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ABSTRACT

A practicum project designed a preschool science curriculum and requisite environment to improve students' enjoyment and interest in science. Based on teacher- and parent-questionnaire results, it was determined that student science attitudes were not positive; that students seldom had opportunities to explore, discover, and solve problems; and that the students' curiosity was inhibited by preconceived ideas about insects and rodents. Lack of parent participation and teachers' insecurity with teaching science concepts added to the problem. The solution strategy included developing science concepts as an integral part of each classroom learning center, using a multidisciplinary approach; planning extensive field trips; producing three plays; encouraging parent involvement; and organizing a science fair as part of a city-wide conference for parents, teachers, and the community. Evaluation results indicated that students can and do show an enthusiasm for science activities, that hands-on experiences do increase science vocabulary, that students willingly contribute to science activities, and that they can explain their science activities to others. Much of the success of the practicum was attributed to the outdoor experiences that students had at the park and on field trips to farms, nature centers, and museums. (Four appendices contain checklists for science attitudes, science vocabulary, contribution to the science center, and for explaining science activities. Contains 35 references.) (HTH)

Improving the Preschooler's Science Knowledge and Skills Through Hands-on Activities

by

Anne Wigg

Cluster 53

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

1995

PRACTICUM APPROVAL SHEET

This practicum took place as described.

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This practicum report was submitted by Anne Wigg 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 for the degree of Doctor of Education at Nova Southeastern University.

Approved:

Aug. 4, 1995
Date of Final Approval of Report

June S Delano, Ph.D
June Delano, Ph.D., Adviser

ACKNOWLEDGMENT

This practicum owes its success to the parent volunteers who contributed so much of their time, talents, and resources to bring it to fruition. Their commitment to the vision of their children enjoying and benefiting from the science curriculum involved personal sacrifices which they willingly made. Without help from the bilingual parents, many of the students would not have reached nor would their special talents have been recognized.

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ABSTRACT

Improving the Preschooler's Knowledge and Skills Through Hands-on Activities: Wigg, Anne V., 1995: Practicum Report, Nova Southeastern University, Ed.D. Program in Child and Youth Studies. Science Concepts/Preschool/ Hands-on Activities/Parent Involvement/Dramatizations/ Cooperative Learning/Field Trips/Multidisciplinary Approach/Developmentally Appropriate Practices/Inclusion/ Bilingual

This practicum was designed to create a preschool environment in which students would enjoy and benefit from the science curriculum while improving the students' experiences indoors and outdoors.

The writer developed science concepts as an integral part of each learning center through a multidisciplinary approach; planned extensive field trips; produced three plays; encouraged parent involvement; and organized a science fair as part of a city-wide conference for parents, teachers, and the community.

Analysis of the data revealed that students can and do show an enthusiasm for science activities, that rich, hands-on experiences do increase science vocabulary, that students willingly contribute to science activities, and that they can explain their science activities to others.

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CHAPTER I

INTRODUCTION

Description of Community

The setting for this practicum was a large factory town with a population of 108,961. Many of the factories had relocated and had left, in their wake, an unemployment rate of 9.9 percent. In 1989, the per capita income was $14,209. Fifty one percent of the students received free/reduced priced meals. Eighteen percent of the total school population was from non-English speaking homes.

The newspaper for the community was written on a fifth grade level and contained blatant headline errors such as "then" for "than". It was common for teachers, educated in the community, to say, "I should have went". Institutions of higher learning included one state university extension, one community college, and one private college.

Statistics from the latest state reading test placed fifty one percent of all third graders in need of remedial reading classes, even though recent budget cuts had eliminated all remedial reading teacher positions. Many of the students were "at risk" and were highly migratory.

Pictorially, the condition of the inner city schools was complete disrepair. Vermin were in evidence in classrooms and in the halls. Paint, that contained a high content of lead, was peeling off the walls in the classrooms and chips were scattered about. Self interests prevented this multicultural community from enjoying cohesive attitudes about community spirit and pride.

Writer's Work Setting and Role

The writer's work setting was an antiquated school in an inner city neighborhood. The classroom in which the writer taught was crawling with vermin. The dress up corner had to be dismantled due to a lice infestation. High lead content paint was chipping off the walls. The classroom was located in a dingy, dark basement near odorous lavatories. The playground was black top asphalt and doubled as a parking lot. There was no outdoor playground equipment. Physical education for preschoolers at this location occurred once a week when students could ride wheel toys and walk a balance beam in the gymnasium which also functioned as a lunch room. Computers were available for classroom use on a sign up basis, but had to be carried down a steep flight of stairs. The same was true of TVs and VCRs. On a positive note, morale was high and teachers had attempted to make classrooms and hallways attractive through using much of their own resources.

Stakeholders included an early childhood education director, a special services director, one speech therapist, one social worker, one special education teacher, one typical preschool teacher, two assistants, thirty six 4-year-old students, and parents. As the preschool teacher of 26 typical 4-year-old students, the writer's role was to prepare the students for kindergarten while participating, voluntarily, in a program developed for the inclusion of ten special needs students during the course of a five hour preschool day in split sessions of 2½ hours each. In that environment, the writer was striving to meet 57 objectives designed by the early childhood education program for the typical 4-year-old students who were predominantly Hispanic.

The writer's responsibility included coordinating the preschool curriculum with the curriculum for which the special education teacher was responsible so that all 36 students were in an unbiased, least restrictive environment. Under consideration in coordinating curriculum were the transitionary personnel who were included in the scheduling at least twice a week. Because the early childhood component of the classroom was Chapter I and federally funded, parent involvement was an essential consideration in curriculum planning. Organizing and planning field trips that were of educational value to 4-year-olds was another responsibility that the writer had to meet, along with planning fund raising activities to finance the trips. Being attuned to the myriad problems that were so much a part of inner city life and recognizing and referring those problems through the proper channels was another responsibility that the writer had to meet. Finally, it was the writer's responsibility to insure that school was a place where students would feel safe and cared for, a place where they would enjoy being because they knew that they were recognized as very valuable human beings.

CHAPTER II

STUDY OF THE PROBLEM

Problem Description

Realizing that American educators were striving to meet the national goals for the year 2000 and that science education was a priority goal, the writer was concerned that inner city preschoolers were not benefiting from a science curriculum. That there was a problem was evidenced by student attitudes which were not positive toward science and science activities. Students rarely used a science vocabulary when conversing with their classmates. They showed no interest in the science corner nor were they able to explain simple science experiments conducted in the classroom.

The problem had not been solved because of teachers' feelings of inadequacy in teaching science, blocks of time allocated to established curriculum, and limitations of materials and other resources. Clearly, the problem was that preschoolers were not benefiting from the science curriculum. That preschoolers should have the opportunity to benefit from the curriculum is what should have been.

