students only] Can you tell about your responses on the pre-questionnaire? [Specific prompts per each question]
Appendix F  Bilingual Forest Field Program orientation curriculum

Forest Field Program: 2006-2007

1. Introduction to Douglas-fir forests of Oregon

2. What is a managed forest?
   a. A managed forest involves people.
   b. Weyerhaeuser is a company that manages forests. We can visit a very young Weyerhaeuser forest with saplings (<5 years old), a young forest (15-20 years old), and a mature forest (40-50 years old).

3. What is forest ecology? The study of the relationship between trees and other living organisms is called forest ecology. Trees are often defined as single stemmed woody plants greater than 15 feet in height when mature. Trees serve as food, shelter, clothing, transportation, fuel, and medicine. Trees provide food and shelter, known as habitat, for many other living organisms such as deer, chipmunks, insects, bobcats, cougars, bears, skunks, lichen, and other plants. The tree species that are found in an ecosystem may depend on a variety of factors including climate, geology, and topography (the shape of the land).
4. What can we expect to find in a managed forest?
   a. Different age classes of trees including saplings, young trees and mature trees
   b. Different growth rates among trees, especially on different sites
   c. Different plants in the understory (lichens, herbs, shrubs) and canopy (trees)
   d. Different animals and insects:
      i. White-tailed deer (common)
         1. We can identify them by their scat, resting sites, footprints, and their white tail, of course!
      ii. Chipmunks (common)
          1. We can see them running around.
      iii. Insects (common)
           1. We can trap them in a box and identify them using a book.
      iv. Bobcat, black bear, and cougar (uncommon)
          1. We can identify them by their scat and footprints.
      v. Skunks (uncommon)
          1. We can identify them by their scent (pweww!!).
5. How can we make scientific observations of the forest?
   a. Collect **data** by writing down information on paper.
   b. We can measure the age of mature trees using an **increment borer** and getting a **core sample**.
   c. We can measure the diameter of trees using a **logger's tape**.
   d. We can estimate the height of a tree using a **clinometer**.
e. We can sample the different types of plants using **transects**. Transects are most useful in sampling along linear areas, such as along streams. We can also use them when we move from one land condition of the forest to another, such as moving from the edge of the forest to the center of the forest site.

i. **LINE INTERSECT METHOD**: This transect method can be used to estimate how much area of the forest floor is covered by a certain plant species.

![Diagram of transect method]

ii. **LINE INTERSECT/POINT SAMPLE METHOD**: This method can be used to estimate how many and what kinds of herbs are on the forest floor. This method can also be used to estimate what proportion of an area is shaded by tree foliage for trees taller than 6 feet.
iii. **WIDE TRANSECT METHOD:** This transect method can be used to estimate plant diversity along a stream, for example. It can also be used to count scat!

![Diagram of WIDE TRANSECT METHOD](image)

f. We can estimate the number of trees per acre or the number of plants per square foot using fixed-area plots. We can also use fixed-area plots to compare different areas. Circular plots are the easiest to establish.

![Diagram of 1/10 ACRE plot](image)
g. To use transects, we will need to learn how to use a map and compass.
6. Now that we have some great methods and tools to use for doing science in the forest, what’s next?! 
   a. Brainstorm about what would be interesting to study in the forest. For example, what are some questions we might like to answer. ANY IDEAS?! 
   
   i. Think about how we could go about studying something using what we now know. In other words, design an investigation.
   
   1. ANY IDEAS?!

b. Here are some questions that might get you thinking...
   - What is the estimated volume of wood in the forest?
   - Are the growth rates of the trees the same on all sites or different?
   - What would estimated growth rates be for the forest in the future?
   - What lives in the forest?
   - Which species are more common than others?
   - Are certain species more common in some sites than others?

This curriculum was adapted from Wolftree’s Field Study and Forest Ecology curricula.
Programa de los Estudios del Bosque

1. Introducción al bosque Douglas-fir de Oregon

Foto de Ed Jensen

2. ¿Qué es un Bosque manejado?
   c. Un bosque manejado involucra a la gente.
   d. Weyerhaeuser es una compañía que maneja bosques. Podemos visitar plantaciones jóvenes con árboles de 5 años, bosques jóvenes de 15 a 20 años de edad, y bosques maduros entre 40 y 50 años.

