PRESCHOOL AND KINDERGARTEN CHILDREN'S RETENTION OF ENERGY CONCEPTS AS MEASURED BY A PRESCHOOL TEST OF ENERGY INFORMATION

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PREFACE

This study is concerned with obtaining base data regarding the educating of young children about energy and its use and the evaluating of such instruction. The primary objective is to determine whether a formal testing instrument will indicate that energy information will be retained by preschool and kindergarten children or will tend to disappear with time.

I wish to express appreciation to my major advisor, Dr. Frances Stromberg, for her guidance throughout this study. Appreciation is also extended to other committee members, Dr. Kathryn Castle and Miss Leone List. A special note of appreciation is offerred to Dr. David Fournier as a committee member for his invaluable assistance in the utilization of computer statistical programs and for his helpful suggestions concerning form.

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CHAPTER I

EDUCATING YOUNG CHILDREN ABOUT ENERGY

The major goal of this research project was to obtain information about educating young children about energy and its use. This thesis will describe findings related to that major goal and a critical analysis of such instruction based upon the use of a formal testing instrument used as evaluation.

Introduction

In our modern world energy has assumed a major role in our lifestyles. It is a basic component of all goods and services, since it is used directly in manufacturing, transportation and housing and is used indirectly in the conduct of business, education and public services (Shelley, 1982) as well as being a component of many leisure activities. Indeed, our lifestyles in America have for years been built around the premise that energy resources are both abundant and inexpensive (Paolucci, 1978). Yet even though the standard of living to which the majority of Americans adhere is supported by vast expenditures of energy, the resources that provide that energy are finite (Zielinski and Bethel, 1983).

In North America the switch to fuel oil and natural gas from coal as a major energy source has made us dependent upon such outside suppliers as Libyan, Venezuelan and Arabian oil fields. Even prior to the 1973 energy crisis, energy conservationists were warning that political unrest makes these sources unsuitable (Sale and Lee, 1972). Shelley (1982) has pointed out that dependence upon imported oil places a dangerous constraint upon foreign policy, exacerbates inflation while increasing unemployment, reduces our standard of living and increases the social and economic gaps between the poor and the wealthy. In addition, the past two years have indicated an increasing danger of military confrontation in the mid-east with American involvement.

Canada, the United States and Venezuela now account for about 85% of the Western hemisphere's production of needed gas and oil, yet some energy advisors believe that they will be producing only 60% to 70% of their current levels of conventional oil and natural gas recovery by the year 2000. Even though such experts believe that other Mexican and South American reserves exist, these can probably only be recovered by highly aggressive energy exploration programs (Fisher, 1982) and will not contribute to the energy independence of the United States.

Conservative environmentalists posit that the quantity of energy available may, in the long run, prove much less important than where and how this energy is obtained. They suggest that depleted reserves and environmental concerns will force industrialized nations to an energy transition that will reshape the world--just as the shift to coal from wood in Europe at the beginning of the Industrial Revolution altered society (Hayes, 1978). Such a theoretical position suggests that we should concentrate energy research on innovative source technology. More optimistic scientists believe that the "...key to energy independence is an increase in the efficiency with which we use energy..." (Shelley, 1982, pp. 42-43). This stance, of course, implies that we concentrate on educating the public in energy use as well as improve the design of energy consuming goods, homes, etc.

As "...large and complex as the subject may be, an understanding of energy is critical to coping with the future..." (Fowler, 1983, p. 37). Our only certainty is that the energy sources of the future will probably not be inexpensive and will require careful decision making upon the part of all citizens.

Statement of the Problem

Since the very basis for our democracy is a citizenry able to make informed and independent choices and since the use of energy will continue to be critical to the well-being of our society, we should begin to educate young children in energy concepts.

Helping future citizens learn how to best use available energy and how to make good energy decisions can be a role of the early childhood educator. Children who do not learn to make reasoned choices during the early years may be at a disadvantage for the rest of their lives (Banks and Clegg, 1977). Children are never too young to learn more about the problems of the environment and how they themselves can effect change (Education USA, 1971).

Although the energy crisis has been with us for a decade, Fowler (1983) points out the attention to the issue has fluctuated between hysteria and complacency. Home economists have indicated that home economics research focused on the attitudes and the perceptions of the public toward the energy situation indicates widespread skepticism about the severity of energy shortages (Rudd, 1978). Approximately half of American citizens express disbelief in an energy crisis (Morrison, Gladhart, Zuiches, Keith, Keefe and Long; 1978). Until the public perceives energy as a critical social issue, informed decisions will not be made.

Schools can serve as the locus for society's transformation from an apathetic to an informed citizenry. Home economists have pointed out that our values are shaped by the resources available as well as our perceptions of how such resources should be allocated. They state that we can continue to make haphazard energy resource decisions; we can have rigid, highly controlled energy decisions made for us out of economic necessity; or, we can increase our individual responsibility for making informed choices (Paolucci, 1978). As Rudd (1978, p. 25) has stated,

"...people can hardly be expected to conserve (energy) without knowing how to do it...."

Children who begin in kindergarten today to acquire such basic energy knowledge as practical conservation practices are more likely to assume such responsibility and to make informed choices as adults. They can learn foundational concepts such as energy transfer. They can begin to be aware of the variety of energy sources. They can acquire vocabulary related to energy concepts. They can, in short, begin to have a foundation of learning upon which to build a construct of knowledge.

It is important, however, that teachers know what kind of information has been absorbed and retained by the child before additional concepts are introduced. That is, the teacher must be aware of whether prerequisite knowledge has been acquired before introducing other concepts. Although traditionally early childhood teachers have used informal evaluations in preschool settings, in the public schools it becomes imperative in some instances to be able to demonstrate with formal instruments the level of understanding of kindergarten youngsters--although the good teacher of young children will continue to use informal observation as a major source of evaluation.

Thus, in addition to using a curriculum unit of study and an evaluative instrument specifically designed for young children, it is important for teachers to know what concepts have been retained by the youngsters prior to the introduction of additional concepts. This implies that we must know how much information young children are able to retain over a period of time following initial introduction of an energy curriculum unit.

Purpose of the Study

The purpose of this study was to provide some base data regarding information about energy, energy sources and energy uses possessed by young children prior to and after the introduction of a unit of study on energy. Little research has been done in this area, and few curriculum guides exist that are appropriate for use in early childhood centers.

The study was a five-group design utilizing local preschools and kindergarten classes in Stillwater, Oklahoma. Two of the groups were control groups, while the other three groups were presented with a teaching unit about energy with Energy: A Curriculum Unit for Three, Four and Five Year Olds (Diener, Jettinghoff, Robertson and Strickland; 1982) developed at The University of Alabama. All five school settings participating in the study follow the traditional curriculum of an early childhood center.

The testing instrument used in the study to evaluate the children's retention of energy information was also developed at The University of Alabama (Strickland, Robertson, Jettinghoff and Diener; 1981). This instrument was used at The University of Alabama in the preschool laboratory with a test-teach-test research design (Strickland, Robertson, Jettinghoff and Diener; 1984). Since no control groups were used in the Alabama study and since no follow-up study has been done, one of the purposes of the current study was to provide more information about the effectiveness of introducing energy concepts in a teaching unit with young children as measured by the Preschool Test of Energy Information.

The current study utilized the Preschool Test of Energy Information to measure the information already acquired by young children without the intervention of a teaching unit as well as provided a temporal element. That is, two of the groups were subjected to a time delay prior to a formal posttest evaluation. The design was intended to determine whether treatment (i.e., teaching of an energy unit) would produce short-term effects which would tend to disappear with time. In addition, an effort was made to determine whether males and females indicated similar pretest and posttest scores as measured by the Preschool Test of Energy Information.

Hypotheses

Specifically, the following hypotheses have been developed for this study:

1. The pretest scores of children as measured by the Preschool Test of Energy Information will show no significant difference among the five classrooms.

2. There will be no significant difference between the pretest scores and posttest scores of males and females as measured by the Preschool Test of Energy Information.

