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ABSTRACT

In response to the poor achievement, negative attitudes, and anxiety of limited-English-proficient (LEP) ninth-grade students (n=90) in science classes, a cooperative learning approach to instruction was adopted. In an effort coordinated with teachers of English for Speakers of Other Languages (ESOL), the students were assigned to cooperative learning groups and given specific projects corresponding to the curriculum but requiring exploratory and investigative methods rather than reading from a textbook. In addition, the teacher contacted parents by telephone and wrote to them in English, Spanish, and Creole, offering tips for assisting their students. An additional 21 students were brought into the program. Results indicate that project objectives were met in: student achievement on a teacher-made criterion-referenced post-test; majority passing the course with a C or better grade; entries in the science fair; regular student participation in hands-on classroom activities; improved student attitudes toward science; use of alternative student evaluation techniques; and parent contact. Suggestions for improvement include further development of the post-test to reflect class activities, creation of a parent guide, and provision of tutoring options. The post-test and class-related forms are appended. (MSE)

ED 385 154

INCORPORATING COOPERATIVE LEARNING STRATEGIES
TO IMPROVE SCIENCE ACHIEVEMENT SCORES
AMONG NINTH GRADE ESOL I AND II
PHYSICAL SCIENCE STUDENTS

by

Marilyn Correa

Cluster 49

A Practicum II Report Presented to the
Ed.D. Program in Child and Youth Studies
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Education

NOVA SOUTHEASTERN UNIVERSITY

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PRACTICUM APPROVAL SHEET

This practicum took place as described.

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April 21, 1995

This practicum report was submitted by Marilyn Correa under the direction of the adviser listed below. It was submitted to the Ed.D. Program in Child and Youth Studies and approved in partial fulfillment of the requirements the degree of Doctor of Education at Nova University.

Approved:

6-22-95
Date of Final Approval
of Report

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Incorporating Cooperative Learning Strategies To Improve Science Achievement Scores Among Ninth Grade ESOL I and II Physical Science Students. Correa, Marilyn, 1995: Practicum Report, Nova Southeastern University, Ed.D. Program in Child and Youth Studies. Secondary/Science Education/Bilingual Education

The problem of this practicum was ninth grade ESOL I and II physical science students who were not achieving in science. These students were not interested in science because they could not relate to the subject matter due to poor command of the English language, and in turn, feared the class because it was too difficult. The goal of this practicum was to get these students to achieve on grade level in physical science.

In order to get students' attitudes to improve towards science and increase their achievement scores in the subject, the writer taught physical science through a hands-on investigatory approach that incorporated cooperative learning strategies. The students were allowed to demonstrate competency of the subject matter through various alternative assessments.

Analysis of data revealed that the students increased their achievement scores on a teacher-made criterion referenced test after investigating physical science through 52 laboratory activities in 32 weeks. The students found science to be interesting and exciting when they learned scientific concepts and principles through a hands-on, discovery approach.

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Permission Statement

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CHAPTER I

INTRODUCTION

Description of Community

The work setting for this practicum was a senior high school located in a southeastern coast city of the United States. The campus is located on a 36 acre tract surrounded by a predominantly residential area. Within the last 30 years, this area has undergone rapid change. The area has grown into a large, multiethnic metropolitan community consisting of largely low income, single family homes, and multiple dwellings. These homes are surrounded by businesses, factories, and shopping centers. The area is extremely overcrowded, with predominantly Hispanic families. It is a cosmopolitan setting with many cultures represented. The exact racial/ethnic composition of this city is 89 percent Hispanic, two percent Black, eight percent White, and one percent Asian. The socioeconomic status of these residents is low to lower middle income. A large portion of the inhabitants are recent immigrants to the United States. They have predominantly come from a variety of countries in the Caribbean, Central, and South America. The people are bilingual with English and Spanish being the two most frequently spoken languages.

Writer's Work Setting and Role

The work setting for this practicum was a three level cinder block senior high school built in 1971. It was built as an interconnected complex of four buildings which houses educational facilities including an auditorium, a planetarium, a soundproof audiovisual and electronic center, and a two-story physical education wing. This first level of the school has a cafeteria, main office, attendance office, student clinic, teacher mailroom, classrooms, and an auditorium. Located behind the cafeteria is the physical education field along with basketball, racquetball, and tennis courts. Behind the physical education field are 38 portable classrooms. The second floor contains classrooms and a teacher lounge. On the third floor of this structure there are classrooms, student restrooms, and the media center which is equipped with a planetarium. It is on this third floor in one of the science classrooms that this practicum took place. This classroom was fully equipped with eight sinks and faucets that offer both hot and cold water and 16 electrical outlets. Each sink was accompanied with a cabinet and a drawer for storage of laboratory equipment. The classroom comfortably seats 45 students with one instructor.

The school had an enrollment of 3300 students. This student population was generated from four middle schools. The racial/ethnic composition of the student population was 70.2 percent Hispanic, 19.6 percent Black, 9.6 percent

White, and 0.6 percent Asian. The students' age range was from 13 to 19. Of these students, 72 percent participated in free or reduced lunch programs. Eighty-four percent of the students were in basic education, four percent in exceptional education and 12 percent in vocational education. One percent of the student population was labeled gifted, having superior intellectual development. Eight percent of the student population was classified as limited English proficient, having difficulty in reading, writing, or understanding English. College admissions for this senior high school's graduates has remained in the 70 percent range over the past five to ten years. The students at this school mostly came from single-parent homes with the one parent working two jobs. The socioeconomic status of these families is lower middle income. Very few of the students' parents speak English. The students for this practicum were limited English proficient ninth graders enrolled in regular physical science classes. The stanines of these students ranged from one to seven in both the mathematical and reading scores. Ninety-eight percent of these students were Hispanic and two percent were Haitian. All of these students spoke English as a second language.

The school staff consisted of one principal, three assistant principals, eight guidance counselors, one occupational specialist, one college advisor, two psychologists, 144 classroom teachers, two media specialists, two work experience coordinators, one reading specialist, one treasurer, one registrar, four secretaries, three security guards, two resource officers, 20 cafeteria workers, and nine janitorial personnel. The racial/ethnic composition of the staff was 20 percent Hispanic, 22 percent Black, and 58 percent White.

This senior high school offered many extracurricular programs for the students to participate in which include Varsity and Junior Varsity sports such as football, soccer, baseball, volleyball, swimming, and cross country, Art Club, Brain Bowl, Builders Club, Computer Club, Cheerleaders, Drama Club, Foreign Language Club, Future Business Leaders of America, Future Educators of America, Language Arts Club, Marine Club, Math Club, National Junior Honor Society, Photography Club, Student Government, Science Club, Soccer Club, Television Productions, Yearbook, and Youth Crime Watch. Other special organizations in which teachers may have participated in are the following: Attendance Committee, School Improvement Committee, Attendance Task Force, Parent Teacher Student Association (PTSA), Dade Partners, Blueprint 2000, and Peer Teachers.