Problem Documentation

Documentation of the problem consisted of a questionnaire to which teachers and parents responded. From the responses on the questionnaire, the writer determined that preschoolers did not participate in science activities on a daily basis either in school or in the home. Some preschoolers had limited exposure to science and science activities. Some preschoolers had never participated in science activities.

Causative Analysis

In analyzing the causes of the problem, the writer saw three areas as contributing to the problem of students not benefiting from the science curriculum. First, students were not benefiting from the science curriculum because they had few opportunities to explore, discover, and problem solve or to claim ownership of science projects. They also had limited opportunity to act on objects to help them develop their physical knowledge. Students were not benefiting from the science curriculum because of preconceived ideas about insects and small animals that made them fearful and inhibited their curiosity. The students in the writer's work setting had few opportunities to visit nature centers, museums, farms, or parks.

Second, students were not benefiting from the science curriculum because parents were not an integral part of their child's educational experiences. Their primary concerns for their children were, of necessity, very basic.

Finally, the students were not benefiting from the science curriculum in the writer's work setting because the writer had little training in teaching science concepts to preschoolers. Students were not benefiting because the writer was inhibited by the fear of giving incorrect answers to spontaneous questions asked by the students. Students were not benefiting because the writer was less than comfortable with the prospect of being in the role of a facilitator and of losing the students' respect if science activities went awry. Students were not benefiting because materials and resources were limited in the work setting.

Relationship of the Problem to the Literature

Support for the evidence and causes of the problem was found in the literature.

The problem was that, in the writer's work setting, children were not benefiting from the science curriculum. This was of great concern for the writer because of the emphasis on Goals 2000. Andersen (1994) states that 100 years ago, students were not benefiting from the science curriculum and that 100 years later, even though strides have been made to create effective change, students still, are not benefiting from the science curriculum to the extent that they should be.

Evidence of the magnitude of the problem is found throughout the literature as educators write of the problem and the concerted efforts abroad to rectify the alarming condition (Lindberg, 1990). Because early childhood is the time of life when basic concepts are being formed at the greatest rate, the writer felt that it was imperative for children to benefit from the science curriculum at the preschool level.

Newport (1991) states that science education is in a state of crisis at the early childhood level. This was evident in the writer's work setting. Perry and Rivkin (1992) state that science is the weakest component of the preschool curriculum. This was also evident in the writer's work setting. Davis (1994) states that research shows that if students do not benefit from the science curriculum at an early age, they are not likely to pursue science education in later years.

Because students were not benefiting from the science curriculum in the writer's work setting, the implications for student achievement in science education in later years, were not acceptable. Obviously, the writer had cause for concern when the literature revealed that many educators were writing of the problem and the long range educational ramifications of students not benefiting from the science curriculum. As an educator, the writer had genuine concerns for the students in the work setting who were at a distinct disadvantage for future achievement.

The causes of the problem in the writer's work setting were many of the same causes that other educators were writing about in the literature. The writer saw three areas that represented the causes of the problem. These areas involved students, parents, and the writer. In the work setting, many of the students were "at risk". Their predominantly one parent families were at or below the poverty level. Many parents did not speak English.

Because of these socioeconomic conditions, parent resources were limited. Many of the students lived in crowded, unsafe, three family tenements and had little opportunity for outdoor exploration and discovery which was a contributing factor to the problem. Dighe (1993) states that infrequent outdoor activity inhibits a young child's natural curiosity. As parents strove to meet their child's basic needs, little attention was paid to fostering science concepts.

Simpson and Oliver (1990) state that young children, whose parents do not foster science concepts, are less likely to benefit from a science curriculum than those children whose parents do foster science concepts. Many parents missed opportunities to foster science concepts in their children by not realizing the value of family outings to nature centers, museums, farms, and parks and by not selecting toys that promote science concept development. Martin (1989) addresses this problem and states that children suffer, in the long run, from these missed opportunities.

Many of the young parents in the writer's work setting did not have a high school education and were highly intimidated in the school setting. Attempts to develop positive home school relations were often futile because many of the parents only spoke and understood Spanish. As a result of these conditions, many of the students entered the writer's work setting with limited readiness skills, delayed language skills in English, low motivation, and poor attention spans. Karnes, Johnson, and Beauchamp (1988) address the problem when stating that poverty inhibits school performance which, in turn, lowers the child's self-esteem which, in turn, affects school performance.

Although most of the students were exposed to science education on television, the medium does not afford the child the opportunity to act on objects through touching, tasting, and smelling, therefore, many of the students had developed one dimensional science concepts before entering preschool. Smith (1987) states that young children who have few opportunities to act on objects in nature, do not fully develop a physical knowledge that is necessary for intellectual development. Many of the children exhibited an element of fear when exposed to small creatures that represented negative aspects of their environment. Some of the students were very hesitant to touch unfamiliar objects. Holt (1989) recognizes that some children do have fears and that this is a very real aspect of the problem when children do not benefit from the science curriculum. Because of these preconceived fears, many students in the writer's work setting lacked an enthusiasm for exploration and discovery.

Finally, students had few opportunities to claim individual ownership of science projects. Iatridis (1981) and Pearlman and Pericak-Spector (1993) state that when students cannot claim individual ownership of a project, they are less likely to be enthusiastic and cooperative during science activities. Lindberg (1990) states that, even though research supports it, hands-on science has not been universally accepted by educators. In the work setting, students were not benefiting because rich, hands-on experiences were infrequent and lacking in the development of problem solving skills.

Students were not benefiting from the science curriculum in the writer's work setting because the writer had not been adequately trained at the graduate level for teaching appropriate science concepts to preschoolers. An example of this was the sink and float experiments the writer encouraged at the water table. Wolfinger (1982) considers the traditional experiments inappropriate for preschoolers if they are to derive the greatest benefit from the science curriculum. Teaching colleges and universities attest to the problem and are currently addressing the issue by making serious attempts to correct it at the graduate level (Tolman and Campbell, 1989) and (Andersen, 1994).

Students were not deriving the greatest benefits possible from the science curriculum because the writer was fearful of giving incorrect information which might have impacted negatively on science concept development. Pearlman and Pericak-Spector (1992) support this attitude which, they state, is shared by other teachers. Further, they state that teachers who act as an authority figure rather than as a resource for fostering science concepts, miss many opportunities for creating a science environment in which students will truly benefit. Holt (1989) states that when children do not have frequent opportunities for exploration, discovery, and problem solving, they are not likely to view science as a daily living experience.

