AN EVALUATION OF THE OKLAHOMA STATE ENERGY AWARENESS PROGRAM AT THE SEVENTH GRADE LEVEL

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PREFACE

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CHAPTER I

INTRODUCTION

The word "energy" has different meanings to different people, in terms of basic concepts as well as specific definitions. To a person living in a developing country energy as a concept involves a more basic awareness than it does to someone living in an industrialized nation. Developed societies historically have had energy available in so many advanced forms and in such abundance that it has been taken for granted.[1, 2]

Definitions of the term energy will also vary according to the perspectives of the person doing the defining. The consumer views energy as a deliverable product such as coal, wood, natural gas, electricity, gasoline, or fuel oil. The nutritionist thinks of energy in terms of food energy or calories. The scientist defines energy in relation to the natural or thermodynamic laws, or as the capacity to do work. The engineer describes energy by using it in formulas to define power, force, or efficiency.[3]

However one defines it, energy is the most basic natural resource upon which man depends, and he has used it since his beginnings on this planet. What was once a basic prerequisite for man's subsistence and survival has eventually evolved into, at least for some societies, a resource that can be used to control man's surroundings and provide leisure, travel, and relaxation time.[4] Industrialized man became so far removed from the traditional constraints of his energy resources that in his "good life" of cheap and abundant energy he viewed his energy supplies as endless.[5]

A new era of energy utilization for both the developing and developed countries has been gradually unfolding over the past several decades that recognizes finite limits to energy resource consumption.[6, 7] Modern man tended to forget just how finite any resource can be until the lifeblood of the industrialized nations--petroleum--began to be reduced due to the 1973-1974 Arab oil embargo.[8] A sudden awakening to the energy crisis jolted the developed countries, including the United States, into the realization that what was so recently an energy prosperous nation could quickly become an energy impoverished one.[9, 10]

How did such a critical turnaround occur? Briefly stated, the underlying causes of the energy crisis inolved the fundamentals of any resource: demand, supply, and costs. When the demand for energy, particularly oil, began to outstrip a dwindling supply, a higher value (costs) was placed upon the resource. And the recent drastic increases in energy resource prices are the most visible factors in the overall energy picture.[11]

The seriouness of the energy situation has not diminished enough since the initial crisis period began a decade ago to let us go back to our pre-embargo patterns of consumption.[12] Indeed, international tensions resulting from the recent conflicts and civil wars in the oil rich Middle-East are indications that energy supply problems can occur again, perhaps leading to a major confrontation between superpowers.[13] What former President Carter termed the "moral equivalent of war" could conceivably turn into a real war. President Reagan stated that he will commit the U.S. military to ensure that strategically located petroleum bottlenecks such as the Straits of Hormuz or the Trans-Arabian pipeline are kept in operation.[14, 15]

The history of natural resource utilization in the recent past provides an ominous precedent for the future. The overt action plunging America into World War II involved a U.S. oil embargo partially precipitating a violent reaction by Japan; the attack on Pearl Harbor soon followed.[16, 17]

> Wars, including the Franco-Prussian Wars and World War II, have been at least partially caused by the demand for limited energy resources. The distribution of wealth and power is increasingly related to the existence and control of energy.[18]

The recent energy resource and distribution problems took many years to develop, and it will take many years to find long term energy solutions.[19] As Caldwell[20] stated it:

> No lasting solution to the energy problem can be found within the confines of policies concerned only with energy _per se_. The proper context for a national policy for energy is the broader field of social, economic, and environmental policy with reference to the quality of life (p. 221).

The evolution of new energy technologies takes time.[21] In the interim period, the adoption of energy conservation as a social policy has economic and environmental advantages. Such a policy is dependent upon the achievement of a new conservation ethic, especially on the past part of public school students, who will be tomorrow's adults.[22, 23]

Education as an institution concerned with social policy has an integral role in helping America adapt to the energy crisis. Education will need to have an impact on modifying social values and attitudes toward energy, as well as fostering the technological solutions to the crisis by the furthering of energy research and the training of technicians,[24, 25] The governmental or political mechanisms of society will likewise have a crucial role in our country's energy future. The federal, state, and local governments have a responsibility to their constituents to assess the extent of adverse social and economic impacts and then establish the necessary priorities and means to minimize those impacts.[26] Past threats to the American value systems and way of life--espcially the more recent crises of the "space race" and of the environment--have united governmental and educational institutions into a common catalyst for social change.[27]

One example of a unified reaction of educational and governmental agencies to the social problems of energy shortages in Oklahoma was the Public Awareness Demonstration Program. Begun in October of 1977, the program traced its existence to the passage of the Energy Conservation and Production Acts of 1975 (P.L. 94-163) and 1976 (P.L. 94-385). The program was established by the Oklahoma Department of Energy as one segment of a broad mix of strategies and measures with a goal of reducing the state's energy consumption by 5 percent by the end of 1980. Agencies involved with the Public Awareness Demonstration Program were the State Department of Education and three entities of Oklahoma State University: the College of Education, the College of Agriculture, and the Cooperative Extension Service.

The major part of the Public Awareness Program consisted of an Energy Awareness Demonstration Program mobile van, managed by the Department of Curriculum and Instruction, College of Education, Oklahoma State University. The van was used to present multimedia interdisciplinary lecture/demonstration programs to K-12 and college students, civic groups, agricultural groups, and other professional organizations, as well as to the public at large in order to raise energy awareness levels. For an overview of the objectives and standardized presentation of the Energy Awareness Demonstration Program, see Appendix A.

Statement of the Problem

The United States, and indeed the entire world, is faced with the possibility of insufficient energy resources, due to unstable sources of supply. Education, as a part of American society, shares this energy crisis and can be a useful mechanism for lessening its impact.[28] Education tries to impart knowledge, initiate the internalization of value systems, and change behaviors.[29] The problem of successfully accomplishing these tasks is difficult in terms of energy education. One type of an educational response to the energy problem was the initiation of the Energy Awareness Demonstration Program. A lack of knowledge exists about the success of this program in having a positive impact on public school students.

Purpose of the Study

This study attempts to evaluate the success of the Energy Awareness Demonstration Program in terms of measuring the knowledge retention rate concerning energy concepts possessed by selected Oklahoma seventh graders who attended the lecture/demonstration. Possible attitude changes on the part of the students as a result of the program were also investigated. An Energy Awareness Questionnaire consisting of twenty congitive items and ten Likert type items was used as the test instrument to ascertain the knowledge and attitude characteristics of the students prior to and after receiving the standard presentation in 1979.

Available students from the original research group were administered the instrument again when they were high school seniors. The second phase of the research in 1984 was conducted to determine if the students still perceived the energy resource situation as a problem, and to try to establish the evidence of any long term effects the Energy Awareness Demonstration Program had on the students.

Need for the Study

There are several reasons why energy education research studies are needed, the main one being that energy education is based on extremely limited research literature of its own. Almost all of the previous research listed in the available literature has dealt with the status of pre-existing levels of knowledge and opinions concerning energy, whether at the K-12, college, or adult level. Changes resulting from educational attempts to influence these knowledge levels or opinions were usually not addressed.