The writer has taught at this senior high school since August 1993. She has taught regular and bilingual Biology and Physical Science at this school and presently teaches regular and bilingual Physical Science and Biology, and Advanced Placement Biology. Previously, she taught middle school seventh and eighth grade comprehensive science, and ninth grade physical and biological sciences. In addition to teaching students, her professional duties included sponsoring the Science Club, chairing the Motivation in Depth Accelerated Summer Science Program, coaching and sponsoring the junior varsity cheerleaders, and coordinating the high school science fair. She had also been selected by the school board to be a writer on a committee assigned to rewrite the science curriculum. As part of this curriculum committee, she was a lead teacher for the county whose responsibility was to instruct 350 middle school science teachers on how to utilize a competency-based curriculum in the classroom. Recently, she was selected as a teacher consultant for the Urban Systemic Initiative that the National Science Foundation sponsored for the improvement of science and math education for all students.

The writer received an Associates of Science degree in Biology from a junior college and also earned a Bachelor's and a Master's degree in Science Education. She was qualified to address this practicum because of prior teaching experience in bilingual curriculum content.

CHAPTER II

STUDY OF THE PROBLEM

Problem Description

The southeastern part of the United States is often referred to as the gateway to Latin America. Nearly every week in the newspapers, an article mentioned how a group of Hispanics or Haitians had immigrated onto American soil. Whatever the reasons for their coming to the United States, America is their new home. The majority of these immigrants do not speak English fluently. English is not their primary language. Many of these immigrants do not speak nor understand English at all. It was estimated that at least 20 percent of American school-age children speak a language other than English at home (Geisinger, 1992). These children who have difficulty in reading, writing, and understanding English were identified as limited-English proficient (LEP) students.

At this writer's work setting, approximately 300 students were labeled LEP. Upon entry into a public school, the LEP student takes a written test that places the student in one of five levels of English for Speakers of Other Languages (ESOL). ESOL I and II are the entry levels for students with no understanding or very little command of the

English language, respectively. Students in ESOL III to V have different levels of mastery of the English language and were mainstreamed into regular content classes with fluent English proficient students.

This practicum involved ESOL I and II students. These students were provided a bilingual curriculum content (BCC) program. In the BCC program, teachers instructed the content area in the English language, but were allowed to further explain the subject matter in the native language of the students. An ESOL I or II student had a daily schedule consisting of two hours of ESOL, and one hour each of mathematics, American history, science, and physical education.

The writer at this work setting instructed the BCC physical science classes in both English and Spanish. The students were supplied a physical science textbook that is written in English. The majority of the ESOL I and II students were failing physical science. The students were not interested in the course because they could not relate to the subject matter due to poor command of the English language, and in turn, feared the class because it was too difficult. As a result of these feelings, the students were not registering to take science courses that were electives in the higher grades. The problem was that ESOL I and II science students were not performing at grade level in physical science.

Problem Documentation

The writer administered a ninth grade physical science, teacher-made criterion-referenced test (see Appendix A) to 90 ninth grade ESOL I and II physical science students. Eighty-two out of the 90 ESOL I and II science students scored below 60 percent on the test. No student scored above 85 percent on the test (see Table 1).

Table 1

Student Scores on Teacher-Made Physical Science Test

Number of Correct Answers	Number of Students
100 - 85	0
84 - 80	1
79 - 75	3
74 - 70	2
69 - 65	1
64 - 60	1
59 - 50	17
49 - 40	20
39 - 30	36
29 - 0	9

The writer reviewed the report card grades of 90 ESOL I and II students in the physical science classes. Thirtythree out of the 90 students failed physical science. Twenty-seven out of the 90 students received the unsatisfactory grade of a "D". Only 30 students passed the course. Of those 30 students that passed physical science, only five earned an "A" in the class.

The writer kept track on a School Science Fair Log (see Appendix B) the number of ESOL I and II students that entered a project in the science fair. Not one ESOL I or II student entered a science project in the school science fair.

The writer conducted individual student surveys utilizing a teacher-made student attitudinal survey on science (see Appendix C). The writer surveyed 90 ESOL I and II students enrolled in physical science. The responses for all 90 students were written in qualitative and subjective form. The results from the surveys showed 72 out the 90 ESOL I and II students fear physical science. Of the 18 students that liked physical science, only four were interested in pursuing a career related to science. Eighty-three of the 90 students felt physical science was a difficult subject for them and should be reserved only for the highly intelligent. When asked why they were enrolled in the course, all 90 students responded that physical science is a required course.

The writer also kept a log of student participation in hands-on laboratory activities (see Appendix D). ESOL I and II physical science students participation in hands-on activities was at an extreme low of only four labs per every nine weeks.

Causative Analysis

Several causes for the inadequate academic achievement in physical science of ninth grade ESOL I and II students were identified. As mentioned previously, ESOL I and II students have a poor command of the English language. Although explanations of scientific concepts were provided in Spanish, the class lectures and assignments were presented in English. All examinations were the traditional lower cognitive level, rote memorization, multiple choice tests that required a reading level that was higher than what the LEP students possessed.

The writer recognized that very little time was provided for ESOL I and II students to perform hands-on laboratory activities. It took twice as long to lecture and explain a scientific concept to an ESOL student than it did to a fluent English proficient student. The writer spent two hours lecturing and explaining in English and in Spanish to ESOL students what the same instructor would spend one hour in teaching the same material to an English proficient student. In order to teach all the competencies required by the county for a student to receive credit for physical science, very little time was organized for laboratory activities.

The few lab activities that the LEP students did get to perform were done on an individual basis. Students worked by themselves. Each LEP student spent the majority of the allotted lab time trying to read and understand the lab instructions and questions that were written in English. By the time the student understood what was to be done, there was little to no time to carryout the procedures.

The writer asked the LEP students why they did not enter a science project into the school science fair. All 90 ESOL I and II students stated that they had never done anything like that before in their native countries. Several responded that their parents did not have the money or the time to purchase the materials necessary for a science project. Many times students did not inform the parents of materials and supplies that were necessary for school.

The county provided its teachers with a 60 hour inservice required by the META (Multicultural Education, Training, and Advocacy) Consent Decree presently in force in the state that was designed to provide educators with multi-ethnic teaching assistance. Unfortunately, the program did not achieve its goal. The program emphasized the fact that the Hispanic population in the United States was growing very rapidly, but the program did not offer applicable strategies on how to help the LEP students.