3. There will be a significant improvement in the posttest scores among children taught an energy curriculum unit using Energy: A Curriculum Unit for Three, Four and Five Year Olds as measured by the Preschool Test of Energy Information.

4. There will be no significant difference in the posttest scores among classrooms taught an energy curriculum unit of study as measured by the Preschool Test of Energy Information.

Assumptions and Limitations

During this study, it was assumed that the teachers would cooperate fully and their teaching philosophies and methods would be consistent. Several limitations existed for the conclusions of this study. The conclusions were limited to children who: are four to six years of age; attend early childhood education programs staffed by professionally trained teachers; possess normal physical and mental characteristics.

Conceptual Terms

In the current study, several terms were used that may require some explanation for the reader to more fully understand the meaning of the author. These conceptual terms have been listed below with an explanatory note for each.

1. Energy Education was intended to convey the deliberate teaching to children concepts about sources and uses of power in today's society for heating and cooling homes, for transportation needs, for recreational use, for electrical needs in homes and businesses. The term was also used to imply that food is a chemical source of energy.

2. Energy Conservation was intended to convey those methods used to prevent the wastage of power provided by natural resources as well as the methods that can be used to provide the most efficient use of power in society.

3. The scale Totscore was comprised of all 42 test items in the Preschool Test of Energy Information as a test score with all items equally weighted. A child's test score would therefore be additive for correct responses with the highest possible score of 42.

4. The subscale Conserv was composed of those test items in the Preschool Test of Energy Information that dealt with practices promoting energy conservation and wise energy use. The subscale was comprised of 10 of the 42 test items, and these test items were designated by the researcher. Test items employing such terms as <u>least</u> or <u>most</u> were included as indicating amount of energy wasted or conserved. A score on the subscale Conserv was additive with a highest possible score of 10.

5. The subscale Vocab was composed of those test items in the Preschool Test of Energy Information that contained

vocabulary dealing with understandings of energy source or energy use such as gasoline. The subscale was composed of 14 test items designated by the researcher and was additive. The highest possible score was therefore 14.

6. The subscale Ensourc was composed of 18 test items on the Preschool Test of Energy Information designated by the researcher as dealing with the the sources of energy power. These included wind as a power source, petroleum as a power source, water as a power source as well as electrial power. The test items dealing with food as a source of human energy were also included in this category. The score for Ensourc was additive with a highest possible score of 18.

7. The subscale Enuse was composed of 14 of the 42 test items on the Preschool Test of Energy Information. The items were designated by the researcher as dealing with use or non-use of energy power. The score on Enuse was additive with a highest possible score of 14.

CHAPTER II

REVIEW OF THE LITERATURE

Former presidential science advisor Lee A. Dubridge has suggested that environmental and energy education should span the entire academic career from kindergarten through high school and then be continued into adulthood (Education USA, 1971). Even though specialists have indicated an increasing urgency that all of us understand the realities of the energy situation and learn to use energy wisely, there continue to be few teaching resource guides on energy available to teachers of young children (UNESCO, 1977). More importantly, although human developmentalists agree that concrete activities are the optimal method for young children to acquire basic concepts, many currently available curriculum guides that do include kindergarten as a grade level dictate inappropriate worksheets or abstractual material for child use as a major means of instruction.

While many energy concepts such as nuclear fusion are too abstract for introduction to kindergarten children, they are not too young to begin acquiring a foundation of basic energy information and vocabulary (Diener et al.; 1982). Seefeldt (1980) has said that it is unfortunate that while many teachers of young children feel comfortable working in the area of natural science and while appropriate materials for such instruction are usually readily available, when it comes to concepts about energy, teachers may shy away. She has suggested that even though we use electricity and other forms of energy daily, many of us have incomplete concepts about these forces. Such feelings of inadequacies may limit the experiences teachers provide children.

Seefeldt (1980) has also pointed out that young children cannot easily handle abstractions---and energy is certainly an abstract concept---but that we must begin to introduce basic science concepts in a form the child can relate to his daily world. Others also have argued that, despite its abstraction, the subject of energy and energy use can and should be a part of the curriculum for young children. Hymes (1974) has stated that in every field, there are foundational learnings that are appropriate for early beginners' learnings:

> There are highly specific, advanced, more technical and detailed learnings of the "graduate" student---in swimming and in the humanities and mathematics and the sciences and the social sciences. Three, four and five year olds study Anthropology, Arithmetic, Arts, Astronomy---right on down through the Z's. And they will learn as much as a three, four or five year old can learn in one year (pp. 120-121).

Craig (1966) has given guidelines he feels that teachers should use in introducing science to children. He says that learnings should be built around seven basic conceptions of science relating to time; space; energy, motion and change; adaptation; variety; interrelationship or interdependence; and equilibrium and balance. He has suggested that teaching of content is not an end in itself, since science facts are so easily outdated and since it is far more important how the child thinks about science in his world. Such key concepts, stated Craig, can be used again and again as the child progresses through the grades. They give teachers a framework for planning experiences.

Bruner (1965; 1979) has also suggested the use of repetitious exposure to science themes as a means of helping the child build upon basic concepts that are difficult to learn. Prestigious scholars, scientists and educators who met at Woods Hole to discuss the problem of improving the dissemination of scientific knowledge in the primary and secondary schools called for the implementation of what Jerome Bruner at that meeting dubbed the spiral curriculum (Bruner, 1965). He held that any subject can be taught effectively to any child at any stage of development and that the early teaching of science should be designed for teaching such subjects with scrupulous intellectual honesty. He asserted that schools may be wasting precious years by postponing the teaching of many important subjects on the grounds that they are too difficult, but that the difference should be in degree and not kind.

According to those attending the Woods Hole Academy of Sciences meeting of 1959, as a child progresses through the primary grades he should be exposed to basic ideas repeatedly in order to build upon them, and that later presentations are more powerful because of the child's early experiences with the subject or idea (Bruner, 1965). Professor Inhelder of Geneva stated that teaching basic ideas in science and mathematics to young children can lay a groundwork in the fundamentals, and that such early learnings have the effect of making later learnings easier (Bruner, 1965).

Tyler (1977) also advocated the teaching of concepts built around basic themes or elements. He stated that the use of an organizational element such as the idea of the interdependence of living things can help to tie the learnings together in the curriculum structure. International specialists meeting at the United Nations Conference on Human Environment in Stockholm stated that we should encourage the teaching of ecological interdependence, including the use of energy resources, in the modern world for all age levels (UNESCO, 1980).

Researchers have also suggested that it is imperative that we begin to teach young children concepts about energy use and the conservation of natural resources in order to protect future society. Some have stated that science education should incorporate environmental awareness and the consequences of depleting sources of energy into all age and grade levels (UNESCO, 1980). Others have stated that the most urgent task educators face today is helping students to clarify society's values toward the use of natural resources supplying energy and to develop an environmental ethic (Education USA, 1971). Hymes (1974) and LeVasseur (1979) have suggested that we must decide what kind of environment we want in the year 2001 A.D. and that we must provide society-centered programs for young children, since schooling is one means of providing resourceful and courageous problem-solvers for tomorrow's society. Frazier (1970) also advocated the teaching of science concepts early so that children will grow up helping to resolve the conflict between economic growth and damage from such growth. Braun and Wilson (1978) have also given arguments for the teaching of energy education to preschoolers and primary grade children. They have stated that children should be a potential target audience for such education because they are developing the values, attitudes and behaviors that can promote the long-term wise use of energy.

Different methods of implementing environmental education---or, education that includes energy use and energy source as a part of an instructional umbrella such as environmental education---have been tried with young children. Innovative approaches to energy education have included a two-day conference with four and five year olds to learn what energy is, how it works, and to devise methods they themselves could use to conserve energy (Hankla, 1975). Songs, stories, activities and discovery learnings provided the vehicle for concepts at the conference for preschoolers, but such a method of teaching is not feasible for instruction of all children since it entailed transport of the youngsters from a distance---in itself an energy inefficient practice---and served only a limited number of children.