Morris and Jensen[30] studied the energy perceptions of middle school students (grades 5-9 or 7-9) in five southern states while Lawrenz[31] assessed Arizona fourth, seventh, and high school students in order to identify areas in which energy curricular emphasis was most needed. Ayers[32] measured attitudes of rural fifth graders concerning the energy crisis. Kuhn[33] assessed the attitudes of a group of academically select secondary school students in the southeastern U.S. regarding energy resource development, use and conservation. Crater[34] studied the attitudes of a group of high school students toward nuclear energy and nuclear science in conjunction with a National Science Foundation Summer Enrichment Project. Kushler[35] studied energy attitudes of high school students.

Fazio and Dunlap[36] researched the background energy knowledge levels of college students. A Florida study gathered information from adults about their opinions on the energy crisis,[37] as numerous public opinion polls also have done.[38] A survey in 1978 sponsored by the Education Commission of the States entitled the National Assessment of Education Progress tabulated opinions regarding energy held by young adults who were from 26-35 years of age.[39]

No similar study pertaining to junior high students has been done at the state or local level in Oklahoma. Smith[40] researched the effect of a one day model driver education energy awareness program in causing a change in attitudes toward energy awareness and knowledge of conservation practices on the part of college level students and adults. This 1978 Oklahoma study also included a small sample of high school students, and findings indicated that significant differences occurred between the pretest and posttest cognitive scores on the part of all the subjects, but their attitudes toward energy awareness did not change significantly.

Ehrlich[41] researched 287 Oklahoma teachers to assess their energy awareness and attitude levels. The results of his study seemed to indicate a general lack of knowledge concerning the production of energy, its use and conservation among the teachers participating in the study. The study results also seemed to indicate the teacher's general attitudes toward energy production, use, conservation, and governmental energy policies were favorable.

Ehrlich's research instrument has also been used to evaluate the success of annual teacher Energy Awareness Work Conferences at Oklahoma State University, after its initial use in 1978. The work conferences were started in 1976 and have consistently improved the performances of Oklahoma teachers on cognitive energy test questions similar to the ones used in this study. Attitudes of the teachers toward energy use and conservation generally showed a positive improvement after they attended the work conferences, although the degree of significance varied and was not as significant compared to the cognitive items.[42, 43, 44, 45]

This research attempts to measure changes in student knowledge of, and attitudes about, energy based on material presented in the Energy Awareness Demonstration Program. This evaluation of the Program will help determine its intrinsic value in order to decide whether similar energy education mechanisms for accomplishing beneficial social change are worth being utilized in the future.

Research Questions

The evaluation is based on determining answers to the following research questions posed to the study samples:

1. Did the material presented in the Energy Awareness Demonstration Program result in improved student knowledge about the energy situation?

2. Did the material presented in the Energy Awareness Demonstration Program result in improved student attitudes concerning the energy situation?

Assumptions

The following assumptions were made:

1. The data gathered were interval data.

2. The students attempted to answer the cognitive and affective items honestly and completely.

3. The differences in the experimental and control group mean scores are due to the treatment, insofar as the short term phase of the research is concerned.

Limitations

Although the research may give an indication of how other Oklahoma 7th graders in demographically similar school districts might perform on the research instrument under similar treatment conditions, generalizations to greater populations cannot be made due to the limited sample size.

The research instrument was limited in size and scope so as not to involve the student beyond an optimum length of time in order to reduce fatigue factors of sampling error.

The high rate of research mortality may have resulted in a bias, in that the performance of the remaining students may not represent the performance of the students who were not available for retesting in 1984.

Because the study depended upon the willingness of the school administration to allow the expenditure of student and faculty time, inherent limitations restricted the researcher's control of the study to the extent that certain goals concerning the chronology of the testing and the completion of all aspects of the study by all the segments of the sample population were not attained to the degree desired.

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CHAPTER II

REVIEW OF SELECTED LITERATURE

Introduction

Energy is such a fundamental part of our lives that a totally comprehensive review of the literature on energy would be practically impossible. Thus the following discussion will be limited to the major considerations in the energy literature that were felt to be related to energy problems from an educational viewpoint in general, and to this study in particular. Four main sections will be addressed: a short history of energy development and use, recent global energy problems and their causes, political considerations, and lastly, educational considerations.

A Short History of Energy Use

Primal Man to the Rise of Agriculture

Why study the past use of energy to address our current energy problems? As Healy[1] stated it:

> Our present uses of energy have much in common with the first human uses. From a study of the past we understand better the present, and these lessons must help us shape our future (p. 3).

Mankind has always been affected by the quantity and quality of available energy resources. The sun is the source of most of the energy for our planet, because it imparts radiant heat, illumination, and the physical and chemical means to supply life on Earth. The sun supplies light energy to plants, and thence to animals and man. Thus the earliest use of energy by man is also its ultimate biological use: the transformation of food energy necessary to sustain life.[2]

Nonsolar sources of energy include nuclear or atomic energy, geothermal energy, and tidal energy. But until about one hundred and fifty years ago, most of our energy came directly from the sun. And the bulk of our energy sources today are directly related to the action of sunlight on plant and animal life: soil, coal, natural gas, and wood.[3]

Man in the earliest of times lived in a world which was intensely linked to nature. Primitive man was restricted to a very narrow range of energy uses simply because he did not have the technolgical capacity or resources to expand these uses, even though he probably was seeking to lighten the load of his daily tasks. Primitive man was a wandering nomad constantly in search of energy (food) resources, and he used his own power (literally, manpower) to carry out nearly all of his activities.[4]

Healy summarized the uses primitive humans had for energy, and notes that these uses still dominate mankind:

1. Sustenance of life;
2. Transportation;
3. Comfort heating;
4. Light; and
5. Food preparation and preservation.[5]

Breakthroughs in energy usage came slowly. Gradually man improved upon his primal existence by fashioning tools to augment his muscular expenditures, and by taking advantage of a serendipitous development--fire.[6] Udall et al., wrote about fire:

> Whatever the date of the first man made fire, it altered the world permanently. Once he learned how to control it, primitive man had light, heat, and a weapon against darkness, cold, and the unknown . . . fire remained the basic means of energy conversion through the ages (p. 59).

While fire could be used to hasten the settlement of previously uninhabitable colder regions, it also gave impetus for the anchoring of individuals or tribes in one location for prolonged lengths of time, in spite of seasonal cold weather. Other events occurred which would, along with the use of fire, allow early man to establish permanent settlements. The first inolved the harnessing of animals to ease man's burdens, and domesticated animals supplemented the usual food supply of wild plants and game.[8] Although this development was notable, it was an underlying factor contributing to an even greater change--the beginning of agriculture.