The writer had noticed that there was no communication between the content area teachers and the ESOL teachers. The science BCC program had no idea what was being taught in the ESOL program or how the ESOL teachers were instructing the LEP students. It is worth noting that teachers were not given the opportunity to explore instructional strategies and activities that would enhance learning for all students.

Relationship of the Problem to the Literature

The United States has 3.6 million school-age children that are Hispanic (Watson, 1989). This number of Hispanic students is continually increasing. The National Commission on Secondary Schooling for Hispanics (1984) said that American schools have "an impending national crisis" on their hands because of these Hispanic students; 50 percent will drop out of school.

The high percentages of Hispanic students dropping out of school is alarming. But why are the LEP students failing? Steeg (1991) stated that limited English proficient students have the ability to learn, but often do not pass science courses or other content area courses simply because of the language disadvantage. Smith (1993) wrote that the limited English proficient student was placed in whatever grade level their chronological age placed them and were asked to compete in a language in which they do not fully dominate.

The increasing dropout rates (40 to 50 percent since the 1950s) indicates that "traditional teaching strategies do not provide the LEP student the opportunity to master English and learn the academic content of the lesson"

(Watson, 1989). "Even if the LEP student has some understanding of English, science terms represent an additional foreign language" (Steeg, 1991). At the present time in this school, the majority of BCC teachers utilized lecturing as the only mode of instruction. Several of these teachers admitted that from their teacher educational programs and training, lecturing was the only way they learned how to instruct students. The science teachers in the BCC program engaged LEP students in passive learning experiences. The LEP students were lectured in English and then assigned a class assignment that was written in English. ESOL I and II students work independently, hardly ever communicating with other students in the classroom.

Too often because the limited English proficient students did not have adequate English language skills, they were placed into low ability tracks. Sutman and Guzman (1993) mentioned that because of such practices, ESOL I and II students were almost never placed in advanced science courses. This is why there is such an underepresentation of Hispanics enrolled in college science courses or pursuing science careers. The 1988 science assessment report card (NAEP) provided evidence that showed the average proficiency of 17 year old Hispanic students lagged four years behind that of their white peers. One of the reasons to explain this difference was because more white students than Hispanic took courses in biology, chemistry, and physical sciences (Bazler, 1991).

The writer surveyed 90 ESOL I and II students enrolled in the BCC physical science program to question why they felt they were failing the course. The LEP students reported that physical science was too difficult. Nearly all the students described the course as boring, mainly because they feared the subject as too challenging. The LEP students complained that all they did was listen to the teacher lecture, of which they understood only parts of, and worked at their seats on assignments that they could not read nor understand. The LEP students informed the writer that they memorized information and definitions in order to receive a passing grade. Once the test or exam was over, the students admitted that they forgot the information. They acknowledged that they learn very little. Finson (1987) conducted a similar survey to English proficient students to learn about their attitudes towards science. Finson's findings were very similar to this writer's. English speaking students felt science classes were only for the very intelligent. They reported science to be boring.

The writer questioned why teachers do not utilize various instructional strategies when instructing ESOL students. Salend and Fradd (1986) explained that usually the teachers that teach limited English proficient students are not bilingual and do not have any training on how to work with such students. This article stated that very little support, if any, is given to these teachers by administrators. To add further to the situation, teachers isolate themselves from other teachers. Rosenholtz and Kyle (1984) reported that teachers are not likely to request or offer assistance to each other for fear that they may come across as arrogant or incompetent.

CHAPTER III

ANTICIPATED OUTCOMES AND EVALUATION INSTRUMENTS

Goals and Expectations

The following goal was projected for this practicum: to have ninth grade ESOL I and II science students perform at grade level in physical science.

Expected Outcomes

At the end of implementing this practicum, the following seven outcomes were expected. First, at least 68 out of 90 ESOL I and II students would score above 60 percent on the teacher-made, criterion-referenced physical science test (see Appendix A). Secondly, more than 68 out of the 90 LEP students would pass physical science with the academic grade of "C" or better. Thirdly, at least 45 out of the 90 ESOL I and II students enrolled in physical science would enter a science project in the school science fair. The fourth outcome to be expected was that all 90 ESOL I and II students would participate in at least two hands-on laboratory activities per week for an eight month period. The fifth expected outcome was to reduce and hopefully eliminate fear or any misconceptions about science from at least 45 out of the 90 LEP students. The sixth outcome to be expected was to utilize alternative assessments when assessing the limited English proficient student. The seventh expected outcome was to contact the parents of the ESOL I and II physical science students at least once every month for a period of eight months to inform them of their child's academic progress, materials required for activities, and any scheduled events that were planned for the class.

Measurement of Outcomes

The writer was to utilize a pre and post teacher-made, criterion-referenced physical science test that consisted of 100 multiple choice questions (see Appendix A). The test was completed in a two hour period. This test was given to all 90 ESOL I and II students enrolled in the BCC physical science program. The test was given prior to and also at the end of implementation of this practicum. The test was administered to all the LEP students at the same time in a group setting. The tests were administered in the school's auditorium which seats 1200 students. The test required that students bubble in their answers on a scantron answer sheet using a number two lead pencil. The writer wrote the teacher-made, criterion-referenced, multiple choice test utilizing the ninth grade physical science objectives mandated by the county. The writer used the same pre and post test in order to maintain the internal validity of the assessment.

Secondly, the writer was to keep record of those ESOL I and II students that passed or failed physical science as measured by the teacher gradebook. The writer also was to log the number of ESOL I and II physical science students that entered a science project in the school science fair (see Appendix B). In order to keep track of the number of hands-on laboratory activities performed by the LEP students, the writer was to log each lab activity on a Hands-On Lab Activity Log (see Appendix D). To ensure that each student was performing the lab activities, the writer would record in the teacher gradebook the number of lab reports that were completed and turned in to the writer.

The writer surveyed the ninth grade ESOL I and II students using a teacher-made student attitudinal science survey that was composed of five questions and required a total of 15 minutes to complete (see Appendix C). The students were given the survey before and also after implementation of the practicum. A survey was used to assess the degree to which the practicum changed the students' attitudes towards science.

The writer used alternative and authentic assessments when assessing the LEP students. An alternative assessment is any non-standard or commonly used assessment (see Appendix E). For an assessment to be authentic, the context, purpose, audience, and constraints of the test should connect in some way to the real world. Alternative and authenic assessments were to be used to try to provide various and different opportunities for all these ESOL students to demonstrate mastery of a curriculum objective.

Lastly, the writer was to call the parents or legal guardians of the ESOL I and II students at least once every month for a period of eight months. This was to be done in order to keep the parents or legal guardians abreast of what was going on in the classroom. The writer also was to keep a log to record the parent telephone conferences (see Appendix F).