More children could be reached by receiving instruction through the public schools, but unfortunately there appear to be few resources for teachers to use in teaching energy concepts to young children. A National Education Association survey of elementary school teachers asked what kind of assistance they most needed in order to develop such programs, and a majority replied the development of appropriate curriculum plans or guides (National Education Association, 1970). In 1975 the Federal Energy Administration sponsored regional hearings to learn what schools were teaching about energy and what needs schools might fill, and educators responded overwhelmingly that there was a need for the development of educational curriculum (Niedermeyer and Roberson, 1979). They said there were no materials and no programs. Buethe (1979) has stated that energy education materials vary widely in quality and that many are "...ill-conceived, opportunistic, untested..." and that "A lot of what is happening is hype, public relations, and self-serving noise..." (pp. 163-164).
He stated that energy education is still poorly defined and that while people are rushing to do something, many large energy education projects have had little leadership from experienced teachers or from experts in energy content.

Nevertheless, Buethe (1979) urged that quality programs with background information for teachers be made available, since his findings indicated that energy literacy among teachers is low.

Part of the problem, of course, is <u>who</u> writes such curriculum guides. For example, one federally funded project to write such guides for grades kindergarten through twelve consisted of a writing team composed of eight elementary school teachers and seven secondary school teachers, none of whom was professionally trained in early childhood education (Edmonds School District 15, Lynnwood, Washington; 1973). What should be kept uppermost in mind is that the proliferation of such guides is not helpful if they are not designed with the learning modes of the young child uppermost in mind. Biber, Shapiro and Wickens (1971) point out that it is fruitless to introduce energy information with methods that are beyond the child's level of mastery. Curriculum guides that are not appropriate in the early childhood center are useless to the preschool or kindergarten teacher, and while such guides may be adopted by school boards and presented to the public as the real curriculum, in actuality they will have little impact upon what is really going on in classrooms. The teacher is the key to science instruction in the classroom (Helgeson and Stake; 1978) and the ultimate curriculum planner (Saylor, 1982). If the curriculum guides that form the reservoir upon which the teacher must draw do not meet her needs, it must be remembered that the teacher has a high degree of control in planning curriculum (Saylor, 1982). In other words, if the guide is garbage the teacher will not use it regardless of the expense in its production.

A review of existing guides purported to be designed for use in teaching energy concepts to kindergarteners or preschoolers reveals a great many guides were produced following the period following the oil embargo of 1973. A number were produced with federal grants. The state of Wisconsin produced several guides for various grade levels under different curriculum topics such as music, art and environmental education (Project I-C-E, Green Bay, Wisconsin; 1974). One of these guides suggested for use with kindergarteners supposedly deals with twelve basic energy concepts. Among activities suggested for the child are the making of snowflake patterns, the making of a model of the child's neighborhood and the production of conservation posters. A suggested teaching aid directs the classroom teacher to collect pictures of dried riverbeds. While it is not the intent of this paper to evaluate teaching guides, it could be suggested that the average kindergarten or preschool teacher might find it difficult to collect such pictures even should she have access to specialized publications. She should find it even more difficult to find a five year old capable of producing a three-dimensional model of his neighborhood.

Many guides produced in various areas of the country do not inspire greater confidence. One guide listed as an activity for the child to draw pictures within a space approximately two square inches in size, and other suggested activities revolved around listing, drawing, discussing or completing worksheets (Ward, 1973). Other guides that lack discovery learning opportunities or opportunities for child-child interaction suffered from the similar handicap of being produced for multiple grade levels (Brennan, 1982; Allen and LaHart, 1977; Payne, 1981; Smith, Crocker and DeRose, 1975; Oklahoma State Department of Education, n.d.). Even when designated for use limited to kindergarten, curriculum guides dealing with energy concepts often used teacher questions and teacher demonstrations as the major method of learning (Walter, Pech and Stein; 1967).

Some guides designed for primary grades use more activities that are child-centered. Pohlman (1980) authored an energy conservation activity packet for lower primary grades that included concrete activities for the classroom. In addition, it offered suggestions for home contacts regarding concepts and listed those concepts that would be covered in upper grade levels. Herrington and Robbins (1964), Braun and Wilson (n.d.) and Diener et al. (1982) also produced guides for the primary grades with concrete activites listed and suggestions for interaction with the home.

Four guides designated for use with young children have also developed a test for evaluation of instruction. Smith et al. (1975), Brennan (1982), Niedermeyer and Roberson (1979) and Strickland et al. (1981) have developed methods for evaluating the effectiveness of energy instruction to young children. The evaluative method advocated by Smith et al. (1975) directs the teacher to evaluate student knowledge by having each child complete a checklist, name correct responses or draw correct responses. No scoring method is given with the evaluation for the teacher to use. Brennan (1982) lists twelve questions the teacher is to ask the child as a means of evaluation for the teaching unit. The questions include listing things which store energy, how clothing keeps a child warm, why children get tired, etc. Responses therefore require a high degree of verbal ability. Niedermeyer and Roberson (1979) have designed a thirty-item pretest and a thirty-item posttest that require about thirty minutes to complete. A checklist is also completed by the child. The test designed by Strickland et al.(1981) is non-verbal and includes visual cues. Unlike the other three tests, the Strickland test was designed for preschool and kindergarten aged children rather than primary grades.

Mares (1978) designed a testing instrument for the primary grades that also concerns environmental education and has been suggested for use with a teaching unit. Both the learning materials and test were a part of a project to increase children's awareness of litter and environment. The evaluation was based on questionnaires completed by teachers, observations made in classrooms, discussions with teachers and children as well as a series of tests administered to the children. Mares reports a significant improvement in the posttest scores of children who completed the environmental unit.

Summary

Since all our lives are and will continue to be affected by the use people make of energy resources, we must begin to discuss issues related to energy and energy use in the classrooms in order to prepare future citizens for decision making. Seefeldt (1980), Hymes (1974), Bruner (1965; 1979), Craig (1966), Braun and Wilson (1978), and Strickland et al. (1984) have suggested that such education begin with young children. Few teaching guides exist that are based upon the premises that children learn best through first-hand experiences, by manipulating materials and by discussing what is happening as it takes place (Buethe, 1979; Strickland et al., 1984; UNESCO, 1977). Guides developed for kindergarten and primary grades that comply with such criteria include those authored by Braun and Wilson (n.d.), Herrington and Robbins (1964) and Diener et al. (1982). Strickland et al. (1981) have developed the only known test for evaluation of kindergarteners and preschoolers for energy education.

CHAPTER III

METHODS AND PROCEDURES

The primary goal of the described study was to assess whether energy could be used as a topic in the science curriculum with kindergarten and nursery aged children. A subgoal was to assess the effectiveness of the Preschool Test of Energy Information (Strickland et al.; 1981) as a means of measuring children's energy knowledge. The methods and procedures for this research project were selected to minimize the influence of the person administering the test, reduce any possible stress on the young subjects, and evaluate the effectiveness of the curriculum unit of study by using a formal testing instrument designed for use wih young children.

Subjects

The subjects for the current study were kindergarten and nursery aged children in Stillwater, Oklahoma. These children were chosen since the primary goal of the study was to determine whether children in this age group can retain information about energy and energy use when taught as a science unit. Stillwater is a city of approximately 50,000 residents and is the site of one of the two major State universities in Oklahoma. Oklahoma State University has many graduate students from other countries whose children attend public and private schools in the city.

The subjects for this study included five and six year old children enrolled in Westwood Elementary School in the public school district of Stillwater, Oklahoma; four and five year old children enrolled in the Oklahoma State University Preschool Laboratories; four and five year old children enrolled in the First Presbyterian Church Preschool in Stillwater, Oklahoma; and, four and five year old children enrolled in the First United Methodist Church Preschool of Stillwater, Oklahoma. These children were primarily from middle class socioeconomic homes and represented a variety of nationalities and cultural backgrounds. All of the children spoke English. There were five groups of subjects with approximately 20 children in each group. There were a total of 54 male and 43 female children.