The Development of Agriculture

The biggest breakthrough affecting mankind up to this point in its energy history was the development of agriculture. As Udall et al. stated it:

> Some ten thousand years ago, neolithic man turned from his nomadic . . . ways. From this point, man was freed from the ritual of hunting and food gathering. Now he could cultivate and store food. . . Inevitably, the first major civilizations grew up in fertile areas where the domestication of animals and cultivation of grain thrived (p. 60).

"Primitive Agricultural Man"[10] eventually improved the techniques of growing and harvesting crops, and tools were improved upon so that they could be used to plant crops. The growing process, in which solar energy is converted into protein and stored in the grain kernals, yielded an energy transformation that was unique up until that time. Agriculturalists produced a surplus of energy, enabling some individuals to be free from the requirement of devoting all of their waking hours to the pursuit of survival.[11]

Agriculture was the social mechanism that took mankind from the unrecorded prehistory to a written history.[12] Hearly[13] notes that "the foundations were laid for a new kind of human life which would in time lead to the birth of cities (civilization), to the industrial revolution, and to the atomic age (xi)."

The ongoing adoption of new energy resources or stategies was accompanied by refinements of previous uses or processes. The first uses of windpower helped propel ships, while a much later application--windmills--resulted in the draining of wetlands and for supplying water to canals.[14]

Fire was essential to the development of the various "metal ages," both for the smelting of copper and tin (the components of bronze) as well as for the tempering of metal tools and weapons. Fire was also a critical precursive element in the invention that would usher in a new age of energy utilization: the steam engine.[15]

Waterpower was used first for irrigation purposes, and was eventually harnessed by man to power watermills. The energy inherent from falling water gave rise to grain processing and textile manufacturing, laying the foundation for the Industrial Revolution.[16]

Mankind was on the eve of a great Industrial Age that would revolutionize the civilized world with exponential increases in the capacity to do work. But it had taken so very long to arrive at this point. "For perhaps five to ten thousand years the human capacity to control energy did not change a great deal."[17] Man's energy history up to this time had seen many years pass with only a few changes occurring in energy technologies. An era was beginning that has not ended yet, characterized by rapid advances in energy conversions spread over a relatively short period of time.

The Industrial Revolution

The energy developments that datd back to prehistory paved the way for an awaiting technology that began in the 18th century, gathered momentum for another century, and blossomed into a progressive cycle of change that continues at an even faster pace today. "The Industrial Revolution is correctly named. Few transformations of society have gone so deep."[18]

James Watts' modifications to the earlier versions of steam engines were to start into motion a series of events that eventually would lead up to our current energy problems. Machines gradually supplanted human labor in factories. Industrial production of manufactured goods had increased substantially even before the steam engine arrived on the scene. But machine-powered factories resulted in a mass-production of goods that had previously been slowly and laboriously handmade. New markets were created, and to fill these markets different strategies of distribution were necessary. If machines could help make the products they could also be used to transport the product to market, and the steam engine helped revolutionize the traditional means of transportation.[19]

The increasingly industralized society of the 18th and 19th centuries was dependent upon greater and greater amounts of fuel to operate its greater and greater numbers of machines. Wood and coal were the pricipal early fuels. As the forested areas of Europe were consume for heating and other purposes, coal came to the forefront. Indeed, the Age of

Coal was a major factor in the success of the far flung British colonial empire, for Britain had adequate reserves of coal during that period of expansionism.[20]

Coal is labor-intensive to mine, however, and solid fuels are not as convenient or as efficient as other types of fuel, such as liquids or gases. These were factors in a switch to other fuels, but the initial reason for coal's eventual demise as the most used resource was unrelated to its fuel characteristics. Whale oil had been used as a lamp light fuel for as long as the whales remained abundant. But as substitute had to be found once the whales became scarce, and this substitute turned out to be petroleum. Petroleum was to gradually replace coal for majority of uses in many countries within a century after the first well "came in" in 1859 in Pennsylvania.[21]

The widespread utilization of new sources of energy does not occur as quickly as these new sources are found. It took many years before the United States, for example, turned to coal, then to oil and other types of fuels to power the factories and transportation. Wood was still the predominant combustible fuel as late as 1885 before coal surpassed it, and oil did not overhaul coal in the U.S. until 1950.[22] Oil was more versatile in its liquid form than coal, but it took the development and eventual proliferation of internal combustion engines to create a thriving market for low-priced petroleum fuels.[23]

Udall et al., wrote of the impact of petroleum on our recent energy history:

> The past century has been the most dynamic in the history of man. After rushing through several sources of energy, the uniqueness of petroleum was discovered and its abundance, price, and efficiency opened horizons never imagined. It fueled the technological age and was the underlying factor that altered the national social structure (p. 54).

Along with petrolum came natural gas. Originally it was considered a waste product of petroleum extraction and was discarded until its use as a primary energy source became a realization.[25] It had excellent burning characteristics and was sold at bargain prices--initially due to marketing factors but later because of government regulatory practices, at least in the U.S. The post World War II economic boom resulted in a rapid increase in demand for natural gas due to its low cost and increasing availability by way of improved long distance pipelines.[26] Shortly after oil surpassed coal as the predominant energy resource in America, natural gas relegated coal to third place in U.S. energy consumption, in 1958.[27]

As in North America, the other industralized nations of the world also turned to newer technologies. Hydroelectric power and more recently, nuclear power have made contributions as energy sources. But it was an increasing reliance on depletable fossil fuels, especially oil and natural gas, that would eventually bridge the gap from the Industrial Revolution to what Daniel Bell has coined the Post-Industrial Society, and which others have called the Age of Technology.[28]

The Technolgocial Age and Modern Global Energy Problems

One of the best examples detailing the degree of change occurring since the relatively recent history of the Industrial Revolution to the present is described by Healy.[29] The example involves the evolution of the methods and speeds of increasingly sophisticated modes of transportation over the last 150 or so years of your energy history. Prior to the perfection of the steam locomotive, the fastest speed man could attain throughout his entire history was that of a speed of a horse--about 50 miles an hour. By 1850 trains reached 60 mph, cars travelled 70 mph by 1900, planes got up to 700 mph by the 1950's, until by the time of the manned space missions to the moon, speeds of approximately 25,000 mph were attained, which is an exponential rate of increase since the horse and buggy days.[29]

The transportation sector of energy use also was a crucial element contributing to our recent energy shortages. This was due to social factors as well as the physical amounts and kinds of resources used. The technological age could be called the age of mobility, because modern society is so mobile with its cars, planes, ships, and trains--but mostly due to its cars. Automobiles provide an unprecedented freedom of individual mobility, and their usage deserves a large measure of blame for the rapid dependence on petroleum by the industrialized world and especially the United States, which has almost half of the world's supply of motor vehicles.[30, 31]

The feasibility of massproducing cars in Henry Ford's day resulted in a market situation that parallels events today: an increasing availability of products leading to more and more consumption. Ford's techniques put the price of cars within the reach of many more people, just as a short span of fears later the post-war baby boom of the industrialized nations of the world created a market for additional auto sales. Refinements of assembly line techniques, coupled with cheap energy expenditures for both manufacturing and operating automobiles, resulted in an increase in registered automobiles from about one million in 1973[32] to about 160 million cars, trucks, and buses in 1979, so that the ratio of people to cars dropped from three to one to less than two to one.