Students also lacked the full benefit of the science curriculum in the writer's work setting because the writer had felt at a loss when past attempts at science activities did not produce text book results, as often happens. It was especially embarrassing to have to justify errors to the many adults who were in the classroom as a result of the inclusion program in which the writer and students were involved. Rossman (1993) supports the writer's concerns in stating that science discovery is risky for teachers. Galvin (1994) concurs that parents and teachers are often out of their element when pursuing science activities with young children, so to save face, they refrain from doing so. Rossman (1993) states that there is a need for sweeping reform in attitudes toward teaching science. Howe (1975) states that students must have the opportunity for scientific inquiry at the preschool level if they are to derive any benefits from the science curriculum. Part of the problem in the writer's work setting was that the writer was more concerned with disseminating information than with exploring and discovering in partnership with the students. Evidence of the impact of this problem was exhibited in the short attention span of the students when being led to conclusions by the writer.

Students were not deriving benefits from the science curriculum because of the lack of adequate materials for rich, hands-on science activities. An antiquated building lacked a convenient source of water and an adequate electrical system to create an effective preschool science curriculum. The best of the writer's plans were inhibited by frequent power overloads which rendered the whole school "powerless", causing fellow teachers to complain. A black top playground also inhibited exploration and discovery in a natural environment. Newport (1991) states that if students are to benefit from the curriculum, it is critical that adequate materials and resources be at hand. Collins and Hastings (1990) address both the misconceptions about science and limited expendable materials as a cause for students not benefiting from the science curriculum.

In summary, the problem, "Children are not Benefiting from the Science Curriculum", not only has implications for change in the writer's work setting, but also has broader implications for reform at the national level if educators are to meet Goals 2000. This is supported over and over again in the literature. This practicum is the writer's attempt not only to eliminate the problem of children not benefiting from the science curriculum in the work setting, but also to make a contribution to the attainment of national goals for the science education of all students.

CHAPTER III

ANTICIPATED OUTCOMES AND EVALUATION INSTRUMENTS

Goals and Expectations

The following goals and expectations were projected for this practicum.

The goal and expectation for this practicum was to create an environment in which students would enjoy and benefit from the science curriculum.

Expected Outcomes

The following expected outcomes were projected for this practicum.

Out of 36 students, 31 will show that they are enthusiastic about science activities through a Checklist for Attitude. (See Appendix A).

Out of 36 students, 31 will show that they are using a science vocabulary in all disciplines through a Checklist for Vocabulary. (See Appendix B).

Out of 36 students, 31 will show that they are contributing to the science corner through a Checklist for

Contributions to the Science Center. (See Appendix C).

Out of 36 students, 31 will show that they can explain simple science experiments conducted in the classroom through a Checklist for Explaining Science Activities. (See Appendix D).

Measurement of Outcomes

Measurement of outcomes was determined by a Checklist for Attitude, a Checklist for Vocabulary, a Checklist for Contributions to the Science Center, and a Checklist for Explaining Science Activities. These four checklists were developed by the writer and were used as an evaluation instrument because of their adaptability to teacher based observations that were necessary due to the ages of the students. The checklist was used as an evaluation instrument during the entire course of implementation. Results ere compiled at the conclusion of the eight month period of implementation.

CHAPTER IV

SOLUTION STRATEGY

Discussion and Evaluation of Possible Solutions

The problem restated was that children in the preschool were not benefiting from the science curriculum. A review of the literature revealed many solutions that could be effectively applied to the writer's work setting.

To maximize the potential for preschoolers to benefit from the science curriculum, the writer's goal was to incorporate a multidisciplinary approach when introducing science concepts. Riley and Coe (1992) suggested carrying out a central theme concurrently in all centers. Perry and Rivkin (1992) suggested "treasure hunts" as a way to encourage preschoolers to become involved in science activities in a meaningful way. Lehman and Kandl (1992) suggested extending science concepts from the learning centers to outdoor playgrounds when discussing inclined planes, levers, and wedges.

Incorporating cooperative learning into implementation was a goal the writer had. Freier (1994) suggested dividing the students into small manageable groups for separate science experiences in the learning centers and then encouraging each group to share their activities with the whole class.

Insuring that all activities were developmentally appropriate was, to the writer, a prerequisite for success. All ideas for developmentally appropriate practices were gleaned from the literature (NAEYC, 1986). Dighe (1993) suggested age appropriate environmental involvement and Smith (1987) suggested painting, experimenting with musical instruments, and cooking activities as being developmentally appropriate.

Because many inner city preschoolers are fearful of small animals, insects, and slimy things, the writer searched the literature and found some interesting ways to alleviate their fear. Holt (1989) advocated introducing science as a daily living experience. Raze (1993) suggested that nature walks might dispel misconceptions about science concepts held by many inner city preschoolers. Goff (1981) suggested that a sense of awe would replace fear if the small child had the opportunity to experience a walk in the forest. McIntyre (1984) advocated dispelling fears by introducing animals into the classroom in such a way as to allow the student to observe from a distance. Perry and Rivkin (1992) agreed that providing many opportunities for exploration and discovery would develop an affinity for science in young children. This is best done when teachers explore and discover with preschoolers rather than "teach" science concepts (Ziemer, 1987).

In teaching the physical properties of objects to allay fear, Hill (1977) uses natural materials such as sand, rocks, and water as an introduction to science concepts because of the inanimate nature of the objects. As many preschool centers involve students in sink and float experiments at the water table, it was interesting to read that Wolfinger (1982) considers the experiments inappropriate for preschoolers.

It did not occur to the writer to plan for an indoor and an outdoor science center until reading about the rich, hands-on experiences preschoolers could have through making comparisons between the two (Ziemer, 1987). Iatridis (1981) suggested that both centers contain self directed materials to increase verbalization and cognition. Smith (1987) stated that understanding the physical properties and the way they respond when acted upon is necessary if logical thought is to occur. This was especially important information for the writer to consider since ten special needs students were to be incorporated into the plan for implementation.

Because parent involvement is such a vital part of Chapter I, federally funded programs, the writer had to search the literature for innovative ways to do this. Hyndman (1991) suggested sending science projects home with the students to be logged and charted by the whole family. Romjue (1992) suggested a non-competitive science fair to promote ownership and foster self-esteem in the preschooler and involve the parents in the project. Martin (1989) suggested that teachers create an awareness of the many opportunities parents have to foster science development through family outings to museums, nature centers, and parks. In selecting toys that teach science concepts, parents also have the opportunity to foster science development.

To help parents take advantage of the many opportunities they have for encouraging their children to discover and explore, Dreyer and Bryte (1990) suggested that when they take their children to the park, that parents make a connection between the slides, swings, and seesaws and inclined planes, wedges, and levers. Galvin (1994) suggested that parents take advantage of the seasons to talk with their children about how change affects the environment. Awbry (1989) and Carter (1992) suggested that parents could use every day experiences in the home to explore and discover with their children. Finally, Braun and Braun (1990) and Misiti (1993) suggested that parents could encourage their children to use their five senses to form concepts of physical properties. Parents could also encourage their children to verbalize their findings.