Design of the Study

The study was designed to utilize five classrooms. All five classes received the pretest in order to establish whether there was a difference among the groups of children as to the extent of existing energy information. Of these five groups, one group responded to the pretest only and another group was again tested after a three week period with no intervening teaching. This posttest information allowed the researcher to determine to what degree the test itself allowed learning to take place.

The three remaining groups of children comprised the classes that were actually taught the three-week energy unit of study using a curriculum guide developed at The University of Alabama (Diener et al.; 1982). One class was taught and immediately received a posttest using the Preschool Test of Energy Information (Strickland et al.; 1981) to measure learning that took place. A second class was taught and was subjected to a three-week delay before receiving a posttest; the third class was subjected to a six-week delay of the posttest. Those groups receiving delayed posttesting were then compared to the posttest scores of the class undergoing no delay in order to determine whether the children indeed retained the energy information. The taught classes were then compared to the group receiving no instruction to determine whether an improvement in test scores occurred.

The reader may refer to Table I for a visual representation of the five-group design. Note that pretest and posttest scores for each class are designated by subscript notation. Each class would therefore have a score for the pretest, as Score 1_1 and Score 2_1, etc. The four classes receiving a posttest would also have a score for the posttest, as Score 1_2 and Score 2_2, etc. Therefore, Score 1_1 would refer to the first of the classes and to the pretest scores of that class, whereas Score 1_2 would refer to the

TABLE I

RESEARCH CONDITIONS DELINEATION

Research Conditions	Classes				
	Class 1	Class 2	Class 3	Class 4	Class 5
Pretest	Score 1_1	Score 2_1	Score 3_1	Score 4_1	Score 5_1
Teaching of a three-week Energy Curriculum Unit	*	*	*		
Posttest (Three weeks after pretest)			Score 3_2	Score 4_2	
Posttest (Six weeks after pretest)	Score 1_2				
Posttest (Nine weeks after pretest)		Score 2_2			

first of the classes and the posttest scores of that class.

The classroom environment for all children consisted of the traditional early childhood setting, with an emphasis upon self-selection of activities and child-child interaction as opposed to teacher-directed activities and formal instruction. All classroom teachers have degrees in Family Relations and Child Development with teaching certificates in Early Childhood Education. Teachers who participated in the instructional portion of the program had similar professional backgrounds, experience and educational philosophies. These early childhood centers are viewed by the teachers as emotionally supportive settings that aid the young child in the transitional progression from the home to the more socially complex environment of a primary classroom. Indeed, the primary purposes of the early childhood center are viewed by the teachers as a means to ease the entry into group settings and to allow the child to learn to relate to others.

The primary means of instruction in early childhood centers is viewed by the teachers as informal play in which the children are able to select from a variety of activities. Careful planning occurs that will enhance positive social interaction between child-child and teacher-child. Exploratory behavior within classroom guidelines is encouraged, and it is viewed as a means of discovery learning. The opportunity for the child to repeat activities in different locations and/or with different media is considered essential.

Instrumentation

The testing and instructional program utilized an existing formal instrument to test for energy information and an existing curriculum guide designed for use with young children. The instrument used as a means of assessment of the children's understanding of energy and its use was the Preschool Test of Energy Information developed at The University of Alabama Child Development Laboratory (Strickland et al; 1981). This instrument consists of 42 items using pictorial representation and concrete objects which the child identifies nonverbally as the answer of his choice. The test is designed to be administered individually and requires approximately ten minutes to complete. A copy of the test questions is provided as Appendix C.

Correct responses for the 42 items on the Preschool Test of Energy Information were calculated for the pretests and the posttests administered to the children. The test items were equally weighted, resulting in a possible score of 42. These total scores comprise the scale Totscore used for the pretest and posttest.

In addition, test questions were assigned by the researcher to four subscale categories. These are refered to as Conserv, Ensourc, Enuse and Vocab in the accompanying tables and discussion. The total scores on the subscales for both pretests and posttests were also calculated.

The subscale Conserv consisted of 10 of the 42 test items that dealt with conservation of energy. Subscale Enuse dealt with the use of energy and consisted of 14 items. The category Ensourc was composed of 18 test items that related to the source of various types of energy. The fourth subscale was Vocab and consisted of 14 test items that contained specific words, such as gasoline, that relate to energy concepts. Some test items appeared within more than one subscale, but all items were equally weighted. Therefore, it should be noted that the total score for the test instrument cannot be obtained by adding the subscale scores. The reader may refer to Table II for a listing of the test items that are included in each subscale.

Reliability of the Preschool Test of Energy Information

The original study conducted at The University of Alabama (Strickland et al.; 1984) used a split-half method of assessing reliability of the Preschool Test of Energy Information. The authors in the Alabama study reported a reliability coefficient of 0.86. A need was indicated by the authors for further analysis of the test.

Therefore in the current study the Preschool Test of Energy Information (Strickland et al.; 1981) was subjected to a reliability analysis using the reliability subprogram of the $SPSS^x$ computer package (SPSS Inc.; 1983). The RELIABILITY command of the $SPSS^x$ package was used to perform

TABLE II

TEST ITEMS COMPRISING SUBSCALES

Scale	Test Items	Total Number of Test Items Comprising Scale
Conserv	3, 5, 7, 9, 12, 17, 18, 20, 24, 32	10
Enuse	1, 4, 6, 15, 19, 21, 23, 28, 30, 31, 33, 38, 39, 40	14
Ensourc	2, 8, 10, 11, 13, 14, 16, 22, 25, 26, 27, 29, 34, 35, 36, 37, 41, 42	18
Vocab	2, 8, 10, 11, 14, 15, 16, 18, 25, 27, 29, 40, 41, 42	14

an item analysis on the components of each additive scale, and this procedure computed Cronbach's alpha. The RELIABILITY command was also used with the SPLIT subcommand. The SPLIT model partitioned the variables in each scale into two subsets. The sum was computed for each subset and the reliability calculations made use of only the information contained in the two sums for each case. The RELIABILITY command with the SPLIT subcommand therefore calculated the correlation between the two sums and gave the Spearman-Brown split-half coefficient and the Guttman split-half coefficient as well as a coefficient alpha for each part. These split-half alpha models were selected since the original study utilizing the Preschool Test of Energy Information employed a split-half method of evaluating test items for construct validity (Strickland et al.; 1984). The reliability analysis was obtained using a total of 166 cases in the current study.

Sequence of Instruction

Following the administration of the pretest, a teacher in the Oklahoma State University Pre-Kindergarten Laboratory and a kindergarten teacher in the public school system introduced a three-week unit of study about energy and its use. The curriculum guide used as a basic means of instruction was <u>Energy: A Curriculum Unit For Three, Four and Five Year Olds</u> (Diener, Jettinghoff, Robertson and Strickland; 1982). All of the teacher-made materials suggested in the curriculum guide for use in the unit of study were produced by the researcher to ensure uniformity of media. This unit of study was presented to three of the five groups of subjects.

One of the five groups of children received no posttest. One of the groups of children was again tested with the Preschool Test of Energy Information three weeks after the administration of the pretest but received no instruction on the unit of study. Another group of children, following the unit of study, received posttests at the completion of the unit. A fourth group of subjects received the posttest, but this testing was delayed a three-week period after the conclusion of the unit of study. The fifth group of subjects also received delayed posttesting, and they were tested six weeks following the conclusion of the unit of study. This control-group time-series design has been suggested by Isaac and Michael (1982) as a means of determining whether treatment is a short-term influence which will tend to disappear with time.

Data Collection

The pretests and posttests were administrated by a graduate research assistant in Family Relations and Child Development during the fall of 1983. The graduate assistant was trained in the administration of the test. All tests were conducted by this single individual to ensure, insofar as possible, a common testing procedure. The tests were administered in a secluded area of each childhood center---but no child was removed from the familiarity of his classroom. Responses were recorded on a specially designed data collection coding sheet, and a sample of this coding sheet is provided in Appendix D.