3. Que es ecología forestal? El estudio de las relaciones entre los árboles y otros organismos se llama ecología forestal. Los árboles se definen como una simple planta de tallo leñoso que mide más de 15 pies de altura cuando está maduro. Los árboles sirven como alimento, protección, vestido, transporte, combustible y medicina. Los árboles proporcionan alimento y cobertura, conocido como hábitat para muchos otros organismos como el venado (deer), chipmunks, insectos, linces (bobcats), pumas (cougars), osos (bears), zorrinos (skunks); líquenes y plantas. Las especies de árboles encontradas en un ecosistema
depende de una variedad de factores que incluyen el clima, la geología y la topografía del lugar (elevación y perfil del terreno).

4. ¿Qué esperamos encontrar en un bosque manejado?
   e. Árboles de diferentes **clases de edad**, incluyendo plantones (saplings), árboles jóvenes y árboles maduros
   f. Diferentes **tasas de crecimiento** entre árboles, especialmente en sitios diferentes.
   g. Diferentes plantas en el **sotobosque** (líquenes, hierbas, arbustos) y **estratos de árboles** (Canopy)
   h. Diferentes animales e insectos:
      i. Venado de cola blanca (White-tailed deer) (común)
         1. Podemos identificar su presencia por los pelets (desperdicios o deposiciones), sitios de descanso, huellas, y por su cola blanca, por supuesto!
      ii. Chipmunk (común)
         1. Podemos verlos corriendo alrededor.
      iii. Insectos (común)
         1. Podemos atraparlos con una trampa e identificarlos en un libro.
      iv. Lince (Bobcat), oso negro (black bear), y el puma (cougar) (poco comunes)
         1. Podemos identificar su presencia por sus deposiciones y sus huellas.
      v. Zorrino (Skunks) (Poco común)
         1. Podemos identificarlo por su olor (**pwajjj**)!
5. ¿Cómo podemos hacer observaciones científicas en el bosque?
   i. Colectando datos escribiendo información en un papel.
   j. Podemos medir la edad de los árboles maduros usando un **taladro forestal** y obteniendo una **muestra del corte del árbol**.
   k. Podemos medir el diámetro de los árboles usando una **cinta diamétrica**.
   l. Podemos estimar la altura de un árbol usando un **clinómetro**.
m. Podemos obtener una muestra de los diferentes tipos de plantas usando transectos. Los transectos son más usados en el muestreo de áreas a lo largo de una línea. Podemos usar este método cuando medimos la vegetación a través de diferentes condiciones del terreno en el bosque o entre el límite del bosque y el centro del bosque.

i. **METODO DE LÍNEA DE INTERCEPCIÓN**: Este método de transectos puede ser utilizado para estimar cuanta área del bosque está cubierta por ciertas especies de plantas.

![Diagrama de transecto](image)

ii. **METODO DE MUESTREO PUNTUAL SOBRE LA LÍNEA DE INTERCEPCIÓN**: Este método puede ser usado para estimar cuantas y que clase de herbáceas están cubriendo el suelo del bosque. Este método también se puede usar...
iii. **METODO DE FAJAS DE ANCHO DETERMINADO:** Este método puede ser usado para estimar la diversidad de plantas a lo largo de una quebrada. También puede ser usado para contar desperdicios (scat) o huellas.

n. Podemos estimar el número de árboles por acre, o el número de plantas por pie cuadrado plots de áreas fijas (de tamaño fijo). Estos plots de áreas fijas se pueden usar para comparar diferentes áreas del bosque. Los plots circulares son los más fáciles de establecer.
o. Par usar transectos, necesitamos aprender como usar los mapas y la brújula.
6. Ahora que tenemos algunos métodos herramientas que se usan en las ciencias forestales. ¿Cuál es el siguiente paso?

p. **Tormenta de ideas.** ¿Qué sería interesante estudiar en el bosque? Por ejemplo, ¿cuáles son algunas preguntas que nos gustaría contestar? **¿ALGUNAS IDEAS?**

q. Aquí hay algunas preguntas que tal vez podrías pensar.
   - ¿Cuál es el **volumen** de madera que hay en el bosque?
   - ¿Son las **tasas de crecimiento** de los árboles iguales en todos los sitios? O son diferentes?
   - ¿Cuáles serían las **tasas de crecimiento** estimadas para el bosque en el futuro?
   - ¿Qué cosas viven en este bosque?
   - ¿Qué especies son más comunes que otras?
   - ¿Son algunas especies más comunes en unos sitios del bosque que en otros?

Este plan de estudios fue adaptado de estudio en el campo y de plan de estudios de la ecología del bosque de Wolftree.