Description of Selected Solution

To create an environment in which students would enjoy and benefit from the science curriculum the writer selected five solutions. The first was to develop an understanding of science concepts designed to alleviate fear in young children. This was to be accomplished through introducing the students to living things and life cycles, natural materials, the changes of the seasons, and the physical properties of objects (Holt, 1989), (McIntyre, 1984), and (Hill, 1977). The second solution was to create indoor and outdoor environments for rich, hands-on learning (Ziemer, 1987) and (Iatridis, 1981). The third solution was to create a developmentally appropriate, multidisciplinary approach that would incorporate the concept of cooperative learning (NAEYC, 1986), (Riley and Coe, 1992), and (Freier, 1994). The fourth solution was to involve parents in their homes and as volunteers in the classroom to foster an awareness of science concepts in their children (Dreyer and Bryte, 1990), (Galvin, 1994), and (Awbry, 1989). The fifth solution was to provide science activities that would build self-esteem by providing the students and their parents with the opportunity for ownership of their projects (Romjue, 1992), (Hyndman, 1991), and (Martin, 1989).

Justification for the solutions came from the literature which suggested that all of the ideas had been applied in real life settings and that the approaches had produced positive results. Introducing living things and life cycles was a valid solution because the writer had the flexibility and could create the needed resources to get the students out of the classroom and into a broader environment for exploration and discovery. Creating indoor and outdoor environments for rich, hands-on experiences was a valid solution as it would afford the students the opportunity to make comparisons between the two. Using a developmentally appropriate, multidisciplinary approach that would incorporate cooperative learning was a valid solution because the design would be on the level of a 4-year-old child, would reinforce concepts in each learning center of the classroom, and would encourage the students to explore and discover together. Involving parents was a valid solution that was critical because the success of federal programs is determined by the extent to which parents become involved in their child's education. Building self-esteem in students was a valid solution because of the many opportunities that would be provided for them to claim ownership through their creative efforts.

Report of Action Taken

The goal and expectation for this practicum was to create an environment in which students would enjoy and benefit from the science curriculum.

To implement this practicum, the writer developed science concepts that focused on living things and life cycles, natural materials, seasons, and the physical properties of objects. The writer also created indoor and outdoor science environments for rich, hands-on learning. In using a multidisciplinary approach to create these environments, the writer was able to expand on the concepts that were the focus of each learning center. Developmentally appropriate in nature, these concepts were also expanded on through cooperative learning experiences in which the writer primarily functioned as a facilitator. Parent involvement was a major part of this practicum which incorporated within its design the skills parents needed to foster an awareness of science concepts in their children. All activities were designed to build self-esteem in the students and their parents by providing them with the opportunity for ownership of their finished products.

At the outset of implementation, all stakeholders attended an open house that was designed to introduce the parents to the vision of their children truly benefiting from the science curriculum and to gain their support of and their commitment to that vision. At open house, all parents were given a schedule of workshops planned. Also distributed at open house was a schedule of all planned student activities that were to occur during the eight month period of implementation. Some of these activities included weekly walking trips to the park, bimonthly field trips to farms, nature centers, and museums, and three class productions for the benefit of the parents and the whole school. These schedules were preplanned by the writer who developed the format, the special education teacher, and two classroom assistants so that each would have a stake in the outcome. Along with the schedules, the writer distributed a list of services in the community designed to aid parents in need of such services.

It was at open house that the writer encountered the first unexpected event. Many of the parents did not speak English and all of the information that had been prepared was written in English. A quick telephone call to the bilingual adjunct of the adult education department provided the writer with a translated version of the information within a few days. This version of the information was then distributed to the appropriate parents the following week as they brought their children to school.

It soon became apparent to the writer that to be the most effective in this new school assignment, the writer must have some knowledge of the Spanish language. With the permission of the Early Childhood Education Director, a bilingual parent was hired by the writer to teach the four classroom personnel the dialect spoken by the parents rather than a more formal Spanish. Therefore, on a weekly basis during implementation, the writer, the special education teacher, and two classroom assistants struggled through Spanish lessons with the bilingual parent who proved to be invaluable to the success of the practicum implementation.

In planning for indoor science activities, four central themes, living things and life cycles, natural materials, the seasons, and the physical properties of objects were incorporated into the design of each learning center. There were many pictures at eye level in each of the centers to further encourage concept development. As the students moved from one learning center to another, they began to make connections between the family, the habitats of living things, the ways in which living things do work, how they are affected by the changing seasons, how natural materials are used to meet the needs of living things, and the physical properties of many materials used in the course of daily life. This was done by providing many rich, hands-on experiences around a central theme in each of the learning centers rather than creating a specific science center.

In the kitchen center, the students sorted and classified the play food into the four food groups. They made nutritious boxed lunches to take to the "workers" in the block corner and the garden center. Real fruits and vegetables were cut open so that the students could dry the seeds, then plant them in the kitchen window boxes. In the fall, the students planted pumpkin seeds that grew into healthy plants, but a window was left open too long and the plants died. This too, was a learning experience. As classroom personnel and parent volunteers became more involved in these classroom projects, it was decided that each adult would go to the grocery store and take back to the classroom, fruits and vegetables that were unfamiliar to them so that everyone could experience a new taste sensation. Star fruit, papayas, cherimoyas, fiddle heads, passion fruit, okra, and mangos were just a few of the taste sensations experienced by all.

More seeds were planted and as the plants began to grow, the writer began to search for unusual plants to broaden the scope of the project. At year's end, the garden center contained Spanish moss, air plants, a Venus Fly Trap, an aloe plant, cactus plants, and a kumquat tree. And the school yard was filled with beautiful flowers that the students had transplanted from their garden center. To illustrate root growth, sweet potatoes were grown in water. The students marvelled at the profusion of roots that developed and the leaves that appeared. In caring for these plants, the students became aware of the many adaptations living things must make in order to flourish.

Because the writer's classroom included ten special needs students, the typical students also became aware of the many adaptations some human beings must make in order to overcome their limitations. Compassion and caring were qualities that were developed as the students helped each other meet with success during the eight months of implementation. There were many troubled children in upper grades in the writer's work setting, so the writer suggested to the school principal that those children be allowed to "work" with the preschoolers when they experienced "overload" in their own classrooms. Although this idea had not been conceived of at the outset of implementation, it proved to be one of the outstanding aspects of the practicum because it created a sense of unity within the school setting.

In the block corner, many interesting projects evolved as a result of the playground experiences in the park which included seesawing, swinging, and sliding. Those first hand experiences had developed concepts which helped the students understand the reasoning behind creating a balance scale, a pendulum that deposited sand as it moved, and an inclined plane built for racing their cars. To further develop spatial concepts, blueprints, hard hats, dust masks, protractors, and levels were added to the block corner. From an industrial arts class at a local high school, the writer gathered wood scraps, shavings, and saw dust so that the students would also be encouraged to "build" in the art corner. The end result was a "what'sit?" demonstration to which the whole school was invited. As interest built, many visitors, including community representatives, appeared at the classroom door. Soon, new faces were helping the students create wind socks, bird feeders, and wind chimes made from plastic plates and old spoons. All of these projects were taken to the park for outdoor observation. The bird feeders, made from plastic cups covered with peanut butter and rolled in bird seed, were hung on trees and left in the park. The students had a good laugh when a very brazen squirrel snatched the entire bird feeder and scampered up a tree with it.