CHAPTER IV

SOLUTION STRATEGY

Discussion and Evaluation of Possible Solutions

ESOL I and II ninth graders were not performing academically at grade level in physical science. It is quite a difficult task to learn a content area while trying to master a second language. Educators are examining various methods and techniques integrating language and content instruction that will enable LEP students to achieve success in their education.

Sutman and Guzman (1993) found cooperative learning groups as the most effective method for teaching science to the LEP student. Cooperative learning groups place two to four students in a group working together to reach the same goal. This goal results from the contribution of each student to the group. The students work with each other verbalizing instructions, questions, and information about the activity at hand. Sutman and Guzman (1993) explained that this type of verbal exchange, student to student communication, helps foster language development. LEP students need maximum amounts of time using the English language. Cooperative learning groups allow the LEP students to practice English in a low-risk environment.

Chips (1993) explained that students with low levels of English proficiency can "interact" with LEP students that have higher levels of proficiency in "order to negotiate the meaning of content."

Steeg (1991) recommends that when trying to teach scientific concepts to LEP students, utilize concrete, visual examples. She advises teachers to make the LEP students work with all their senses. LEP students need to perform hands-on activities in order to truly comprehend and master a scientific concept. Computers may be used to reinforce topics discussed in class. Watson (1989) advises ESOL teachers to utilize audio visual aides such as movies and videos to help the LEP student "see" the concepts.

Bazler (1991) combines both instructional strategies and confirms that hands-on laboratory activities that incorporate cooperative learning groups increases the amount of science learned by LEP students and at the same time, promotes changes in their attitudes towards science. Allowing LEP students to work together in small groups develops critical thinking skills (Cummings, 1991). The students in a group can verbalize their thoughts and the other students listening become aware of the thinking process occurring in their classmates.

When assessing limited English proficient students, teachers need to utilize many alternate assessment tools. Little emphasis should be placed on multiple choice exams, and more on oral exams and presentations. The LEP students should be allowed to make posters and projects that they may explain to the entire class. This may help their language development and allow the student to show the teacher through several avenues that they not only know the scientific concept, but understano it well enough to explain it to other students.

In order to provide the LEP students the best possible educational program that fits their individual needs, Hudson and Fradd (1990) required that the ESOL teachers and the content area teachers cooperatively work together designing strategies that would create such a program. Collaboration is the key word in this arrangement. Both ESOL and are content teachers can share and learn instructional strategies and techniques that will develop and promote language skills and learning of content area concepts. Hudson and Fradd (1990) encourage the inclusion of any individuals that may contribute to the enhancement of an educational program the will benefit the students. A portfolio should be kept on each student that collaborates the various works from both the ESOL and content area teachers. This portfolio is also a means of communication between the content area and ESOL teachers, as well as counselors and parents.

Another important aspect in developing a successful educational program is the inclusion of students' parents. Sutman and Guzman (1993) inform teachers of the importance of parent involvement in the preparation of LEP students for effective schooling. Parents were asked to "provide material and references at home" to facilitate and support the LEP students (1993). Parents need to be contacted to be informed about student academic progress, materials necessary for class activities, and suggestions that the parents can do at home to further enhance and support the school program.

Description and Justification for Solution Selected

After reviewing the literature for methods of improving instruction for limited English proficient students, the writer incorporated cooperative learning groups to enhance science instruction in the Bilingual Curriculum Content program at this senior high school. The LEP students were placed in groups of four students, and each student was assigned a specific role in the group (see Appendix G of Loret-de-Mola & Thornton, 1993). Each student in the cooperative learning group performed the responsibilities for that role for an entire month. At the end of every month, the students in the group switched roles. This provided every student the opportunity to experience every role in a cooperative learning group. The writer required the cooperative learning groups to work on at least two laboratory activities per week for a period over eight months. These hands-on laboratory activities related specifically to the science objectives being taught in the physical science class for that week. The labs were structured to reinforce the scientific concepts being taught for that week. Each lab was designed to require the student to use critical thinking skills that applied the scientific concepts to situations that may occur in everyday life. The writer kept a log tracking the number and titles of lab activities occurring throughout the practicum (see Appendix D).

When assessing the LEP students, the writer allowed the students to choose his or her method for being assessed (see Appendix E). To ensure that the instructional strategies and techniques were appropriate and improving academic success for the LEP students, she met once a week for eight months with the ESOL teachers of the students. During these collaborate sessions, she created a portfolio for each student that illustrated student academic progress.

Throughout the practicum, the writer contacted the parents of the students at least once a month for eight months. Each parent contact was recorded on a teleconference log (see Appendix F). These telephone contacts informed the parents of their child's academic progress in the physical science class, and to let them know of the objectives for the month. Part of acquainting the parents with the class objectives was to inform them of any materials they may need to purchase for their child or of any activities or readings that they may help reinforce at home.

Report of Action Taken

The curriculum component for the first month was science skills and attitudes, applications, and contexts of the physical sciences. During the first week of this month, the writer contacted the parents of the LEP students informing them about the implementation of the practicum. She discussed what was to be expected from each student. The writer arranged a meeting with the ESOL teachers of the LEP students and set up a weekly arrangement for discussion of student academic progress and instructional strategies. She gave the students the Student Attitudinal Survey regarding their feelings and attitudes toward science. The LEP students were given the teacher-made criterion-referenced physical science test. The writer assigned each student into a cooperative learning group, and appointed each student a specific role in the group.

In the second week of the practicum, the writer met with the ESOL teachers. At this time, she and the ESOL teachers created portfolios for each student in the Bilingual Curriculum Content program. The writer assigned each cooperative learning group a science project. The class objectives for this week were safety procedures and laboratory apparatus. The LEP students performed lab activities that identified the parts, function, proper care, and use of appropriate scientific equipment.

Week three was dedicated to discussing the scientific method. Students were asked to analyze and develop problem statements, hypotheses, data, and conclusions. The students performed experiments that illustrated the importance of the five steps to the scientific method. The writer worked with the ESOL teachers in selecting appropriate lab activities that illustrated the scientific method.

Week four reinforced the scientific method by having students apply science investigation skills through their designing and carrying out of appropriate types of experiments. During this week, the writer worked with the LEP students on their individual science projects that would be entered into the school science fair.

In the second month of implementation, the curriculum competency was the physical and chemical properties of matter. At the beginning of week five, the parents were contacted by telephone. The LEP students worked on the differences between physical and chemical properties of matter.

Week six concentrated on the differences between the phases of matter, mixtures, and compounds. The students used the Kinetic Theory to further differentiate. The LEP students investigated the variables that affect the solubility of a solute in a solvent as they related to saturated and unsaturated solutions during the seventh week of implementation.