In addition, the greater number of vehicles on the road were driven more miles each year, while delivering lower fuel efficiency due to power-consuming optional equipment and pollution controls.[33, 34]

Energy use by the transportation sector accounted for 52 percent of America's petroleum annually by 1980. Almost half of the supplies to meet this demand were imported because domestic petroleum production peaked around 1970 and declined annually until the Alaskan North Slope fields finally began contributing to the U.S. oil output in 1977-78.[35, 36]

In addition to the transportation portion of petrolum use, modern society had a plethora of over 3,000 uses for oil. It fueled industry, heated homes and businesses, grew crops as a fertilizer, was worn by people as a fabric, kept them healthy in the form of medicines, and supported a vast petrochemical industry.[37] By 1979, petrolum supplied 28 percent of the U.S. residential, commercial, and electric utilities consumption, and 20 percent of industrial requirements. America used 3 times as much oil in 1980 as in 1950, but her 1980 oil imports were 13 times that of 1950 imports.[38]

Natural gas production and consumption patterns mirrored those of petroleum, as these two fossil fuels provided a combined total of 75 percent of America's energy use by the latter part of the 1970's.[39] Natural gas replaced coal as a boiler fuel and also became a favored residential and commercial heating source. It was used to supply over 26 percent of the nations total energy consumption in 1979, with the major users being the residential, commercial, and industrial sectors.[40]

Modern Global Energy Problems

The post-World War II energy consumption patterns created a bubble that was about to burst, and America was not alone in her vulnerability. If the U.S. had been alone in exponential growth of energy consumption the supply crunch would not have occurred. But many industrialized countries also went through historic growth patterns at the same time, and they competed for the increasingly limited supply of petroleum.[41] Western Europe increased its oil consumption rate 14 fold between 1950 and 1973, while Japan's rate was 167 times what it had been over this period of time.[42] By the mid-1970's, Japan imported 99 percent of its petroleum to supply 65 percent of its total energy needs.[43] Canada's needs for energy in the year 2000 are predicted to be 4 times greater than the mid-1970 demand, for like the U.S., Canada converted from coal to natural gas and petroleum in the 1950's and 1960's.[44]

Based on annual energy demand growth rates from 1965 until the year of the OPEC embargo, the U.S. increase of 4.4 percent was surpassed by Japan (11.8%), Canada (5.6%), and Europe (5.1%).[45] This high rate of atypical demand during such a short span of time was a chance occurrence that would increase the vulnerability of these nations to an enforced petroleum shortfall.[46]

A salient point concerning the subject of U.S. energy usage up to the eve of the oil boycott is brought out by a leading political figure of the day, Henry M. Jackson:[47]

> If there is anything that has characterized the post-World War II period, it has been the change in our national life. At the core of it is the gross national product. It took 200 years to reach $1 trillion gross national product, which, as I recall, occurred inDecember, 1970. It took about 185 years to get the first $500 million gross national product and only fifteen years to get the second $500 million. . . The demand for energy has been insatiable on the part of industry, government, and all the people (p. 238).

The 1973-74 OPEC oil boycott was only the symptom of a larger problem, that of unrestrained growth demanding more of a limited resource than could be supplied at then-existing prices.[48] The pre-crisis period had seen indications that all was not well with the nation's energy supplies. The closing of the Suez Canal in 1967 as a result of the Six Day War caused a shortage of oil tankers[49] that, combined with the cutting off of the Trans-Arabian petroleum pipeline due to an accident, would cause the first 1970's era opportunity for the middle East producing countries to gain economic clout. Previous to this various Arab nations had tried to take an active part in the total operation and market decision-making phase of their guest international oil companies, and some had even nationalized their oil industries, but on the whole the Arab nations lacked unity and a determination to press their demands. But a political coup in Libya brought to the forefront a leader who would successfully press his demands on the foreign oil companies due to the tight European oil supply at the time. Muammar Quaddafi set into motion what was eventually to become the oil crisis and then an energy crisis once other Arab and non-Arab oil producing countries followed his example of cutbacks in output coupled with very grave threats such as nationalization if demands were not met.[50]

The United States, and particularly the East Coast, already was in an energy pinch during this time period due to a lack of refinery capacity and coal-fired electric utilities, and the previously utilized oil imports from Europe started slowing down due to disruptions in European supplies by Arab nations. This resulted in utility brown-outs, winter heating fuel and even gasoline shortages in the early 1970's, and some American consumers were realizing that the energy resources that had heretofore been thought endless were becoming scarce.[51, 52]

A few voices were heard crying in the wilderness that a major energy crisis was just around the corner, but no one paid much attention to them.[53, 54, 55] Even though President Nixon began to initiate proposals regarding American energy policy,[56] the administration conceded that the public was not being provided with information to let them sense the national needs, the options they faced, or the cost factors involved.[57]

The Yom Kippur War between Israel, Egypt, and Syria in October, 1973, set in motion a chain of events that are still being felt over a decade later. As a result of the war and the continual U.S. suport of Israel, the OPEC oil cartel cut back production up to 25 percent while singling out America for a total embargo.[58] R. S. Knowles summarizes the effect of the boycott:

> Throughout the industrialized countries the immediate chain reaction to the Arab maneuver was astonishing. . . . The militant problems of 90 million people in the Middle East plunged the remaining 2.6 billion people of the free world into unexpected, painful difficulties and threatened their growth and progress. Stock markets plunged to new lows as analysts and economists predicted a world recession, bringing massive unemployment and rampant inflation. Factories closed for lack of fuel. Workers were laid off by the thousands in a startling variety of industries. Many countries began to ration gasoline and fuels. There were growing shrotages in food, clothing, housing, and manufacturing materials--all stemming from oil shortages. Airlines drastically reduced their flights. Everywhere the price of everthing went up. . . . In the United States there was bewilderment, confusion, and disbelief. . . . The public was bitter and accusing.

The dramtic OPEC embargo and fourfold oil price increases that ocurred by the time the boycott ended in the Spring of 1974 contributed significantly to the worst global recession since the Great Depression.[60] U.S. trade deficits increased from $2 billion in 1971 to $14.8 billion in

1976. During this same period of time, oil imports costs jumped from $3.7 billion to $36.4 billion.[61]

Causes of the Energy Crisis

In reviewing the information available about the causes of the energy crisis, the following factors are commonly mentioned. These economic, social, political, and other factors are hard to separate from one another because they overlap in many ways. The difference in quantities are due to varying estimates among sources.