In the language corner where the weather was charted daily, a barometer was created from an upended plastic bottle and a deep dish to measure air pressure. A rain gage and a wind gage also became part of the weather station. In each of the centers, language flowed in Spanish and English. As the students listened to the many stories read to them in both languages, a rich, bilingual vocabulary developed.

In the music center, kazoos were created from combs and waxed paper, guitars from shoe boxes and rubber bands, xylophones from glass bottles filled with varying amounts of water, tambourines and drums from coffee cans and bottle caps, and maracas from plastic plates and seeds. Environmental sounds were captured on a tape recorder for later identification. This also encouraged recall of past experiences and built listening skills in a way that was relevant to the students.

From a workshop the writer attended in the past, came the idea of using all natural materials in the manipulative corner. Shells, acorns, pinecones, and rocks were used as counters to build the concept of one-to-one correspondence. Sorting and classifying were other concepts built in the manipulative corner. Through these activities, parents were able to see that costly materials were not necessary for concept development.

One of the most positive aspects of implementation was the element of trust that was built between home and school. This was especially important because of the language barrier which gradually disappeared as parents began to realize that school personnel was making a serious attempt to create an atmosphere of open communication.

In establishing an outdoor environment for rich, hands-on learning experiences, the writer determined that a nearby, city park would be the ideal location for that purpose. As the students walked to the park once a week, they made many observations. They saw and felt the change in the seasons. They developed a sense of their neighborhood through the sights, sounds, and smells they encountered as they walked leisurely to their destination. Once there, the students discovered many small animals whose natural habitat was the park. They discovered squirrels gathering acorns, observed pond life, and encountered many interesting people who were walking their pets. They observed how people and animals carry seeds from one place to another. They discovered two trickling brooks and a small waterfall. The writer aided the students in briefly damming the brook in order to observe the results. Soon, the students were collecting natural materials to take back to the classroom. Parents who accompanied the students to the park were also collecting materials to take home for further study.

An unexpected event was the many creative projects that evolved in the classroom as a result of the trips to the park. The students used their milk cartons from the lunch room, cut them in half, painted them, and made boats to race in the brooks at the park. They wanted to race the boats in the huge, central pond, but there was no way to retrieve those that might have floated beyond reach, so discussions about a clean environment ensued. Soon after, leaf collections became placemats that the writer laminated so the students could take them home and use at mealtime. After a field trip to an American Indian archeological institute, the students wanted to use the natural materials they had collected to create Indian "artifacts". With the help of the adults in the classroom, the students created vests and dresses out of brown, paper, grocery bags and glued the materials to the costumes to create designs. Rocks and sticks became tomahawks, fishing spears, and grinding stones. The fishing spears were taken to the park, but the fish did not cooperate in this project.

As winter approached, weekly walking trips to the park focused on the many changes that had occurred in the park since the earlier trips in the fall. The trees were bare and the Canada geese were gone, but the squirrels were still scampering about gathering acorns. The pond was lightly frozen. As the seagulls landed on the ice, they slid across the pond and literally, fell in. The students took great delight in observing this. As was their habit by this time, the children continued to take bread from home to feed the gulls and pigeons who flew overhead, providing the students with the opportunity to observe the birds in flight at close range. The students had observed many stuffed animals on field trips to nature centers and museums, but their first-hand experiences in the park, which was by all accounts the best possible outdoor science center, were the most memorable experiences.

When a blanket of snow covered the earth, new discoveries were possible. Familiar paths disappeared and new ones had to be created. Warmer clothing was needed to make the trip which was made at a much brisker pace than at earlier times. The fish and the turtles could no longer be seen in the pond, for it had completely iced over. One very brave dog walked out on the ice as the students held their breath until it was safely back on shore.

Snow was collected in different types of containers which were upended to create a snow castle. To the delight of the children, the castle could still be found several weeks later, along with the snow angels that they had made. Several containers of snow were taken back to school on one trip and were deposited at different locations in the building. One container was deposited in the lunchroom freezer, one on the classroom radiator, one in a window, and one in the school yard. Daily observations were charted in the classroom.

In the fall, the park department maintenance crew had given the students bulbs to plant in the park so that when spring finally arrived, the students were in awe of the results of their earlier efforts, for the park was a mass of color as crocus, daffodils, and tulips began to appear. Soon, the fish and turtles made their appearance as did the leaves on the trees. The grass became very green and everything smelled so fresh.

By the end of implementation, the students had observed seasonal changes from fall to spring on a weekly basis in an outdoor environment that had provided them with many rich, hands-on experiences that they would never have had indoors. As the writer explored and discovered the out-of-doors with the students, it soon became evident that many trips to the school library were going to be necessary in order to answer the many questions the students asked. Leaf and tree identification, the names of birds, and cloud formations were just a few of the topics covered as a result.

To involve parents at home and as volunteers to foster an awareness of science in their children, the writer planned four workshops which were held every other month during implementation. These four workshops were held from 9:00 a.m. until 2:30 p.m. and again from 7:00 p.m. until 9:00 p.m. for the benefit of working parents. The central theme of each workshop focused on the importance of parents taking an active role in their child's education. At each workshop, the bilingual parent who had become instrumental to the success of the practicum, served as the translator for all Spanish speaking parents.

The first workshop was held the second month of implementation and focused on developmentally appropriate classroom practices so that parents would have a full understanding of teacher expectations for the students that would serve as a guideline for the parents who wished to evaluate their own expectations. The second workshop was held in the classroom during the fourth month of implementation so that parents could observe, first hand, the mechanics of the multidisciplinary approach as students learned cooperatively. It was explained to the parents that a central theme, based on specific science concepts, was being developed concurrently in each learning center. The parents were also able to observe the writer in the role of facilitator rather than teacher. The third workshop conducted during the sixth month of implementation focused on the value of parents reading to their children. The writer planned for the workshop to coincide with the city-wide "read in" program in which the mayor and many other community volunteers visited the city's schools and read to the students. The parents who volunteered to read in the writer's classroom chose books from a lending library the writer had established that included tapes, CDs, and videos that had science themes. After the "read in", all readers were invited to a reception which was very exciting for the parents who had the opportunity to meet socially with the mayor. The fourth workshop, held toward the end of implementation, was designed to give parents insight into ways to foster the development of science concepts in their children while using everyday materials found in the home to achieve that end. Parents were encouraged to chart and log their activities so that the whole family would become involved. Hand-outs were given to the parents. These hand-outs explained how to graph, chart, and log heights and weights, seeds from fruits and vegetables, and plant growth.