Week eight demonstrated the relationships among ionic and covalent properties, organic and inorganic compounds, and their conductivity in solutions. The LEP students w re asked to classify solutions as electrolytes or nonelectrolyte.

In the third month of implementation, the curriculum competency was the Atomic Theory of matter. This component concentrated on the Periodic Table and on Nuclear Chemistry. During the ninth week, the parents were called and informed on student academic progress and class objectives and activities. The writer had the students construct a periodic table analyzing atomic structure, mass, and number.

Week 10 required the LEP students to use the Periodic Table in categorizing the elements by metals, non-metals, and metalloids. The students were asked to construct a table that identified the common features that elements share in their families such as outer electron shell configuration.

In week 11, the LEP students analyzed the typical use of radioactive isotopes and explained how the isotope is produced, detected, and measured for that application.

Week 12 distinguished between nuclear fission and fusion reactions. The LEP students reported on at least three applications of nuclear reactions, e.g. nuclear medicine, nuclear energy, and nuclear weapons.

In the fourth month of implementation, the curriculum component for physical science was the chemical reactions of matter. Parents were contacted to keep them updated on academic progress and activities.

Week 13 discussions were on the parts of a chemical reaction. The lab activities concentrated on household products that demonstrated reactions when mixed.

Based on laboratory experiences, week 14 illustrated the concept of ionic and covalent bonding, valence shell model of the atom, and the periodic table. The LEP students wrote formulas of common binary compounds. The lab activities for this week required the students to search their homes for binary compounds present in household products.

In week 15, the LEP students used the formulas of common binary compounds and the principle of conservation of mass to balance simple composition and single replacement reactions. It was also during week 15 that the senior high school held its annual Science Fair. The LEP were asked to enter their individual science projects into the fair. The writer logged the number of entries and all the prize winners in each category (see Appendix B).

In week 16, the students analyzed experimental pH data of an incomplete neutralization reaction, described the reactants and products, and determined which reactant should be increased to produce a neutral solution.

The curriculum component for the fifth month of implementation was motion and forces. During week 17, the writer contacted the parents of the LEP students. Based on laboratory activities, the LEP students used Newton's three laws of motion to explain common situations in terms of balanced and unbalanced forces.

Week 18 asked the LEP students to design and conduct experiments that studied the factors that influence friction.

During week 19, from the everyday world examples, the LEP students identified and described different types of motion as linear, projectile (trajectory), simple harmonic (pendular), or orbital.

In week 20, based on lab experiences, the students used Newton's laws of motion to explain the relationship between drag force and terminal velocity. An exciting lab that applies Newton's laws of motion is the construction of model rockets. One of the days in week 20 was selected for the construction and blasting off of model rockets.

The curriculum component for the sixth month was the relationship among work, kinetic energy, thermal energy, and matter. During week 21, the writer contacted the parents of the LEP students. The LEP students investigated the relationship among energy, work, power, and simple machines.

In week 22, the LEP students designed and performed experiments that investigated the transformation among kinetic energy, potential energy, thermal energy, and work in situations such as oscillating mass on a rubber band.

In week 23, the students investigated the relationship among temperature and volume, and pressure and volume for gases and used these observations to confirm Charles' Law and Boyle's Law.

In week 24, the LEP students described how thermal changes in gases or in phase changes can do mechanical work.

In the seventh month of practicum implementation, the curriculum component was the wave behaviors in matter. The writer contacted the parents of the LEP students. In week 25, the students investigated the common features of waves such as frequency, wavelength, amplitude, and energy.

In week 26, the LEP students described how wavelengths of light and pitches of sound carry energy from a source to a detector.

In week 27, the LEP students demonstrated the principles of reflection and refraction of light. From laboratory activities, they students measured the angles of incidence and reflection.

During week 28, the students investigated the behavior of water, sound, and light waves. From lab activities, the LEP students demonstrated refraction and interference and developed theories to explain these behaviors.

In the final month of implementation, month eight, the curriculum component was electricity and magnetism. In week 29, the writer contacted the parents. Based upon lab experiences, the LEP students explained the differences between static and current electricity.

In week 30, the students constructed, diagramed , and compared advantages and disadvantages of simple series and parallel circuits.

In week 31, the LEP students designed and completed activities using ammeters and voltmeters to quantitatively investigate Ohm's law and electric power in simple resistive circuits consisting of batteries and bulbs.

In the final week of implementation, week 32, the LEP students presented the individual and group science projects. The students were given the post teacher-made criterion-referenced physical science test. The writer assessed each student portfolio and evaluated them as part of the student's progress. The LEP students were asked to respond to the post attitudinal survey. The ESOL teachers and the writer made final evaluations of the practicum. The parents and the school administration were informed of the final outcomes of the practicum.

CHAPTER V

RESULTS, DISCUSSION AND RECOMMENDATIONS

Results

This practicum focused on the problem of ninth grade ESOL I and ESOL II physical science students who were not achieving at the ninth grade level. These LEP students were not interested in physical science because they could not relate to the subject matter due to poor command of the English language, and as a result feared the class because it was too difficult. It became evident to this writer that lecturing, the primarily sole mode of instruction for this course, was not working.

The writer began to solve this problem by incorporating the use of various instructional strategies that required the students to be placed in cooperative learning groups. The writer placed the LEP students in cooperative learning groups made up of at least four students in each group and presented these groups with laboratory activities that required the students to explore and investigate science rather than read about science. The hands-on lab activities brought scientific concepts and principles to their fullest application, a living exploration where students carry out investigations about questions they seek rather than reading answers and information from a textbook.

The writer identified seven expected outcomes that were to be addressed during the implementation of the practicum. The first outcome was the students' test scores on the teacher-made criterion referenced test. The writer expected at least 68 out of the 90 ESOL I and II students to score above 60 percent on the post test. After implementation, 97 out of 111 LEP students scored above 60 percent on the post test. This practicum began with a total of 90 ESOL I and II ninth grade physical science students. This number of students increased to a total of 111 students by the end of implementation.

The scores on the teacher-made criterion referenced post test were as follows: 22 students scored between 90-100 percent; 39 students scored between 80-89 percent; 19 students scored between 70-79 percent; 17 students scored between 60-69 percent; and 14 students scored between 48-59 percent. From the 22 students that scored between 90-100 percent on the post test, nine scored a perfect 100 percent.

The second outcome was to get more than 68 out of the 90 LEP students to pass physical science with the academic grade of "C" or better. From the beginning of implementation until the end of the practicum a total of three academic semester had taken place. Each academic semester is a total of nine weeks. During the first semester, 71 out of the 90 LEP students passed physical science with an academic grade of "C" or better. In the second semester, 83 out of 94 LEP students passed physical science. In the third semester, 99 out of 111 students passed the class with a grade of "C" or better. In the third semester, 25 out of the 99 LEP students that passed physical science earned an "A" for the academic grade.