Economic Factors

1. Real energy prices, adjusted for inflation fell 28 percent between 1950-1970. This low cost encouraged consumption, especially since per capita real income doubled over the same time span.[62]

2. Energy consumption increased at annual rates of between 3-1/2 and 4-1/2 percent from 1950-1973.[63, 64] Total energy consumption increased 98-132 percent during this time frame.[65, 66]

3. Per capita energy consumption doubled since the end of World War II, due to population growth creating a demand for more energy.[67]

4. Gross National Product growth rates averaged out to about 3.6 percent from 1950-1970.[68]

5. Because energy costs were so undervalued, rate structures were not energy efficient. The more electrical power residences used, the lower the cost per unit of power was.[69]

Social Factors

1. Cheap energy prices led to a way of life uniquely American-one

that was energy wasteful, to a large degree. Three adjectives could be used to describe it: bigger, mobile, disposable. Bigger was better, America was a nation on wheels, and we discarded so many recyclable items.[70]

2. Our machine-powered society led to large amounts of leisure time, which was filled by doing things which usually required energy. The spectator sports stadium, the recreational vehicle industry, the power boating industry--all required energy.[71, 72]

3. American society could be termed the affluent society. Push a button, and a machine would do chores easier than manual labor. Our standard of living was the highest in the world, and if that also required us to be the most intensive users of energy in the world, energy costs were cheap enough to meet our extravagent needs.[73, 74]

Political Factors

1. Government polices frequently were at cross purposes in the area of petroleum and natural gas exploration and marketing regulations. The main segments of federal regulatory efforts concerned the industry's tax load, the control of interstate natural gas prices, and import quotas. The tax breaks the oil industry got for exploratory drilling was proportionally bigger than the tax deductions allowed for expenses for other businesses. However, exploration for new fossil fuel sources was hindered by the 1954 natural gas pricing policies, which did not provide enough profits for investing in new exploratory wells. The import quotas first imposed by President Eisenhower in 1959 were designed to stimulate domestic exploration. But the tax structures were such

that foreign exploration was more attractive than domestic searches and the quotas were eventually dropped in 1973.[75, 76, 77]

2. Another area of policy conflicts involved the environment/energy dichotomy. The environmental crisis had preceded the new pretender to the throne of priority, and indeed the legal mechanisms in operation prior to the new energy scarcity exacerbated the shortages. The National Environmental Policy Act was used to hold up urgently needed energy projects as well as changing the consumption mix of industrial and elctrical utility boiler fuels from coal to less polluting oil and natural gas, thus increasing their consumption.[78]

3. Pollution control regulations would exact energy efficiency penalties over a growing number of energy processes and uses. Emission controls of automobiles lowered their efficiency somewhat, while adding weight and/or chaning performance standards. Extra energy would be consumed in hauling coal into areas requiring low-sulfur coal for a boiler fuel.[79]

4. A growing environmental awareness on the part of the public would focus on such things as nuclear power plants, ocean tanker oil spills, the trans-Alaskan pipeline, and Continental Shelf offshore drilling operations. Addressing these issues fairly from an environmental viewpoint will sometime require construction delays, and usually adds costs on to the development and operation and maintenance of such facilities.[80, 81]

5. America's reliance on finite fossil fuels, which were being rapidly depleted led to a dependence on an unstable foreign supply from the Persian Gulf region.[82]

Other Factors

1. It was the convenience of the two fossil fuels that the U.S. uses the most oil and natural gas that is in large measure responsible for our energy problems. The fuels are clean burning and in readily transportable forms, therefore, they matched the American form of life-style at the right time of the nation's industrial and social growth.[83]

2. The nature of the complexity of the multinational petroleum industry had an effect on the amounts of confusion emanating from the crisis. The man on the street did not understand a lot of the issues involved, and even the oil companies could not present a clear, cogent picture of what was going on and why, in order to justify their actions.[84]

Political Considerations

President Nixon was moving in the direction of energy policy prior to the OPEC embargo. In 1970, he established a task force on energy, and in his 1971 state of the union address he called for the streamlining of the 64 federal departments and agencies relating to energy into one cabinet level Department of Natural Resources. In June of 1971, for the first, but unfortunately not the last, time in the nation's history a president would give an address on energy.[85]

Eventually President Nixon was to expand upon his proposals on energy and modify them into his Project Independence, whereby the U.S. would be energy self-sufficient by 1980. Persons knowledgeable about the situation thought the 1980 deadline was a pipedream.[86, 87]

Throughout the rest of the decade during the Ford and Carter administrations the energy situation dominated the political scene. Some noteworthy measures were taken, like the consolidation of previous energy agencies into the new federal Department of Energy, and decontrol of oil and natural gas was partially accomplished, with commitments for complete decontrol in the early 1980's. The country had just about weathered the economic hard times created by the OPEC boycott, which was a faded memory. Then the coldest winter in a century brought back reminders of the crisis era, days of closed factories and homes without heat.[88]

President Carter took office in the middle of this fuel crisis, and he submitted his plan for taming the energy beast. The energy problem just would not go away, although Congress procrastinated throughout the '70s as if they hoped it might. Carter's plan was finally approved, although it bore little resemblence to his original proposal. At least the U.S. had something coherent to go on, and it would need it, because political stormclouds over the Mid-East were again appearing on the horizon.[89]

The Iranian Revolution started the latest round of oil import anxieties. The U.S. had been importing 37 percent of its petroleum needs in 1973, but these had risen until just about half of our demands were provided for by imports. The energy problems, which had seemed like a lot of rhetoric in the past two years, returned in late 1978. The revolt in Iran had strained world oil supplies again, doubled prices, caused lines for gasoline and reminded Americans of there dependence on Middle East oil supplies.[90]

Tension levels in the Arab regions increased with the invasion by Russia of Afghanistan, and with the taking of American embassy hostages in Iran. After the hostages were released, additional worries cropped up, this time with the Iran-Iraq war, and the eventual U.S. involvement in Lebanon after the Israeli troop pullout there.[91]

The political events of the 1970's were being repeated in the 1980's, leading to resource shortages, inflation, and economic recessions on a worldwide scale. Industrialized societies faced escalating balance of payment deficits, while developing countries tried to keep their financial solvency. The world's monetary and banking systems were on shaky ground because the $40.00/barrel oil prices had resulted in massive monetary transfers from the oil consuming nations to the oil producing ones. Thus, the past decade since the oil embargo has not seen much progress toward any major improvements in the overall energy picture.[92]

Education's Response to the Energy Crisis

Past crises that have affected America prompted social and political efforts to foster an educational response to such problems. Educational institutions geared up to deal with the environmental crisis as well as the "space race"[93, 94] and establishing a field of energy education was a valid outgrowth of the effect of the energy crisis on society.[95, 96, 97]

In defining energy education one writer pointed out that energy education entails more than just energy conservation education. It is a broader and more profound topic that must approach students from at least three different perspectives: citizen, career, and consumer. As decision-makers, citizens must deal with and understand a depth of information concerning energy that has seldom been demanded before of the general public. The changing energy situation will have a wide impact on careers in general. Lastly, energy education can affect students as consumers by showing them how to conserve energy, and why a new conservation ethic is necessary.[98]

A wide variety of energy education materials and curricula have been, and are continuing to be, developed in response to the state of our nation's energy situation. Items ranging from brief background readings to textbook chapters have been prepared by local districts, state and federal governmental agencies, curriculum project staff, professional teacher organizations, private industry and business sources, commercial publishing companies, and individual teachers.[99, 100]

Duggan[101] writes of the impetus the federal government gave the energy education movement, explaining that the first efforts involved Atomic Energy Commission, sponsored teacher and faculty training programs in nuclear energy, even before the oil crisis days. He noted that, as federal or national energy policies evolved, various administration and research and development agencies such as the Federal Power Administration and the Energy Research and Development Administration became more involved in energy education areas. These agencies expanded the content of their educational efforts to include the various energy sources and technologies, and broadened programs of campus-based teacher training. Curriculum development efforts were also initiated at this time.