Statistical Procedures

One of the goals of this research project was to determine whether a formal test designed for use with preschool and kindergarten children would indicate a significant improvement in test scores following a teaching unit about energy. The teaching unit employed a curriculum guide also developed for use with this age group (Diener et al.; 1982). The primary goal was to ascertain whether such an improvement was a short-term effect or whether delayed testing would indicate a similar increase in test scores. In addition, the researcher hoped to determine whether gender was a factor in such test scores.

The ONEWAY command of the $SPSS^x$ package (SPSS Inc., 1983) was used to test for one-way analysis of variance. The ONEWAY command was used with subcommands of RANGES and CONTRAST to test for trends across the groups of children. The CONTRAST subcommand provided an A Priori contrast of groups. Output included the value of the contrast, the standard error of the contrast, the *t* statistic, the degrees of freedom for *t*, and the two-tailed probability of *t*. The test designated under the RANGES subcommand was TUKEY, which provided data on honestly significant differences between groups with 0.05 as the alpha value. The RANGES test produced multiple comparisons of scores between all groups using the Student-Newman-Keuls procedure to calculate multiple range tests. This information was used to compare the pretest scores of groups of children as well as the posttest scores of children in classes taught an energy unit of study with posttest scores of the control group.

The ANOVA command (SPSS Inc., 1983) was also used for an analysis of variance of the factor of classroom assignment upon the total scores in each scale. This information was used for a comparison of the pretest scores of children by classroom assignment.

The T-TEST command of $SPSS^{x}$ (SPSS Inc., 1983) was used to compare the effect of gender upon pretest and posttest scores of the children. T-TEST calculated the Student's $\underline{t}$, degrees of freedom, and two-tailed probability for a comparison of means. That is, it tested for the significance of the difference between male children and female children on the pretest and posttest scores of each scale.

CHAPTER IV

RESULTS OF THE STUDY

The major goal of this study was to determine whether a test designed for young children would indicate an improved performance among preschool and kindergarten children following the introduction of a teaching unit about energy and whether the effects of such a unit of study would tend to disappear with time. In addition, an attempt was made to determine whether males and females differed in test scores. The results of the study were based upon 97 preschool and kindergarten children in five classrooms in Stillwater, Oklahoma. The results of the study confirmed in a statistical sense those hypotheses stated in Chapter I.

Reliability of the Testing Instrument

The Preschool Test of Energy Information (Strickland et al., 1981) was subjected to a reliability analysis using the RELIABILITY subprogram of the SPSS^{x} computer package (SPSS Inc., 1983). The Cronbach's alpha was computed, and the equal-length Spearman-Brown and the Guttman split-half models were also obtained. The testing instrument was subjected to a split-half method since the original study at The University of Alabama used a split-half method of evaluating the test items for construct validity (Strickland, Robertson, Jettinghoff and Diener; 1984). The reliability analysis was obtained using a total of 166 cases.

The Cronbach's alpha for Totscore was 0.81, the Guttman split-half alpha was 0.81 and the equal-length Spearman-Brown split-half was 0.81. These results differ from the reliability coefficient of 0.86 reported by Strickland et al. (1984), and such a difference is probably attributable to the more rigorous test of construct validity to which the test was subjected in this study. However, both findings tend to support the overall reliability of the testing instrument.

The subscale Conserv had an alpha of 0.43, with 0.45 for the Guttman split-half model and 0.46 for the equal-length Spearman-Brown split-half model. The alpha for the subscale Enuse was 0.63, with 0.63 for the Guttman and 0.64 for the equal-length Spearman-Brown split-half models. The subscale Ensourc indicated an alpha of 0.68, with 0.75 and 0.76 for the Guttman and the equal-length Spearman-Brown split-half models. The subscale Vocab indicated an alpha of 0.55, 0.56 for the Guttman split-half model and 0.58 for the equal-length Spearman-Brown split-half model. Thus, three of the four subscales appear to be a reliable measure of energy information when using a general cutoff point of 0.55 as suggested by Nunnally (1959). The reader may refer to Table III for a review of the reliability coefficients for the

TABLE III

RELIABILITY OF TESTING INSTRUMENT AND SUBSCALES

Scale	Cronbach's Alpha	Guttman's Split-Half Alpha	Equal-Length Spearman-Brown Alpha
Totscore	0.81	0.81	0.81
Conserv	0.43	0.45	0.46
Enuse	0.63	0.63	0.64
Ensourc	0.68	0.75	0.75
Vocab	0.55	0.56	0.58

scale Totscore and for the subscales Enuse, Ensourc, Conserv and Vocab.

An analysis of the individual items comprising the Preschool Test of Energy Information indicated that not all items were a reliable measure of such information, in that they do not correlate well with other test items. Test items numbered 12, 28 and 35 have negative correlation with the other test items and negatively affected the reliability of the instrument. For this reason, future work with this instrument should consider eliminating or revising those items.

Comparison of Pretest Scores

All children in the five classrooms were given a pretest during the fall of 1983. The average for Totscore (i.e., the average score on the 42 items comprising the Preschool Test of Energy Information) among the 97 children taking the pretest was 24.2. A comparison of the average scores among the five classes for Totscore and for the subscales Conserv, Enuse, Ensourc and Vocab on the pretest may be obtained by viewing Table IV.

An analysis of variance of these mean scores indicates no significant difference at the 0.05 level among the pretest scores of the five groups of children on the scale Totscore for the Preschool Test of Energy Information. This offers support for the first hypothesis given in Chapter I, that the children in all five classes began with essentially

TABLE IV

COMPARISON OF PRETEST SCORES FOR ALL CLASSES

	Pretest Scores												
	Score 1[1]		Score 2[1]		Score 3[1]		Score 4[1]		Score 5[1]				
Scales	$\bar{X}$	sd	$\bar{X}$	sd	$\bar{X}$	sd	$\bar{X}$	sd	$\bar{X}$	sd	F Ratio	Probability of F	
Totscore	23.1	4.2	25.1	7.3	24.8	5.2	25.2	4.8	22.9	6.0	1.25	0.29	n.s.
Conserv	3.4	1.5	4.3	2.1	3.5	1.5	3.9	1.3	3.3	1.5	2.43	0.05	
Enuse	7.9	2.2	8.6	2.8	9.1	2.6	8.9	2.0	7.6	2.0	0.90	0.47	n.s.
Ensourc	11.9	2.1	12.3	3.6	12.3	2.4	12.4	2.8	12.0	3.7	0.42	0.79	n.s.
Vocab	10.2	1.6	10.4	2.7	9.7	1.9	10.3	1.5	9.5	2.4	1.39	0.24	n.s.

the same amount of energy information prior to the beginning of the energy unit of study. However, while there is no significant difference between pretest scores in the five classes on the subscales designated by the researcher as Enuse, Ensourc and Vocab, there is a significant difference between the five classes on the subscale Conserv at the 0.05 level.

Comparison of Test Results by Gender

There were 54 males and 43 females participating in the study. The average total score among males on the pretest was 24.2 and among females was 24.1. The comparison of pretest scores by gender for Totscore and the subscales may be seen in Table V. The reader will note that there was no significant difference among the pretest scores on Totscore or the subscales by gender at the 0.05 level.

The average gain in posttest scores did not differ significantly at the 0.05 level when scores were compared by gender. The average posttest score for Totscore among males was 29.8. The average posttest score for Totscore among females was 29.6. The average Totscore for all children on the posttest (i.e., even including those children who did not receive instruction in an energy curriculum unit of study) was 29.7, with an average gain of 5.5 points from the pretest. A comparison by gender on Totscore and the subscales Conserv, Enuse, Ensourc and Vocab for the posttest scores of the children on the Preschool Test of Energy

TABLE V

COMPARISON OF ALL PRETEST SCORES BY GENDER

	Gender						
	Male		Female				
Scales	$\overline{X}$	sd	$\overline{X}$	sd	t Value	Probability of t	
Totscore	24.2	6.1	24.1	5.1	0.04	0.97	n.s.
Conserv	3.6	1.5	3.7	1.8	-0.27	0.79	n.s.
Enuse	8.4	2.4	8.3	2.3	0.04	0.96	n.s.
Ensourc	12.2	3.3	12.1	2.5	0.20	0.85	n.s.
Vocab	10.3	2.2	9.6	2.0	1.65	0.10	n.s.