All of the workshops were directed toward parent input for the end of the year science fair in which they took an active part. The science fair, planned for the final week of implementation, actually became a part of a city-wide conference held in a large community center for the benefit of parents, teachers, and the community. Workshop topics included Special Education: Rights of Parents, Kindergarten Readiness, Technology and Basic Skills, Effective Communication, Leadership Development, Protection Against Disease, Early Intervention, Migratory Programs, Language Development, Displaced Homemakers, and Skills for Change and Family Development. Children who attended the conference were treated to face painting, a production of Jack and the Bean Stalk, a puppet show, a movie, a story hour, arts and crafts activities, snacks, and a community supper. Over fifty local businesses contributed prizes for the event.

From 12:00 p.m. until 7:30 p.m., the student's projects were on display. Many of the writer's students attended the conference so they were able to explain their projects and how they were created to the onlookers. In attendance was the bilingual parent who translated for

Spanish speaking parents. Projects in the fair included the bird feeders, wind socks, many of the plants grown in the classroom, charts and graphs depicting the student's heights and weights, number of seeds found in fruits and vegetables, and the barometer, rain gage, and weather vane from the classroom weather station. There were fifty projects in all. A clothespin art show depicted the projects created from natural materials.

During the science fair, the writer conducted four, hour long workshops on Science for Children with Materials Found in the Home. During these workshops, the special education teacher and the two assistants managed the science fair. All during the day, Channel 13 filmed the events which were aired as an hour long program a few weeks later.

Three dramatizations were directed by the writer at two month intervals during implementation. These dramatizations were presented on the stage in the auditorium for the benefit of the parents and the entire school. The first, an adaptation of Beatrix Potter's Peter Rabbit, was chosen because of the many science concepts the story contained. Kindergarten teachers were invited to participate with the preschoolers. One teacher responded. Those students sang a selection of songs about animals and the seasons before, during, and after the play. The art teacher made a computerized banner announcing the title of the play which was hung across the stage. Parents helped construct the costumes and donated props which were labelled in large print for the production so that students in the audience would have the opportunity to practice their reading skills. The plants used in the play were actual plants that the preschool students had grown in the classroom. Several of the bean plants had actually matured enough to have small beans on them. During the production, the audience observed living things and life cycles, natural materials, the effects of the seasons, and the physical properties of the props used. This production was filmed and aired on Channel 13, three weeks later.

The second dramatization, Children of the World, depicted the customs, costumes, and languages of the many different countries. Two kindergarten teachers joined with the preschool for this production. As a leader, the writer made many attempts toward school unity during the year. Creating and producing plays with other classes proved to be one of the most effective ways to achieve that end. For their part in the production, the preschoolers danced two ethnic dances in native costumes and signed as they sang songs about children in other lands. After the production, the parents offered an international luncheon.

The final production, I Spy, was a total preschool production done in mime and based on the student's experiences in the park. As the play opened, the stage was set for the fall season. A boy and girl entered the stage dressed in sweaters and Sherlock Holmes caps. They held magnifying glasses as they began to walk across the stage and examine the colorful construction paper leaves on the tree branches. Student "birds" flew across the stage as the boy and girl observed them and made notes in their notebooks. Student "frogs" hopped across the stage as the "squirrels" scampered for acorns. By the time the boy and girl had crossed the stage, the scene behind them had been changed, by the preschool stage hands to a winter scene. At the side of the stage, the boy and girl donned hats, gloves, scarves, and jackets for their trip back across the stage. As they walked, styrafoam packing snow began to fall. A fan produced the wind.

The trees were now bare as the boy and girl built a large snowman out of styrafoam balls and threw snow balls at each other. When they reached the side of the stage, the boy and girl shed their winter clothes to reveal their shirt sleeves and when they turned, there were paper flowers and green trees everywhere. They met couples in the park on this trip across the stage. The girls were dressed in dresses and matching hats made from brown, paper bags on which tissue paper flowers had been glued. They carried pocket books that matched their hats and dresses. The boys wore top hats, tuxedo jackets, and carried canes. The audience went wild when live rabbits, in cages, were carried onto the stage.

As the boy and girl made their final trip across the stage, they shed their shirts and pants to reveal bathing suits. On this trip, they met other children throwing balls, jumping rope, and hula hooping. They met a man selling balloons. As the play drew to a close, the boy and girl were doused with a bucket full of confetti water as were the students in the front row of the audience. As this occurred, all of the participants in the play came on stage to wish the audience a happy and safe summer vacation. This production was also aired on Channel 13.

Bimonthly field trips to farms, nature centers, and museums provided the students with the opportunity to pick apples and make apple cider, observe bees making honey, collect eggs from a chicken coop, discover the difference between mammals and birds, hold a live horseshoe crab, a starfish, and a clam and collect feathers from peacocks, phesants, and turkeys. The students observed a sheep being sheared and an Angora rabbit being combed and then, made yarn from the wool and the fur they had collected. They observed live reptiles, llamas, monkeys, and pot bellied pigs. Observing dinosaur bones was as awesome to the writer and the parents as it was to the students who stared in disbefief at the immensity of such creatures. A trip to the beach was another special experience as the students discovered seaweed, shells, and waves and saw tiny fish swimming near the water's edge. These field trips were made possible by parents who organized many fund raisers. For many of the parents who had no means of transportation to other communities, these trips were also meaningful and enjoyable experiences.

In creating a science environment that proved beneficial to the students and involving parents in the process, the writer realized that feelings of personal limitations experienced at the outset of implementation had disappeared. As the writer developed relevant concepts and created rich, hands-on indoor and outdoor science environments, it became apparent that adequate training was occurring as the writer dared to explore, discover, and problem solve with the students, first hand, and to continue to search the literature for even more creative ways to develop the science curriculum in order to derive the greatest benefits for the students. By changing the emphasis from fear of science activities gone awry and of giving incorrect information to developing learning partnerships with the students, the writer's confidence grew, thus creating a broader and more relaxed environment for concept development to occur.

In researching for ways to help parents on limited budgets find ways to foster science concept development in their children while using inexpensive materials found in the home, the writer realized that the same materials could be used in the classroom and that elaborate preschool science kits were not a predeterminant for a quality science curriculum. In focusing on outdoor science experiences, the writer was able to provide the students with many exciting opportunities to explore, discover, and problem solve in a natural environment. This proved to be the best possible way to alleviate the stress that all of the stakeholders felt in trying to overcome the limitations in the school environment. There , in the park, the students experienced a freedom of movement that would not have occurred in the confining environment of the small classroom. Full acceptance of the students' animated enthusiasm was another advantage that the outdoor environment of the park offered. In the end, it didn't matter that the school building had no convenient water source or that the wiring system was inadequate for science activities. In providing a science curriculum in which all students would benefit, the writer had circumvented those challenges.