The third expected outcome dealt with the number of entries into the school science fair. The science fair was held during the 15th week of implementation. At the time, the writer had a total of 94 LEP students taking physical science. Eighty-seven out of the 94 LEP students entered projects in the school science fair. Of the 87 projects, three won first place ribbons in their selected categories, two won second place ribbons, six won third place, and eight earned honorable mention certificates.

The fourth expected outcome was to have all the ESOL I and II students participate in at least two hands-on laboratory activities per week for a total of 32 weeks. The writer kept track of all the laboratory activities on a log (see Appendix D). A total of 52 hands-on laboratory activities were performed during the 32 weeks. Every one of the 111 LEP physical science students worked cooperatively in assigned learning groups investigating each of the 52 lab activities. All 111 students completed and handed in all 52 laboratory assignments and lab write-ups as recorded by the teacher gradebook.

The fifth expected outcome was to get the students interested in science. All of the 111 ESOL I and II physical science students who were surveyed after implementation responded that science was exciting, challenging, and an interesting subject. Of the 111 students, 41 wrote on the surveys that they were interested in pursuing a science-related career. During the 28th week of implementation, the students selected their subjects for the tenth grade. Of the 111 ESOL I and II students, 91 selected a science course as one of their courses for tenth grade.

The sixth outcome was to utilize alternative assessments throughout the assessment aspect of the course. The writer implemented all 21 methods for assessing student progress at least once throughout the eight month implementation period (see Appendix E).

The seventh expected outcome was to contact the parents of legal guardians of all 111 ESOL I and II students at least once every month for a total of eight months. The writer kept track of all the contacts on a parent telephone conference log (see Appendix F). All 111 LEP students' parents or legal guardians were contacted at least once every month for eight months.

Discussion

After taking the teacher-made criterion referenced post test, the LEP students commented how confident they were about their responses. From the student attitudinal science survey, students wrote that through a hands-on laboratory approach, science was fun. The students enjoyed working in cooperative learning groups. They remarked that in these groups they felt science was nonthreatening. Science was easy because they could work together to solve problems. Investigating and exploring science through lab activities as opposed to reading information from a textbook was exciting.

The writer found that the students were running out of time during class in order to complete their lab activities. Students were staying pass to allotted hour in order to finish their work. On several occasions, the students were returning after school to complete that lab activities. The writer stayed at least twice a week for at least one hour afterschool for the entire eight month implementation period. During weeks 12-14 of implementation, the writer worked every day afterschool for three hours each day completing the science fair projects.

During the school science fair, the parents were invited to visit the fair to view the projects. One night during the 15th week of implementation was set aside for "Night at the Science Fair". Sixty-two parents of ESOL I and II students visited the fair that evening. The students were very proud of their projects. Three of the science projects from the LEP students were entered into the county science fair. One the these projects earned an honorable mention at the county level.

The writer intended to have a total of 64 laboratory activities to be performed by the students. Because the classes were only one hour long, many of the lab activities had to be performed in two days rather than one day as originally planned. Towards the end of implementation, the school's Faculty Council was talking about implementing block scheduling into the school's curriculum. Block scheduling may facilitate and encourage many of the science teachers who try to schedule labs that take at least two hours to investigate.

When contacting the parents and legal guardians of the LEP students, the writer found herself repeating information to similar questions asked by the various parents. As a result of these telephone calls, the writer wrote a parent tip letter once every semester. The letter, written in Spanish, English, and Creole, informed parents on tips and ideas they could do at home to help the students learn science.

Recommendations

The writer has three suggestions for this practicum. In the teacher-made criterion referenced post test include essay questions that require the students to critically think. Some of these essay questions should inquire about the laboratory activities that the students investigated.

Another suggestions is the creation of a tips booklet for parents on how they could help their children learn at home. This booklet should not only concentrate on science.

but should include all subject areas. The booklet should be followed with a monthly letter that goes home with the students. In this fashion, parents expect a letter at least once a month and are kept up with school activities.

The writer recommends that an afterschool tutoring program be developed where honor societies within the school could provide the service for all students. This writer began such a tutoring program utilizing the members of the National Science Honor Society as tutors.

Dissemination

At the completion of the practicum, the principal of the senior high school suggested that copies of the practicum be distributed among other science teachers in the department. During the implementation of the practicum, several teachers from various middle and senior high schools throughout the county requested copies of the various lab activities that were being investigated by the students. The county science supervisor requested a copy of the practicum and has suggested that the writer work together with the Bilingual Education department at the central office in creating a document that summarizes suggestions for other educators of LEP students.

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APPENDIX A

TEACHER MADE PRE AND POST
PHYSICAL SCIENCE TEST

_____ 1. A scientific "guess" is a(n)
a. law b. theory c. observation d. hypothesis

_____ 2. A standard for comparison for an experiment is a(n)
a. control b. theory c. hypothesis d. observation

_____ 3. A _____ is a metric unit of length.
a. liter b. newton c. meter d. kilogram

_____ 4. Units of volume are derived from units of
a. length b. mass c. temperature d. force

_____ 5. All of the following are forms of matter except
a. water b. air c. iron d. electricity

_____ 6. The mass of an object may be measured with a
a. ruler b. balance c. beaker d. cyclinder

_____ 7. Work is the product of force and
a. time b. power c. distance d. speed

_____ 8. A measure of the force of gravity exerted on an object is the object's
a. mass b. weight c. volume d. power

_____ 9. The unit of work in the metric system is the
a. joule b. newton c. meter/second d. watt

_____ 10. Which of the following is a compound machine machine?
a. wheel and axle c. inclined plane
b. screw d. bicycle

_____ 11. Some machines make work easier by increasing the
a. force on an object c. resistance force
b. work done on an object d. friction

_____ 12. Which machine is a simple machine?
a. clock b. ramp c. bicycle d. car

_____ 13. Crowbars, scissors, and seesaws are examples of
a. screws b. wedges c. levers d. plane

_____ 14. Levers can be divided into _____ classes.
a. one b. two c. three d. four

_____ 15. In an actual machine, work input is always _____ work output
a. less than b. more than c. equal to

_____ 16. An axe blade is an example of a
a. lever b. compound machine c. pulley d. wedge

_____ 17. The newton is a unit of
a. mass b. force c. inertia d. density

_____ 18. The standard metric unit of weight is the
a. watt b. kilogram c. joule d. newton

_____ 19. What property of an object remains constant no matter where the object is located?
a. velocity b. speed c. weight d. mass

_____ 20. The gravitational attraction between the moon and an object at its surface is _____ the attraction of the earth.
a. more than b. less than c. equal to