Information may be seen in Table VI. There is therefore support for the hypothesis given in Chapter I that no significant difference would be shown between scores of males and females on the pretest or posttest scores on the Preschool Test of Energy Information. A comparison of pretest and posttest scores of youngsters indicated that gender was not a factor in the use of the evaluative instrument.

Pretest Versus Posttest Comparisons

Three groups of children were taught an energy unit of study using the energy curriculum guide. One group of children were not taught an energy unit of study but were again posttested three weeks after the pretest. A comparison of the pretest and posttest scores for Totscore and the subscales Conserv, Enuse, Ensourc and Vocab may be obtained by viewing Table VII and Table VIII.

The reader will note in Table VII that children instructed in energy concepts using the energy curriculum guide gained an average of 6.1 points on the posttest, for an average posttest score on the scale Totscore of 30.4 as measured by the Preschool Test of Energy Information. Information obtained through the TUKEY and ANOVA subprograms of the $SPSS^x$ computer assisted statistical analysis (SPSS Inc., 1983) indicates that there was a significant difference between pretest scores and posttest scores in all three classes instructed in the energy unit of study. The

TABLE VI

COMPARISON OF ALL POSTTEST SCORES BY GENDER

	Gender						
	Male		Female				
Scales	$\overline{X}$	sd	$\overline{X}$	sd	t Value	Probability of t	
Totscore	29.8	5.0	29.6	4.7	0.14	0.89	n.s.
Conserv	4.9	1.7	5.0	2.2	-0.25	0.81	n.s.
Enuse	10.5	2.4	10.1	2.3	0.71	0.48	n.s.
Ensourc	14.3	2.3	14.4	1.6	-0.24	0.81	n.s.
Vocab	11.6	1.7	11.2	1.7	0.95	0.35	n.s.

TABLE VII

COMPARISON OF PRETEST AND POSTTEST SCORES FOR CHILDREN TAUGHT AN ENERGY UNIT OF STUDY

	ANOVA Pretest vs. Posttest								A Priori Contrasts			
	Pretest			Posttest								
	Score 1_1	Score 2_1	Score 3_1	Score 1_2	Score 2_2	Score 3_2			Scores $1_1+2_1+3_1$	Scores $1_2+2_2+3_2$		Prob. of
Scales	$\bar{X}$	$\bar{X}$	$\bar{X}$	$\bar{X}$	$\bar{X}$	$\bar{X}$	F Ratio	F Prob	$\bar{X}$	$\bar{X}$	t Value	t Value
Totscore	23.1	25.1	24.8	30.6	32.6	28.6	6.99	0.0001	24.3	30.4	6.04	0.0001
Conserv	3.4	4.3	3.5	5.2	6.0	4.8	4.88	0.0001	3.7	5.3	4.85	0.0001
Enuse	7.9	8.6	9.1	10.8	10.9	10.1	4.89	0.0001	8.5	10.6	4.75	0.0001
Ensourc	11.9	12.3	12.3	14.7	15.2	13.7	4.08	0.0002	12.1	14.5	4.71	0.0001
Vocab	10.2	10.4	9.7	11.5	12.1	10.9	3.52	0.0009	10.1	11.5	3.86	0.0001

TABLE VIII

COMPARISON OF POSTTEST SCORES OF CHILDREN

	Posttest scores								Score Comparisons Using Tukey; * = P < 0.05					
	Score 1_2		Score 2_2		Score 3_2		Score 4_2							
Scales	$\overline{X}$	sd	$\overline{X}$	sd	$\overline{X}$	sd	$\overline{X}$	sd	1_2 vs 2_2	1_2 vs 3_2	2_2 vs 3_2	3_2 vs 4_2	2_2 vs 4_2	1_2 vs 4_2
Totscore	30.6	3.0	32.1	4.8	28.6	4.7	27.4	5.8				*	*	*
Conserv	5.2	1.8	6.0	1.8	4.8	1.9	3.9	1.3				*	*	*
Enuse	10.8	1.5	10.9	2.3	10.1	2.7	9.6	2.7				*	*	*
Esourc	14.7	1.5	15.2	2.2	13.7	1.6	13.7	2.3					*	*
Vocab	11.5	1.6	12.1	1.6	10.9	1.7	11.1	1.8					*	*

significant difference was shown in all five of the scales.

By referring to Table VIII the reader will also note that there was a significant difference between posttest scores of children not instructed in the energy unit of study when compared with the posttest scores of children taught the energy unit as measured by the Preschool Test of Energy Information. Such a significant difference was also indicated in four of the subscales between two instructed classes when compared with the control group and in two of the subscales of one instructed class when compared with the control group. This would offer support for the hypothesis given in Chapter I that a significant improvement could be shown on the Preschool Test of Energy Information posttest scores among those children who were instructed with the energy curriculum guide.

Comparison of Posttest Scores

Four of the five groups of subjects received posttesting, although one of the four groups received no instruction in the energy unit of study. This group was again tested three weeks following the pretest. The purpose of such retesting in this control group was to determine whether the scores would change without benefit of instruction. As stated above, a comparison of posttest scores of instructed children and the control group may be obtained by viewing Table VIII.

A comparison of posttest scores of children taught an energy unit of study indicated no significant difference among scores of instructed children on the Preschool Test of Energy Information even when such posttesting was subjected to delay. There was also no significant difference between the average posttest scores of instructed children on any of the five scales regardless of which classroom the children attended during the energy unit of study. This would offer support for the hypothesis given in Chapter I that there would be no significant difference among the posttest scores of classrooms taught an energy unit of study. That is, children continue to demonstrate improved test scores following the energy unit of study even when such testing is delayed.

CHAPTER V

SUMMARY

The major purpose of this study was to provide some base data regarding energy information possessed by young children prior to and following the introduction of an energy unit of study. A curriculum guide about energy and a formal testing instrument to measure energy information, both designed for use with young children, were used to determine whether the effects of a teaching unit about energy would tend to disappear with time. In addition, an attempt was made to determine whether the testing instrument indicated an improved performance among children taught an energy unit and whether a difference existed between the scores of males and females.

Methods of the Study

The subjects for the study were 97 children, from four through six years of age, enrolled in the Pre-Kindergarten at the Oklahoma State University Child Development Laboratories, two Westwood Elementary School kindergarten classrooms, the First United Methodist Church Preschool, and the First Presbyterian Church Preschool of Stillwater, Oklahoma. There were 54 males and 43 females in the study.

A formal instrument designed to measure the amount of energy information possessed by young children was used to measure the amount of information prior to the introduction of a teaching unit about energy and energy use. The test was administered to each child by a single individual as a pretest and, following the introduction of a teaching unit about energy and energy use to three groups of subjects, as a posttest. Both the test and the curriculum guide about energy were developed at The University of Alabama.

The teachers involved in the teaching of the three-week energy unit of study were a kindergarten teacher in the Stillwater Public Schools and the lead teacher, graduate assistant and student teachers in the Pre-Kindergarten at Oklahoma State University Child Development Laboratories.

Results of the Study

An analysis of the reliability of the formal testing instrument using the assistance of a commercially available computer package indicated that three of the 42 test items were not a reliable measurement of energy information. Overall reliability of the testing instrument based upon 166 cases indicated a Cronbach's alpha of 0.81. The Guttman's alpha using the split-half method was 0.81, and the equal-length Spearman-Brown alpha was 0.81 using the split-half method.

An analysis of variance among the five classes on the pretest indicated no significant difference at the 0.05

level on the total scores for the 42 test items. However, a significant difference was found between classes on Conserv, one of the four subscales designated by the researcher. Thus, support for the first hypothesis, that the children in all five classes began with essentially the same amount of energy information, is offered but with the above reservation. A comparison by gender on the pretest and posttest scores indicated no significant difference at the 0.05 level, thus offering support for the hypothesis that gender is not a factor in the use of the evaluative instrument.