As implementation of this practicum drew to a close, the writer was filled with a sense of accomplishment. In reviewing all of the many rich opportunities the students had to benefit from the science curriculum, the writer realized that the parents had been an integral part of making those opportunities possible through their volunteer efforts. In providing opportunities for the students to benefit from the science curriculum, all of the adults stretched and grew.

CHAPTER V

RESULTS, DISCUSSION AND RECOMMENDATIONS

Results

The problem in the writer's work setting was that preschool students were not benefiting from the science curriculum. The solution strategy was to develop an understanding of science concepts that would alleviate fear as the students made observations about living things and life cycles, natural materials, the seasons, and the physical properties of many objects. The writer also prepared indoor and outdoor environments for rich, hands-on learning. Indoors, a multidisciplinary approach was used to incorporate science into each of the learning centers. Involving parents at home and as volunteers in the classroom was a major strategy for this practicum so that the parents would become stakeholders in fostering an awareness of science as a daily living experience in their children. From the many science activities that the parents and students experienced, came many well done projects that built self-esteem and the opportunity for ownership.

The following is a composite picture of the expected outcomes and the actual results.

Outcome 1.

Out of 36 students, 31 will show that they are enthusiastic about science activities through a Checklist for Attitude. (See Appendix A).

Results of "Checklist for Attitude".

Out of 36 students, 30 showed an enthusiasm for science activities.

These results were reflected in four very shy students, two of whom were special needs students, one student who was excessively absent due to family conditions, and one student who had serious behavioral challenges.

Outcome 2.

Out of 36 students, 31 will show that they are using a science vocabulary in all disciplines through a Checklist for Vocabulary. (See Appendix B).

Results of "Checklist for Vocabulary".

Out of 36 students, 31 showed that they were using a science vocabulary in all disciplines.

Again, these results were reflected in six students who had to meet special internal challenges that affected their ability to perform.

Outcome 3.

Out of 36 students, 31 will show that they are contributing to the science corner through a Checklist for

Contributions to the Science Corner. (See Appendix C).

Results of "Checklist for Contributions to the Science Corner".

Out of 36 students, 32 showed that they were contributing to the science corner.

These results were reflected in the non-verbal, hands-on experiences offered to the students. Obviously, hands-on experiences produce positive results for student achievement.

Outcome 4.

Out of 36 students, 31 will show that they can explain simple science experiments conducted in the classroom through a Checklist for Explaining Science Activities. (See Appendix D).

Results of "Checklist for Explaining Science Activities".

Out of 36 students, 33 showed that they could explain the projects they had created.

These results were reflected in the pride and self esteem the students exhibited as a result of the projects they had created. Although outcome expectations were not met in "Attitude" and "Vocabulary", they were met in "Contributions to the Science Center". Expectations were exceeded in the students' ability to "Explain their Science Activities". The last two expectations involved a product for which the students could claim ownership.

Discussion

Much of the success of this practicum was contributed to the outdoor experiences the students had at the park and on field trips to farms, nature centers, and museums. The idea for extensive outdoor experiences came from Raze (1993) and Goff (1981) and Perry and Rivkin (1992) who expounded on all of the benefits children could derive from developing an affinity for science in an open environment. Another contributing factor was the open mind with which the writer dared to explore and discover science with the students rather than "teach" the concepts to them as suggested by Ziemer (1987). Because of the many outdoor experiences the students had that gave them the opportunity to explore and discover, the writer began to sense how confining a small classroom could be. Dighe (1993) wrote of this as an inhibiting factor in a child's conceptual development. Extending science concepts from the block corner to the park when developing concepts about inclined planes, levers, and wedges was an idea that worked for Lehman and Kandl (1992) and taking advantage of sand, rocks, trees, and water in a natural setting to introduce their physical properties was an idea that worked for Hill (1977). The writer did all of those things during implementation and observed the enthusiasm and the language development as the students went about their activities, and yet, the standard of achievement was not met for "Attitude" and "Vocabulary".

In interpreting the results of the outcomes, it appeared that the writer had chosen the proper course in focusing on outdoor experiences for the students during implementation, therefore, the fault had to lie in the items on the checklist. Items 7 and 10 under "Attitude" and items 8 and 10 under "Vocabulary" were obviously developmentally inappropriate if so few students met with success. The standard of achievement for outcomes 3 and 4, "Contributions to the Science Center" and "Explaining Simple Science Concepts" was met. Each of these outcomes included items that dealt with ownership and self-esteem and were appropriate for preschoolers, as Romjue (1992) suggested. With all of the precautions for creating a developmentally appropriate environment for students, the writer did not thoroughly examine the appropriateness of the items on the checklist

In summary, the practicum's success lies in the insight the writer has gained in helping students enjoy and benefit from the science curriculum while improving the students' knowledge and skills through many rich, hands-on experiences indoors and outdoors. That the writer's skills in developing a meaningful checklist need improvement is, at once, obvious. What is most important is that this practicum afforded all stakeholders many opportunities to grow and to learn while having fun.

Recommendations

1. The checklist should be revised to include items that

are more developmentally appropriate, Items such as, "Parents report that students are anxious to "spell" words related to science", are inappropriate.

2. Set realistic time frames for the more industrious projects in order to eliminate energy drains that affect all stakeholders.
3. Allowances should be made for weather conditions which can and do affect meaningful field trips.

Dissemination

During implementation, three preschool dramatizations, Peter Rabbit, Children of the World, and I Spy, were taped by Channel 13 and aired on Public Television. Each of these dramatizations focused on science concepts. Also taped and aired during implementation were the activities of a city-wide conference during which the writer and the writer's students presented four, hour long science workshops. The conference was held in a community center central to the city and was entitled, "Parents and Teachers United - Kids Learn". Along with the writer's workshop entitled, "Science for Children with Materials Found in the Home", were other workshops which included "Skills for Change and Family Development", "Kindergarten Readiness", and "Technology and Basic Skills".

To disseminate the results of this practicum among professional colleagues, the writer plans to have the four tapes edited and integrated into a workshop format.

Possibilities for workshop presentation include teachers' professional day workshops and the NAEYC National Conference. At present, the writer is rough drafting an article based on practicum results. This article will be submitted to journals and parents' magazines.

References

Andersen, H. O. (1994). Teaching toward 2000. The Science Teacher, 61(6), 49-53.

Awbrey, M. J. (1989). Humpty dumpty scrambled eggs. Science and Children, 27(1), 60-61.

Braun, A. M., & Braun, M. J. (1990). Five senses fun. Science and Children, 27(5), 44-46.

Carter, G. (1992). Students and chemistry - the perfect mix. Science and Children, 29(5), 27-29.