_____ 21. The distance an object moves per unit of time is
a. velocity b. acceleration c. speed d. displacement

_____ 22. An object is weightless if the force acting on that object is equal and opposite to the
a. object's volume
b. density of the object
c. force of gravity
d. mass of the object

_____ 23. A stone resting on the edge of a cliff has no
a. mass b. kinetic energy c. potential energy d. weight

_____ 24. Which of Newton's laws states that a force is required to change an object's speed or direction?
a. first law b. second law c. third law

_____ 25. One of Newton's laws states that if the force remains unchanged, as the mass of an object decreases, the _____ increases.
a. speed b. force c. distance d. acceleration

_____ 26. If you push against a classroom wall with a force of 40 newtons, the wall exerts a force of _____ against your hand.
a. 0 N b. 20 N c. 40 N d. 80 N

_____ 27. The action force is equal to the reaction force according to Newton's
a. first law b. second law c. third law

_____ 28. The tendency of an object to keep moving is
a. inertia b. speed c. acceleration d. force

_____ 29. The acceleration of gravity on a falling object is
a. 0.98 m/s^2 b. 4.9 m/s^2 c. 9.8 m/s^2 d. 980 m/s^2

_____ 30. Centipetal force acts in a direction
a. along the path of motion
b. away from the center of a circle
c. toward the center of a circle

_____ 31. Which of the following types of matter can occupy the same space at the same time?
a. gas and liquid
b. gas and gas
c. gas and solid
d. none of these

_____ 32. The state of matter that does not have a definite shape or volume and is made up of electrically neutral particles is
a. gas b. liquid c. solid d. plasma

_____ 33. The boiling point is the temperature at which a substance changes from
a. solid to liquid
b. liquid to gas
c. solid to gas
d. liquid to solid

_____ 34. A state of matter that does not have a definite shape but does have a definite volume is
a. gas b. liquid c. solid d. plasma

_____ 35. To find density of a substance, you must know its mass and
a. volume b. weight c. composition d. shape

_____ 36. Isotopes are atoms that have the same
a. number of protons
b. mass number
c. number of neutrons
d. atomic mass

_____ 37. The energy levels within an atom contain
a. protons b. neutrons c. isotopes d. electrons

_____ 38. Al, Cu, N, and O are symbols for
a. compounds b. elements c. mixtures d. gases

_____ 39. Who attempted to classify the elements by organizing them into a seven-column table?
a. Dalton b. Mendeleev c. Bohr d. Thompson

_____ 40. Almost all the mass of an atom is found
a. inside the nucleus c. outside the nucleus
b. in the electrom cloud d. in the energy levels

_____ 41. The nuclei of atoms are electrically
a. positive b. negative c. neutral

_____ 42. The elements on the periodic table are arranged according to increasing
a. atomic mass b. stability c. activity d. atomic number

_____ 43. How many electrons may be contained in the energy level closest to the nucleus?
a. 0 b. 2 c. 8 d. 18

_____ 44. The mass of an atom depends on the number of
a. protons and neutrons c. electrons and neutrons
b. protons and electrons d. electrons and isotopes

_____ 45. The elements on the extreme left side of the periodic table are
a. metals b. nonmetals c. metalloids d. gases

_____ 46. Chemical bonding involves an atom's
a. electrons b. protons c. neutrons

_____ 47. Which group of elements is most chemically stable?
a. IA b. IIA c. VIIA d. VIIIA

_____ 48. Bonding by electron transfer is called
a. electronic bonding c. covalent bonding
b. shared bonding d. ionic bonding

_____ 49. An ion is formed when an atom loses or gains
a. electrons b. protons c. neutrons d. isotopes

_____ 50. The particle that results from a covalent bond is a(n)
a. ion b. molecule c. electron d. isotope

_____ 51. The sum of the oxidation numbers in a compound is
a. 0 b. 1 c. 2 d. negative

_____ 52. The symbol of the element with the _____ oxidation number is written first in a chemical formula.
a. positive b. negative c. smaller d. neutral

_____ 53. The type of substance that most easily loses electrons is a
a. halogen b. nonmetal c. metal d. noble gas

_____ 54. Which family of metals is so reactive that the metals are stored under oil?
a. alkali b. alkaline earth c. zinc d. copper

_____ 55. Most of the metals in the _____ family lose two electrons when forming ions.
a. alkali b. aluminum c. transition d. alkaline

_____ 56. The propertiesof alloys may be different from the properties of original metals
a. true b. false

_____ 57. The most widely used metal is
a. aluminum b. iron c. copper d. tin

_____ 58. Silver and gold are members of the
copper family b. nickel family c. zinc family d. platinum family

_____ 59. Mercury is the only metal that is a
a. nonconductor of electricity c. conductor of heat
b. conductor of electricity d. liquid at room temperature

_____ 60. Boron is a
a. metal b. nonmetal c. metalloid d. liquid

_____ 61. To form salts, halogens combine with
a. oxygen b. hydrogen c. nonmetals d. metals

_____ 62. How many electrons are in the outer energy level of each halogen?
a. 1 b. 2 c. 7 d. 8

_____ 63. The only nonmetal that is a liquid at room temperature is
a. mercury b. iodine c. phosphorus d. bromine

_____ 64. Ten grams of sugar are dissolved in a pan of water. The sugar is a
a. solute b. solvent c. solution d. conductor

_____ 65. Particles in solution _____ the boiling point of the solvent.
a. raise b. lower c. have no effect on

_____ 66. To increase the rate of solution for a solid in a liquid, you should not
a. cool the solvent c. crush the solute
b. stir the solution d. heat the solvent

_____ 67. If you cool the solvent, the rate of solution for a gas in a liquid will
a. increase b. decrease c. remain the same

_____ 68. Dissolving a solute in a liquid lowers the liquid's
a. freezing point c. specific gravity
b. boiling point d. density

_____ 69. As temperature decreases, most solids _____ in solubility.
a. increase b. decrease c. stays the same

_____ 70. Which of the following is not a characteristic of an acid
a. corrodes metals c. feels slippery
b. sour taste d. contains hydrogen

_____ 71. The indicator phenolphthalein turns _____ in a basic solution.
a. blue b. orange c. pink d. yellow

_____ 72. Which of the following acids causes yellow stains on skin?
a. acetic b. nitric c. sulfuric d. hydrochloric

_____ 73. Acids and metals react with one another to form hydrogen and
a. precipitates b. water c. hydroxides d. salts

_____ 74. What compounds react with acids to form salts?
a. bases b. sulfides c. nonmetals d. metals

_____ 75. An acidic solution would have a pH of
a. 5 b. 7 c. 9 d. 11

_____ 76. The _____ of a wave increases as the amount of energy increases.
a. period b. wave length c. speed d. amplitude