The pretest and posttest scores of the three classes taught an energy unit of study and of the group of children pretested and posttested but not instructed were compared. It was found that a significant difference existed between the three instructed groups and the control group on the Preschool Test of Energy Information. A significant difference existed on all four of the subscales designated by the researcher when two of the instructed classes were compared with the control group. A significant difference existed on two of the four subscales when one of the instructed classes was compared with the control group. Thus, support was found for the hypothesis that a significant improvement would be shown on the posttest scores of classes taught a unit of study about energy.

There was no significant difference found between the average posttest scores of taught classes. That is, even classes receiving delayed posttesting had average posttest scores that did not differ significantly from those of instructed youngsters posttested immediately after being taught an energy unit of study. Thus, support was also found for the hypothesis that there would be no difference among the average posttest scores of classes taught an energy unit of study. The results of the current study would tend to indicate that young children do indeed retain information gained from an energy unit of study.

An increasing interest in evaluation of educational programs as shown by demands for schools to justify their actions has created an increasing number of conferences, workshops, professional development programs, etc., that range from single classroom activities to statewide programs in order to provide public and/or professional accountability. The demand for quantitatively measurable proof should not force kindergarten or preschool teachers to distort their programs by concentrating on the few areas for which tests exist. At the same time, the teacher unfamiliar with all areas of science should not avoid the teaching of basic science concepts because she fears they will be too difficult for her or for her students. The kindergarten or primary teacher is frequently unencumbered by a mandated teaching syllabus, but she must not avoid her responsibility to provide the young child in her charge with the foundational science concepts. The results of the current study indicate that young children are quite capable of beginning to acquire an understanding of energy.

Recommendations for Further Research

This study indicated that children appear to retain information concerning energy and energy use as measured by a formal testing instrument even when subjected to a delayed posttest. Based upon the findings of this study the researcher makes the following recommendations for future research:

1. Conduct a similar study but delay the posttesting by a longer period of time.
2. Attempt to evaluate the results of a unit of study confined to within-classroom instruction to the results of a unit of study incorporating contact with parents and home.
3. Attempt to define those elements dealing with conservation that are included in the Preschool Test of Energy Information. It is suggested that a factorial analysis be completed on test items.
4. Because some test items were revealed in the current study to be unreliable measures of the energy information possessed by young children, further study should be made in an attempt to refine or eliminate those items.

Finally, the researcher would wish to encourage teachers to become more involved in the processes of planning, conducting and documenting curriculum evaluations and to actively participate in the development of teaching guides to be used with young children.

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APPENDIXES

APPENDIX A

CORRESPONDENCE

August 16, 1983

Ms. Faye Ann Presnal, Director
First United Methodist Church Preschool
400 West Seventh
Stillwater, Oklahoma 74074

Dear Ms. Presnal:

This is to confirm our conversation this date in which you stated that your morning prekindergarten program of four and five year olds would be able to participate in the research study on young children's concepts of energy and energy use that will form the basis of my master's thesis. As I said, the children in your class would be the control portion of the study and would be tested on their concepts of energy using the Strickland Preschool Test of Energy Information.

As I explained, the children will be tested individually using picture cards and concrete objects. The test takes approximately ten minutes to complete. A graduate student in Family Relations and Child Development from Oklahoma State University will administer the test. At this time the testing period for your preschool is scheduled for the week of October 17 through October 21. Should these dates be unacceptable to you for any reason I would appreciate your letting me know as soon as possible.

I would be most happy to provide examples of the testing materials for your parents to examine, should they care to do so, and as you suggested will provide an explanation of the study for your parent bulletin board. The parental permission forms will be delivered to you sometime after the beginning of the school term, and your assistance in collecting these will be greatly appreciated.

I thoroughly enjoyed talking with you and am looking forward to working with you. I want to thank you again for agreeing to participate in this study. I believe that it should prove very interesting, especially in view of the fact that so little research has been done in this area. Should you or your parents have any further questions, please do not hesitate to contact me at 377-5316.

Sincerely,

Linda Rhoten
2919 North Monroe
Stillwater, Oklahoms 74075

August 14, 1983

Ms. Leone List, Director
Oklahoma State University Preschool Laboratories
Oklahoma State University
Stillwater, Oklahoma 74078

Dear Ms. List:

This letter is to request the participation of the Oklahoma State University Preschool in a research study on young children's concepts of energy and energy use. This study will form the basis of my master's thesis in Family Relations and Child Development.

I have discussed the research design with Dr. Frances Stromberg, who suggested that I contact you regarding utilization of the children in Mrs. Janet Gambill's prekindergarten group at OSU. In order the complete the study, Mrs. Gambil's children would be pretested using the Strickland Preschool Test of Energy Information. A unit of study would then be presented to the children using a curriculum guide developed at the preschool laboratories at The University of Alabama. Following the end of the unit, the children would again be tested.

The children would be tested individually using picture cards and concrete objects. The test takes approximately ten minutes to complete and will be administered by a graduate student in Family Relations and Child Development. The pretest for Mrs. Gambill's group is scheduled for the week of September 26 through September 30. The unit of study is scheduled for the period of time beginning October 3 and ending October 21. The posttest is currently scheduled for the week of October 24 through October 28. Should this schedule be inappropriate for any reason, please contact me as soon as possible.

During the last school year I discussed with Mrs. Gambill the possibility of using her youngsters as a part of the study, and she seemed most agreeable to participating. Naturally, I am aware of the task I am asking of her and of course I am most grateful to have her cooperation.

You may have questions and as I am anxious to complete the schedule for the study, I would appreciate meeting with you as soon as possible.

Sincerely,

Linda Rhoten
2919 North Monroe
Stillwater, Oklahoma 74075
(377-5316)

April 22, 1984

Mrs. Martha P. Strickland
The University of Alabama
Department of Human Development and Family Life
P. O. Box 1488
University, Alabama 35486

Dear Mrs. Strickland:

I wanted to thank you for taking the time to let me know that the energy research article has been published. I know you and your staff are pleased.

You will be interested in knowing that the data for my research project was collected during the fall. There were a total of five classes participating in the project with approximately 20 students in each class. All of the children have a profile similar to the study conducted at Alabama: some children are from other cultures, the youngsters range in age from about four to six years of age, and the teachers are child development graduates.

I am in the process of completing statistical information and at this time plan to submit my thesis to my committee for summer graduation. It is somewhat difficult to teach kindergarten full-time while writing a thesis and visiting the computer center, and I am hoping that the ability to devote more time during the summer will expedite my project.

Thank you again for your interest and your encouragement. I shall be anxious to see what you think of the results of the study done in Oklahoma.

Sincerely,

Linda Rhoten
2919 North Monroe
Stillwater, Oklahoma 74075

August 16, 1983

Dear Parent:

As a graduate student in Family Relations and Child Development at Oklahoma State University, I am conducting a study of young children's concepts of energy and energy use. Although it has been a decade since the energy crisis, very little research has been done in the area of children's understanding of energy. Although some teaching materials have been developed for upper grades, virtually none have been designed for preschool and kindergarten youngsters.

The study that I am planning will use a curriculum guide and preschool test developed at The University of Alabama Preschool Laboratory. Using this unit of study and test, I hope to discover what kinds of information preschool and kindergarten children have concerning this important element of their world.

The curriculum guide is especially designed to assist teachers in locating media and developing material to use with young children in learning more about energy. The test is also designed for three, four and five year olds. The test uses picture cards and concrete objects, and it is individually administered to the child in approximately ten minutes.

Five groups of children in local preschools and kindergartens will participate in the research study. Three of the groups will have a teaching unit about energy and will then be tested to evaluate the effectiveness of the unit. Two of the groups of children will be a control to the study, and these children will take the test to see how much information young children already know about energy without having a special unit taught in their school. The timing of the tests is an important part of the research design, since we also hope to discover how much information young children are able to retain about such a complex subject over a period of time.

I feel that it is important that we learn how to begin teaching children at an early age to be aware of energy sources and energy usage, since they will be the decision makers of tomorrow. I am deeply appreciative of the children, early childhood educators and parents who are helping to make this study possible. Should you have questions, please do not hesitate to contact me at 377-5316.