A wider, more grass roots approach to energy education at the federal level was fostered by the newly created U.S. Department of Energy in 1977, while the traditional high-technology approach was phased out. The department had inherited many energy education programs initiated by the previous agencies and commissions, and added to these were programs sponsored by the U.S. Office of Education. Nationwide, the government supported Faculty Development Program and teacher training workshops were complimented by federal sponsorship of curriculum efforts such as: "Science Activities in Energy," the National Science Teachers Association's

"Project for an Energy Enriched Curriculum," "Energy and Man's Environment," and the "Interstate Energy Conservation Leadership Project."[102]

These curriculum projects were not on the scale of the massive curriculum projects of the 1960's, but were instead designed to encourage students and teachers to use the materials to fit into the existing interdisciplinary curricula and conventional goals of education. Federal influences also resulted in the creation and/or strengthening of resource centers and communication channels like the Energy and Education Action Center, the Energy and Education Network, the Resource Materials Center, the Center for Renewable Resources, and the ERIC-SMEAC Reference Center. This approach to energy education at the federal level has not changed significantly from the earlier roles that have evolved in relation to the energy problem.[103, 104]

Sometimes the grass roots approach to energy education led to a patch-work energy curriculum. This was understandable due to the constraints already present in the overcrowded school curriculum. Another "add-on" course is not always welcomed by some school administrations or staffs, however, and several authors do not recommend this approach,[105, 106] even though most K-12 energy education programs are designed for integration into existing curricula.[107]

Energy education followed environmental education historically, and is competing with it for curriculum space, political and financial support. Early aspects of this situation saw energy education being classified as a type of environmental education, so that the uniqueness and worth of energy education did not develop as much curricular momentum as it might have.[108] For example, in 35 of the 50 states, state education agencies have assigned responsibility for coordination of energy education to the same individual who previously dealt with environmental education. These assignments were in most cases add-ons so that the same person may have several other responsibilities with no additional resources to accomplish these added tasks.[109]

Individual teachers have developed energy education materials, both for personal coursework use and as part of teacher education workshops which prepared local, statewide, and nationwide energy education curriculum materials.[110, 111] At the same time, however, energy education programs in schools, especially in the lower grades, are surprisingly dependent on proprietary materials which were developed by private energy and utility companies and their associations. For example, one survey found that 62 percent of the teachers involved in the study produced their own classroom materials on energy, and 48 percent used industry-sponsored materials (the total figures overlap). The privately funded sources are filling a void in energy education because governmental or other entities have moved too slowly in curriculum development. However, there has been criticism that industry-sponsored materials have biased perspectives, and energy educators have to ensure fairness in their presentation of programs.[112, 113]

Commercial textbooks devote various amounts of attention to the energy situation. The concept of a new energy conservation ethic is addressed only in passing in most of the texts in the field of science that are up for adoption in Oklahoma in 1984.[114, 115, 116] This situation is similar to the comments of approximately 1550 teachers who took part in a recently published survey about the way commercial textbooks treat energy. Sixty-four percent of the respondents found their texts inadequate, only about 16 percent declared them satisfactory, while a mere

1.2 percent of the nationwide respondents rated their texts' handling of energy information as exellent.[117]

Recent Energy Education Research

Kushler studied the effects of energy education instruction on high school students. He found that conservation education had a significant effect on the attitudes and behaviors of the subjects, and gender affected the responses.[118]

A research project conducted by Morris and Jensen,[119] published in 1982, dealt with the perceptions and ideas of fifth through ninth grade students in five southern states on current energy problems. Findings included significant differences based on sex and race on some test items, and almost four out of ten students believed the energy crisis would result in improved life-styles. Other data revealed that one-fourth of the 1169 students believed they could cut energy use by 20 percent, and almost 38 percent of them believed solar energy would provide the solution to our energy problems.

Lawrenz[120] reported in 1983 that a study of fourth, seventh, and high school students in Arizona identified areas in which students' energy knowledge was most deficient, in order to concentrate and emphasize instructional efforts in those areas. Student knowledge on energy issues was obtained, which indicated some gender differences in performance, and the grade levels also showed varying trends. Deficiency areas noted included U.S. energy resource knowledge, basic concepts relating to energy issues, and practical constraints of power generation.

Ayers, in 1977, measured the attitudes of fifth grade students toward electric power generation using a 17 item Likert type instrument which listed responses from strongly agree to strongly disagree.[212] He found that, among other things, females appeared to be more cautious in their feelings toward the production of electricity.

Crater[122] studied a small group of high school students taking part in a 1978 National Science Foundation Summer Enrichment Program concerned with the nuclear sciences. He administered a 20 item Likert type attitude survey at the beginning and end of the Program. Findings included a slight, nonsignificant increase in positive attitudes about nuclear energy, although the program had little effect in changing the students' attitudes toward nuclear science in general. His small sample also held a generally positive attitude toward the use of nuclear energy and the construction of nuclear powerplants.

Kuhn[123] assessed the attitudes of 413 academically select secondary school students concerning energy resource development, use and conservation, in 1978. Of 82 Likert style items, he found significant differences in attitudes between sexes on 23 responses. Other findings indicated that males were much more positive about the use of nuclear energy and showed greater faith in technology than females. Females exhibited a slightly higher awareness of the need for energy conservation, and recognized the importance of individual efforts in energy conservation to a great degree than males.

Fazio and Dunlap studied the background knowledge of college students on energy-related matters, in 1977.[124] They reported that the students who were nonscience majors had a poor knowledge of energy facts and concepts, but that the situation could be improved by energy workshops.

Several studies have collected data about the energy knowledge and attitudes of adults. Aside from public opinion polls,[125] the 1978 National Assessment of Educational Progress study found that the majority of the 1300 young adults surveyed realized the energy shortage is a serious potential problem for society for the foreseeable future. It also pointed out that, although the subjects were rather familiar with some practical conservation techniques, they did not seem to be able to effectively apply energy conservation methods to their everyday life activities.[126]

A study in Florida showed that over two-thirds of the respondents felt that oil companies were the major contributors to the energy problem, while only 24 percent saw scarcity of oil, and only 13 percent saw the scarcity of natural gas, as major contributory factors of the crisis.[127]

Ongoing Energy Education Concerns

Several events have occurred recently which have a bearing on the expected future of energy use, and thereby on energy education, in America. Fowler[128] notes that some of the federal government's research and development programs have been sidetraced, such as the solar energy program and energy conservation program, and much of the support for the synthetic fuels program has been withdrawn. Private industry also recently scrapped an alternate energy source project, the Exxon oil shale effort fell victim to the 1982 oil glut and high interest rates. Nuclear power technologies have developed slowly, other alternate energy technologies are lagging, and efforts to develop coherent national energy policies have been hindered by the Reagan Administration's reliance on the marketplace to set energy policies. The Iran and Iraq war has not eased international tensions. We are still overdependent on foreign oil, and our energy planning remains largely short range and incomplete.