_____ 77. At a given velocity, the _____ increases as the length of a wave decreases.
a. amplitude b. frequency c. speed d. time

_____ 78. The velocity of a wave equals
a. wavelength/amplitude c. amplitude/frequency
b. frequency x amplitude d. wavelength x frequency

79. What kind of wave can travel through a vacuum? 45
a. sound b. water c. transverse d. elctromagneti

80. What kind of radiation is used to transmit telephone messages in areas where it is too difficult to put up telephone lines?
a. microwave b. infrared c. ultraviolet d. d. X-ray

81. As an object is raised from the earth's surface, its potential energy
a. decreases b. increases c. remains the same

82. As an object falls toward the earth's surface, its kinetic energy
a. decreases b. increases c. remains the same

83. Temperature is expressed in
a. calories b. joules c. pascals d. degrees

84. The heat of vaporization of water is _____ the heat of fusion of water.
a. more than b. less than c. the same as

85. When keated, most substances
a. contract b. expand c. remain the same size

86. The relationship between the temperature and the volume of a gas at constant pressure is stated in _____ law.
a. Pascal's b. Boyle's c. Charles' d. Joule's

87. The relationship between the pressure and volume of a gas at a constant temperature is stated in _____ law.
a. Pascal's b. Boyle's c. Charle's d. Joule's

88. A neutral object will become positively charged if it loses
a. ions b. neutrons c. protons d. electrons

89. A glass rod will lose electrons when rubbed with
a. wool b. silk c. plastic d. rubber

90. Which is not a electrical insulator?
a. plastic b. aluminum c. rubber d. glass

91. A device used to detect a small static charge of electricity is a(n)
a. electroscope b. galvanometer c. voltmeter d. ammeter

92. Potential difference is measured in
a. watts b. amperes c. ohms d. volts

93. A plastic rod rubbed with wool will become negatively charged by gaining
a. ions b. neutrons c. protons d. electrons

94. The difference in potential energy between the terminals of a battery is an electric
a. force b. current c. charge d. resistance

95. The relationship $I = V/R$ is known as
a. Watt's law b. Ohm's law c. Ampere's law d. Joule's law

96. When a current flows through a resistance, the energy of electrons will
a. increase b. decrease c. remain the same

97. What is the same in each branch of a parallel circuit?
a. current b. voltage c. power d. resistance

98. The equation used to find electric power is
a. $P = IR$ b. $P = V/I$ c. $P = VI$ d. $P = V/R$

99. When one bulb in a string of Christmas tree lights is removed, all

of the lights go out. The lights are connected
a. in series b. in parallel

______ 100 The poles of two magnets are near each other and repel. The poles could not be .

a. two north poles
b. a north and a south pole
c. two south poles
d. both a and c

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APPENDIX B

SCIENCE FAIR STUDENT ENTRY LOG

SCIENCE FAIR STUDENT ENTRY LOG

Student Name	ID Number	Project Title

APPENDIX C

STUDENT ATTITUDINAL SURVEY

STUDENT ATTITUDINAL SURVEY

Physical Science
Ms. Marilyn Correa

Name______________________________
ESOL Level_____
Date______________Period__________

Directions: Please answer each of the following questions as best as possible.

1. Do you like science? Why or why not?

2. What do you like least about your science class?

3. What do you like the most about your science class?

4. Which is your favorite subject in school? Why?

5. Which is your least favorite subject in school? Why?

APPENDIX D

HANDS-ON LABORATORY ACTIVITY LOG

HANDS-ON LABORATORY ACTIVITY LOG

Date	Lab #	Laboratory/Activity Title

APPENDIX E

ALTERNATIVE ASSESSMENT SAMPLES
IN SCIENCE

VARIOUS METHODS OF ASSESSING STUDENT PROGRESS

1. Demonstrations
2. Performances
3. Presentations
4. Exhibitions
5. Discussions
6. Debates
7. investigations
8. I-Search
9. Experiments
10. Projects
11. Models
12. Simulations
13. Self-evaluation
14. Anecdotal records
15. Standardized tests
16. Analytic scoring
17. Textbook or teacher-made tests
18. Holistic scoring
19. Interviews
20. Peer evaluations
21. Portfolios

IDEAS FOR A SCIENCE PORTFOLIO

1. Lab report
2. Cooperative group report on a science investigation
3. Science Fair project
4. Observations
5. Self-assessment
6. Critique of a science film
7. Critique of science software
8. Critique of science newspaper article
9. Illustrations of science equipment and/or materials
10. Scientific autobiography
11. Excerpts from a daily science journal..."Today I learned"
12. Student assessment of an assignment that needs more work and why

APPENDIX F

PARENT CONTACT LOG

PARENT CONTACT LOG

Student Name	Parent	Date/Time	Result of Teleconference

APPENDIX G

STUDENT ROLES IN COOPERATIVE LEARNING GROUPS

Recorder/Reporter RR

You are responsible for:

1. Collecting data from the investigation.
2. Checking all measurements and other data collected by the Materials Manager.
3. Recording the investigation information and results on the group worksheet or diagrams.
4. Checking the investigation results with the Principal Investigator.
5. Filling out data tables, turning in the group worksheets, and writing the results on a class summary chart if required.
6. Describing the procedure and the results.

Maintenance Director MD

You are responsible for:

1. Keeping the work station clean and orderly during investigation.
2. Cleaning-up when the investigation is completed. Other team members may be appointed to assist if needed.
3. Identifying all safety precautions and obtaining any safety equipment needed for the investigation.
4. Making sure all group members follow safety rules during the investigation.
5. Working with the Principal Investigator to design necessary diagrams, charts and graphs.
6. Using data from the Reporter Recorder to label diagrams and plot graphs.
7. Describing diagrams, graphs, and possible experimental errors.

Principal Investigator P I

You are responsible for:

1. Coordinating the duties of the team.
2. Helping to carryout the investigation.
3. Reading the written instructions to your team.
4. Appointing helpers when needed.
5. Leading group discussions.
6. Asking the teacher questions about the investigations.
7. Checking the results of the investigation
8. Writing the problem statement, hypothesis, and conclusion based on team discussion.
9. Describing the Problem Statement, Hypothesis, and the Conclusion of the investigation.

Materials Manager MM

You are responsible for:

1. Collecting the equipment and supplies for the investigation.
2. Setting up the investigation equipment in your work area.
3. Making the observations, measurements and work the investigation equipment.
4. Informing the principal investigator about any broken equipment or missing materials.
5. Returning equipment and materials when the Maintenance Director tells you to.
6. Listing the necessary materials and amounts needed for the investigation.
7. Making a labeled diagram of the experimental set up if necessary.
8. Describing the experimental set up and possible applications of the results.