Sincerely,

Linda Rhoten
2919 North Monroe
Stillwater, Oklahoma 74075

August 14, 1983

Ms. Holly Hartman, Director
Presbyterian Church Pre-School
524 South Duncan
Stillwater, Oklahoma 74074

Dear Ms. Hartman:

This is to confirm our conversation this date in which you stated that your afternoon preschool program of four and five year olds would be able to participate in the research study on young children's concepts of energy and energy use that will form the basis of my master's thesis. As I said, the children in your class would be the control portion of the study and would be tested on two separate occasions using the Strickland Preschool Test of Energy Information.

As I explained earlier this year, the children will be tested individually using picture cards and concrete objects. The test takes approximately ten minutes to complete. A graduate student in Family Relations and Child Development from Oklahoma State University will administer the test. At this time the pretest period for your preschool is scheduled for the week of October 31 through November 4, and the posttest period is scheduled for the week of November 28 through December 2. Should these dates be unacceptable to you for any reason, I would appreciate your letting me know as soon as possible.

I would be most happy to provide examples of the testing materials for your parents to examine, should they care to do so, and you may also be interested in seeing the curriculum guide that will be used in my own classroom as a part of the study. The parental permission forms will be delivered to you sometime after the beginning of the school term, and your assistance in collecting these will be greatly appreciated.

If you or your parents have any further questions, please do not hesitate to contact me at 377-5316. I want to thank you for agreeing to participate in this study. I believe that it should prove very interesting, especially in view of the fact that little research has been done in this area.

Sincerely,

Linda Rhoten
2919 North Monroe
Stillwater, Oklahoma 74075

APPENDIX B

PARENTAL PERMISSION FORM

Consent for Participation in Research Activity
and Release of Information

Date: ____________________

I hereby voluntarily consent to the participation of my child named ____ as a subject in a study about preschool and kindergarten children's understanding of energy. As a subject, my child will spend approximately ten minutes using small toys and picture cards of objects that use energy. I agree that this procedure does not constitute a violation of my child's personal rights or welfare. I understand that strict confidentiality and complete anonymity will be preserved of all data collected as a result of my child's participation in this study.

Signed: ____________________________
(Parent or guardian of minor child)

APPENDIX C

PRESCHOOL TEST OF ENERGY INFORMATION

ENERGY TEST FOR 3, 4 and 5 YEAR OLD CHILDREN

DIRECTIONS FOR ADMINISTERING TEST:

Have everything ready.

Administer individually.

Say: We are going to play a game. You sit here (indicate one side of table) and I will sit over here (opposite side of table). I am going to show you some cards with four pictures on each card. When I ask you a question about the pictures I want you to point to the one you think is the best answer. Let's try one.

(Place sample card in front of child.)

Say: This card has four different pictures. (Point to each picture individually.)

Say: Tell me what this is.

Say: Now I want you to point to the picture of someone driving a car. (Be certain they understand the directions before continuing. Praise correct responses.)

Say: Now we are going to do the same thing with the other cards.

1. Point to the picture where energy is being used.
2. Point to the picture of what can heat a house.
3. Point to the picture where energy is being saved.
4. Point to the picture where energy is being used.
5. Point to the picture where energy is being wasted.
6. Point to the picture where the <u>most</u> energy is being used.
7. Point to the picture where energy is being saved.
8. Point to the picture of the object that uses fuel energy.
9. Point to the picture where the <u>most</u> energy is being used.
10. Point to the picture of what can be burned to give off energy.
11. Point to the picture of the thing you can burn to make heat energy.
12. Point to the picture where energy is being saved.
13. Point to the picture of something that gives your body energy.
14. Point to the picture of the thing that uses gasoline as energy.
15. Point to the picture where fuel energy is not being used.
16. Point to the picture of the thing that uses gasoline as energy.
17. Point to the picture where someone is wasting energy.
18. Point to the picture where fuel energy is being saved.
19. Point to the picture where the <u>least</u> energy is being used.
20. It is cold outside. The heat is on inside. Point to the picture where someone is wasting energy.
21. Point to the picture of the person using the most energy.
22. Point to the picture of the thing that gives energy.
23. Point to the picture where energy is being used.
24. Point to the picture of the person who is saving energy.
25. Point to the picture of the thing that uses gasoline as energy.
26. Point to the picture of the thing that gives energy.
27. Point to the picture of something we can burn to make heat energy.
28. Point to the picture where water is being used as energy.
29. Point to the picture of something that gives your body energy.
30. Point to the picture where energy is being used.
31. Point to the picture of the prrson using the <u>most</u> energy.
32. It is cold outside. The heat is on inside. Point to the picture where erengy is being wasted.
33. Point to the picture where energy is being used.

Say: Now we are going to try something different. (Place card No. 34 in front of the child. Have picture No. 34, 35, 36 and 37 included. Show to the child one at a time.)

Say: I have a picture of a sailboat.

34. Point to the picture of the thing that gives energy to the sailboat.

Say: I have a picture of an electric fan.

35. Point to the picture of the thing that gives the fan energy and makes it move.

Say: I have a picture of a person.

36. Point to the picture of the thing that gives the person energy.

Say: I have a picture of a fire engine.

37. Point to the picture of the thing that gives the fire engine energy and makes it go.

Say: I am going to place four objects in front of you and ask you to pick one of them up.

Say: Here is a turtle, a book, an electric food mixer and a ball. (Place each object in front of the child as you name it.)

38. Point to the object that uses energy to make work easier.

Say: Thank you.

Say: Now I am going to change some of them. Here is a book, a pen, a ball and a piece of coal. (Name each object as it is placed before the child.)

39. Point to the object that is used as fuel to make energy.

Say: Thank you.

Say: Let's change them again. Here is a lightbulb, the turtle, the ball and the pen. (Name each object as it is placed before the child.)

40. Point to the object that can give off heat energy.

Say: Thank you.

Say: I will remove all of these and place a jar of oil, a jar of catsup, a jar of coke and a jar of sand here. (Place each jar as named.)

41. Point to the one that fuel energy comes from.

Say: Thank you.

Say: I am going to change more of these. I will leave the sand and the catsup and add a jar of water and a jar of cereal. (Place as named.)

42. Point to the one that electrical energy comes from.

Say: Thank you.

Objects:

1. turtle
2. book
3. electric food mixer
4. ball
5. pen
6. piece of coal
7. lightbulb
8. jar of oil
9. jar a catsup
10. jar of coke
11. jar of sand
12. jar of water
13. jar of cereal

APPENDIX D

DATA COLLECTION SHEET

____________________ Child's Name

____________________ School

____________________ Date of test

____________________ Test

____________________ Child's ID

____________________ Date of Birth

____________________ Gender

1		22	
2		23	
3		24	
4		25	
5		26	
6		27	
7		28	
8		29	
9		30	
10		31	
11		32	
12		33	
13		34	
14		35	
15		36	
16		37	
17		38	
18		39	
19		40	
20		41	
21		42	

VITA

Linda Sue Rhoten

Candidate for the degree of

Master of Science

Thesis: PRESCHOOL AND KINDERGARTEN CHILDREN'S RETENTION OF ENERGY CONCEPTS AS MEASURED BY A PRESCHOOL TEST OF ENERGY INFORMATION

Major Field: Family Relations and Child Development

Biographical:

Personal Data: Born in Fort Worth, Texas, October 26, 1942, the daughter of William George and Johnnie M. Gwaltney.

Education: Graduated from R. L. Paschal High School, Fort Worth, Texas, in May, 1961; attended the University of Texas at Austin 1961-1963; received Bachelor of Science degree in 1979 from Oklahoma State University, Stillwater, Oklahoma, with a major in Family Relations and Child Development; completed requirements for Master of Science degree at Oklahoma State University in December, 1984.

Professional Experience: Graduate Teaching Assistant, Oklahoma State University Child Development Laboratories, 1979-1980; Teacher of kindergarten at Westwood Elementary School, Stillwater, Oklahoma, 1980-1985.