A noteworthy trend in the literature deals with the emergence of world models to plan for future energy, economic and environmental action in order to address the growing concerns in those areas. One of the earlier models was the Club of Rome's, and when the computer simulations were published in the book The Limits to Growth[129] a controversy was raised. The original model was augmented with additional ones that obtained results which reiterated the seriousness of the resource problems confronting the world, and indications pointed to the world as a whole running out of needed resources fairly soon due to the rapid increases in population. This viewpoint was shared by population growth authorities who have been warning of major catastophies for some time now.[130, 131, 132] The exponential growth in human population and energy consumption has compounded the resource scarcity problems, and some sobering points are brought out concerning the future. This forecast is an example of one that should be incorporated into those educational mechanisms which address energy education and societal needs.

The researcher cannot but agree that national level approaches on resource problems have become outmoded, and so have regional viewpoints which adversely affect the national welfare. The literature, and events within the past decade, have consistently reinforced the fact that, shortly after someone turns a valve on a pipeline overseas, serious things begin to happen here in the U.S. To lessen these serious impacts, if not to try to preclude them in the first place, society can turn to two kinds of natural resources, the inanimate as well as the living types of resources.[133] Increasing the supply of inanimate fuels can be brought about by research and development measures, but the human side of the equation has to be addressed, too. The subject matter of education should be fundamentally mankind--the human experience.[134]

Morris and Jensen[135] stated that "energy education must be an ongoing activity, in which current and emerging knowledge is constantly shared and updated." Based on their research, they recommend the continuing assessment of energy related activities in schools, and feel that educators should determine the energy knowledge that students need in order to function effectively in the future. The evaluation, improvement, and use of an educational program like the Energy Awareness Demonstration Program can be a factor in addressing important energy education issues.

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CHAPTER III

DESIGN AND METHODOLOGY

Introduction

This study was an attempt to assess the energy knowledge and energy attitude characteristics of selected students prior to and after administration of an Energy Awareness Demonstration Program. This assessment was facilitated through the administration of the research instrument, the Energy Awareness Questionnaire. Short term and long term student performance on the research instrument were investigated, with the initial study phase occurring in the Spring of 1979. The January, 1984 phase of the research also investigated student responses on the research instrument to obtain information about their perceptions of the current energy situation to see if they feel it has improved.

Description of Samples

The evaluation of the Energy Awareness Demonstration Program was based on case studies involving three junior high schools. The study group consisted of 133 students representing their entire seventh grades at the schools, which were located in north central Oklahoma. Demographic data collected besides the age/grade level correlation included gender differences of one sample during the 1979 phase of the research.

School A was located in a consolidated school district which had a combined total of 500 people living in the two main towns which comprised the major portion of the school district. Students attending School A were from rural communitites where agriculture was the main economic concern. There were 15 students in the original School A sample, and 6 students completed the long term reassessment when they were seniors.

School B was situated in a town with a population of about 1,000, which was described by the school administration as being a bedroom community within commuting distance of a large metropolitan area. The type of students present in School B therefore, came from families in which a wide range of occupations were represented, including sales, agricultural, industrial, manufacturing, and service oriented livelihoods. The seventh grade class at School B was made up of 39 students during the initial research phase, of which 27 students were part of the long term evaluation.

School C was located in a city of about 8,000 persons. Economic and background characteristics present in the school district included a large number of industrial and manufacturing businesses along with service oriented and agricultural enterprizes. A total of 79 seventh graders comprised the School C sample for the initial study phase. An attempt was made to obtain long term data from the remaining School C students present in 1984. Due to various reasons, however, useable information about this segment of the study was not available.

The sample schools were selected as sites for the study because they represented a cross section of the type of schools that typically host the van demonstration program, and because of their available cooperation in the research project.

Collection of Data

Development and Presentation of the Treatment

The treatment consisted of the presentation of an Energy Awareness Demonstration Program to the research subjects, in conjunction with the administration of the research instrument. See Appendix A for the objectives and an example of a standardized presentation of the program.

A total of seven instructors and graduate research associates involved with the Oklahoma State University Public Awareness Demonstration Program team had input in developing the educational van demonstration program. A resource center on energy and energy conservation measures that was set up as part of the statewide public awareness campaign supplied content for the van program, as did conventional library materials. Input was also provided by experiences from the annual Energy Work Conferences at Oklahoma State University, and the format of the van program was influenced by similar types of mobile education displays/demonstration units, such as the National Aeronautics and Space Administration's Space Science Education van demonstration project.

The Energy Awareness Demonstration Program was a multidiscipinary lecture/exhibit program that relied on audience involvement to make the energy talk an entertaining, as well as an educational, experience. The program was flexible in that it could be modified depending on time constraints and which type of public audience was addressed. Elementary school groups would typically receive a more basic and concise program lasting about thirty minutes, due to the attention span characteristic of such an audience. College presentations usually were up to sixty minutes in length, while middle school and high school lectures averaged between 30 to 45 minutes.

As an example of the adaptability of the program to different audiences, the elementary talk used a cartoon-type slide presentation based on the Energy Ant[1] characters, and the technical jargon relating to energy was kept to a minimum. The older public school students, college age, and adult audiences likewise received appropriately chosen aspects of the program, and more interaction with the lecturer was incorporated into the program presented to these groups.

All of the treatments used in this study were presented by the writer, in order to eliminate possible variables resulting from different lecturers. No advance instruction was offered to the schools concerning energy education, and special efforts to influence student responses were not made; i.e., normal presentation routines were followed.

The Energy Awareness Demonstration Program takes an interdisciplinary approach to influencing student knowledge and attitudes about energy since the causes of and solutions to the energy problem affect all persons. Therefore the intact school classes, such as the fourth, fifth, and seventh hour classes at School C, were not categorized according to disciplines (English classes, Science classes, etc.). The entire seventh grade classes at each of the schools were involved in the research, thus "mainstream" characteristics were represented.

Construction and Design of the Instrument

The research instrument was designed by the investigator, based on experiences with the lecture program involving the levels of energy awareness typically shown by various public audiences of the program, and its content was approved by the author's doctoral committee. The instrument was developed from similar types of research tools used in the energy awareness literature and at Oklahoma State University's summer Energy Work Conferences. The research instrument was adapted for the specific level of the target subjects, and advice was received from experts knowledgeable in education, energy, and instrument design. A copy of the research instrument may be found in Appendix B.