Collins, A., & Hastings, J. (1990). Practice what you teach. Science and Children, 27(6), 38-39.

Davis, L. C. (1994). The elements of science. The Science Teacher, 61(7), 18-21.

Dighe, J. (1993). Children and the earth. Young Children, 48(3), 58-63.

Dreyer, K. J., & Bryte, J. (1990). Slides, swings and science. Science and Children, 27(7), 36-37.

Freier, J. (1994). Getting started in cooperative group learning. Journal of the New England League of Middle Schools, 7(1), 8-11.

Galvin, E. S. (1994). The joy of the seasons: with the children, discover the joys of nature. Young Children, 49(4), 4-9.

Goff, P. (1981). Nature, children, and you. (rev. ed.) Athens, OH: Ohio University Press.

Hill, D. (1977). Mud, sand, and water. Washington, DC: NAEYC.

Holt, B. (1989). Science with young children. Washington, DC: NAEYC.

Howe, A. C. (1975). A rationale for science in early childhood education. Science Education, 59(1), 95-101.

Hyndman, L. (1991). A january spring. Science and Children, 29(3), 31-32.

Iatridis, M. (1981). Teaching science to preschoolers. Science and Children, 19(2), 25-26.

Karnes, M. B., Johnson, L. J., & Beauchamp, K. D. (1988). Enhancing essential relationships: developing a nurturing affective environment for young children. Young Children. 44(1), 58-65.

Lehman, J. R., & Kandl, T. M. (1992). Marvelous marbles. Science and Children, 30(2), 38-39.

Lindberg, D. H. (1990). What goes 'round comes 'round doing science. Childhood Education, 67(2), 79-81.

Martin, P. (1989). Bring out the scientist in your child. PTA Today, 14(7), 14-15.

McIntyre, M. (1984). Early childhood and science. Washington, DC: National Science Teachers' Association.

Misiti, F. L. (1993). A sense of science. Science and Children, 30(4), 28-30.

National Association for the Education of Young Children. (1986). NAEYC position statement on developmentally appropriate practice in early childhood programs serving children from birth through age 8. Young Children, 41(6), 3-11.

Newport, J. F. (1991). Striving for clarity. Science and Children, 29(1), 41-43.

Pearlman, S., & Pericak-Spector, K. (1992). Expect the unexpected. Science and Children, 30(2), 36-37.

Perry, G., & Rivkin, M. (1992). Teachers and science. Young Children, 47(4), 9-16.

Raze, R. E. (1993). Springtime science. Science and Children, 30(7), 26-27.

Riley, M. C., & Coe, D. L. (1992). Whole language activities for the primary grades. New York: Prentice Hall Book Distribution Center.

Romjue, M. K., & Clementson, J. J. (1992). An alternative science fair. Science and Children, 30(2), 22-24.

Rossman, A. D. (1993). Managing hands-on inquiry. Science and Children, 31(1), 35-37.

Simpson, R. D., & Oliver, J. S. (1990). A summary of major influences on attitude toward and achievement in science among adolescent students. Science Education, 74(1), 1-18.

Smith, R. F. (1987). Theoretical framework for preschool science experiences. Young Children, 42(2), 34-39.

Tolman, M. N., & Campbell, M. K. (1989). What are we teaching the teachers of tomorrow? Science and Children, 27(3), 56-59.

Wolfinger, D. M. (1982). Effect of science teaching on the young child's concept of piagetian physical causality: animism and dynamism. Journal of Research in Science Teaching, 19(7), 595-602.

Ziemer, M. (1987). Science and early childhood curriculum: one thing leads to another. Young Children, 42(6), 44-51.

APPENDIX A

CHECKLIST FOR ATTITUDE

CHECKLIST FOR ATTITUDE

Standard of achievement is 8 out of 10

1. Students create unsolicited art work that depicts science concepts concerning animals and life cycles, natural materials, seasons, and physical properties of objects. ______
2. Students eagerly request rereadings of books in science library. ______
3. Students encourage classmates to participate in classroom science activities. ______
4. Students readily discuss science activities. ______
5. Students ask many questions about science activities. ______
6. Students rush to be first at the onset of a new science activity. ______
7. Students are still working on their activity after the activity is over. ______
8. Students carry science concepts across all disciplines. ______
9. Parents report an observed interest in science concepts. ______
10. Parents report an observed student desire to visit nature centers on family outings. ______

APPENDIX B

CHECKLIST FOR VOCABULARY

CHECKLIST FOR VOCABULARY

Standard of achievement is 8 out of 10.

1. Students use words that relate to living things. ______
2. Students use words that relate to life cycles. ______
3. Students use words that relate to natural materials. ______
4. Students use words that relate to seasons. ______
5. Students use words that relate to physical properties of objects. ______
6. Sentences become more complex as student comprehension of science concepts grows. ______
7. Students desire to be the "teacher" to explain science concepts to classmates. ______
8. Scribble stories begin to relate to science concepts. ______
9. Parents report students are using words at home that relate to science concepts. ______
10. Parents report that students are anxious to "spell" words related to science. ______

APPENDIX C

CHECKLIST FOR CONTRIBUTIONS TO SCIENCE CENTER

CHECKLIST FOR CONTRIBUTIONS TO SCIENCE CENTER

Standard of achievement is 8 out of 10.

1. Students show a genuine interest in indoor science center. ______
2. Students show a genuine interest in outdoor science center. ______
3. When given a choice, students opt for the science center. ______
4. Students are adept at sorting and classifying objects at science center. ______
5. Students "overstay" their turn in the science center. ______
6. Students show an interest in objects that classmates contribute to the science center. ______
7. Students encourage classmates to opt for the science center. ______
8. Students show pride when their contribution is made to science center. ______
9. Parents report student interest in collecting objects for the science center. ______
10. Parents report student awareness of the difference between the indoor and outdoor science centers. ______

APPENDIX D

CHECKLIST FOR EXPLAINING SCIENCE ACTIVITIES

CHECKLIST FOR EXPLAINING SCIENCE ACTIVITIES

Standard of achievement is 8 out of 10.

1. Students can convey to teacher what they have done and how they did it at the conclusion of any science activity. ______
2. Students can explain contributions to science center and what it has to do with science. ______
3. Students can convey to classmates the essence of science concepts concerning living things. ______
4. Students can convey to classmates the essence of science concepts concerning life cycles. ______
5. Students can convey to classmates the essence of science concepts concerning natural materials. ______
6. Students can convey to classmates the essence of science concepts concerning the seasons. ______
7. Students can convey to classmates the essence of science concepts concerning physical properties ______
8. Students can explain science project while being video taped for "science fair". ______
9. Parents report understanding concepts being demonstrated in class due to clarity of student explanation. ______

10. Parents report student enthusiasm in explaining science concepts to others ______