The instrument was presented to a seventh grade science class in an attempt to clarify its vocabulary level for the selected grade level, based on the SMOG/FOG Index,[2] and changes were then incorporated.

The instrument consisted of a congnitive portion and an attitude or affective portion. The cognitive portion was composed of twenty multiple choice questions designed to assess the participants' levels of understanding concerning basic facts relating to energy use, production, and conservation. The attitude portion consisted of statements pertaining to various aspects of energy use, problems, conservation, and governmental or social considerations. The subjects were instructed to signify their opinions for the items in terms of strongly agree, agree, disagree, or no opinion.

Instrument reliability was analyzed by using Cronbach's alpha[3] to determine the internal reliability, and the Pearson _r_[4] to determine the test-retest reliability. The control group posttest scores on the cognitive section of the test resulted in a 0.57 internal reliability coefficient.

Lawrenz[5] reported in a study of fourth and seventh graders that two forms of a cognitive type Energy Survey instrument had internal reliability coefficients of 0.27, calculated with Kuder-Richardson r's. Smith[6] reported a internal reliability of .76, based on an instrument presented to high school and college age individuals.

The reliability of the instrument based on test-retest posttest cognitive scores on the control group resulted in a Pearson r coefficient of 0.42. The time between the two test adminstrations was 12 days.

The moderate level of correlation on the cognitive items of the instrument could have been due to the low variance between the scores of different individuals, which may have resulted from the group having similar backgrounds. Some researchers that have used similar research tools did not report their instrument test-retest reliabilities; two that did listed test-retest reliability coefficients ranging from 0.46[7] to 0.63[8].

The test-retest reliability of the affective portion of the instrument resulted in a Pearson r coefficient of 0.17, which is very low. The low reliability probably resulted from the small number of attitude questions, plus the fact that the value scale used on the Likert type items increases the possibility of a wider range of response values, much more so than cognitive type items. Thus a few changes in individual responses on the attitude questions could result in a wide variation in results.

Experts knowledgeable in energy education and instrument design assisted in determining the appropriate content validity of the research instrument. Validity of the instrument was checked by inspection.

Research Design

True experimental research designs require large, random samples and a large degree of control over the testing and treatment conditions.

This level of design complexity and control is not easily achieved, and selected schools and classrooms further these limitations, so that an ideal experimental design would require more effort than some school personnel would want to expend, which is understandable.

Designs involving field research are oftentimes restricted by the field conditions,[9, 10] as was this study. Some schools that were contacted declined to participate, and the selection of the participating schools was not a random process. Inasmuch as the cooperation of the participating schools was partially secured with the understanding that the study was not too involved or time consuming, research limitations resulted in the present format of the study design. Individual case study designs were settled on because: the differing sample sizes would require different statistical treatments; the assumed heterogenous characteristics of the different schools; and the timing of the pre and posttest instrument administrations were not identical.

The small sizes of the School A and School B samples precluded the use of control groups. A pretest/posttest design was employed at these schools.

A design similar to the separate sample pretest/posttest design as described by Campbell and Stanley[11] was used for School C. Because pretest-posttest designs might make the subjects more sensitive to the treatment or result in a practice effect,[12] the School C segment of the research study was designed to avoid pretesting of the entire sample. A control group was chosen, based on the largest intact class, and this group of 25 students was used to establish baseline data which would represent the pretreatment energy awareness levels of the experimental group at School C.

Data Analysis

The scores on each portion of the instsrument were treated separately throughout the study. The cognitive portion of the test instrument consisted of twenty items, and the individual scores were recorded as the number of questions answered correctly. Both raw scores and percentile scores were used in the interpretation of the results. See Appendix B for a copy of the test instrument and an answer key for the cognitive items.

The affective portion of the instrument was scored by determining the total value of each student's score by applying the technique of the summed ratings method, according to Likert. A five point scale was used, with 5 points for the strongly agree response, 4 points for the agree response, 3 points for the no opinion response, and 2 and 1 points, respectively for the disagree and strongly disagree responses for the positive items (Nos. 22, 23, 24, 27, 28, 29, and 30). The negatively scored items reversed these values (Nos. 21, 25, and 26).

The mean, standard deviation and standard error of the measurement were calculated for the cognitive items on the instrument. Mean scores on the individual Part II questionnaire items, or the attitude items, were computed as a basis for analysis and comparisons.

The data analysis was directed at obtaining evidence that would indicate whether or not the demonstration program had important influences on student knowledge and attitudes about energy concepts and conservation, and the degree to which these possible influences were operating.

Due to the small sample size of School A, the data analysis of the results of the School A students on the instrument was limited to determining the general trends of the cognitive and affective pre and posttest responses. In addition to investigating the general trends of the responses by the students at School B and School C, their mean score short term data were analysed by using the F ratio at the 0.05 level of confidence.

Comparisons were made between the responses of the pre and posttest School A students, to determine the basis of any short or long term influences the program had, using both the cognitive and affective item criteria. Similarily, comparisons of the pretest and posttest data obtained from students at School B were made.

School C student performance on the research instrument was analysed by comparing the posttest results of the experimental group to the baseline data results of the control group.

A final category involved the performance of the School B students on the instrument, to determine if important variations existed based on gender differences.

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CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

For this study, an energy awareness demonstration program was presented to seventh grade students at three junior high schools in north central Oklahoma during the initial phase of the study in the Spring of 1979 (April–May). An instrument, developed by the author, was used to measure energy awareness concepts held by the students by means of twenty cognitive style questions developed from energy education sources. Attitudes toward energy conservation and social or political factors relating to the energy shortage were assessed by way of ten statements requesting agreement or disagreement as a response. The values placed on the statements were arrived at by consulting energy education literature and knowledgeable individuals and agencies associated with the Oklahoma Public Awareness Program. A control group at one school was given the instrument but not the treatment, which was the demonstration program.

The second phase of the study occurred in January of 1984 and was done to assess the current levels of energy awareness of those students still available for re-testing who were present in the original research group. The long term phase of the study was intended to seek indications that the demonstration program was still influencing the students.

The study was set up as a series of three case studies, due to the nature of the experimental conditions. The results of each case study will be presented separately.

School A Case Study

School A had the smallest sample of the three schools; 15 students were available for the first part of the research and 6 students for the second part.

The Energy Awareness Questionnaire was administered to the seventh grade students at School A on the morning of April 30, 1979. The presentation was given to the students in the afternoon. The instrument was readministered to the students four days after the energy presentation during the initial phase of the research. During the final phase of the research the instrument was given to the students still present at the school in 1984, by which time the students were high school seniors.

School A Cognitive Data Analysis

The short term results indicated that the student's mean scores on the energy concepts portion of the instrument improved markedly after receiving the treatment. Raw scores on the pretest resulted in a mean of 6.80. Out of 20 pretest questions, then, School A students gave correct responses 34 percent of the time. The mean on the four day postest was 11.07, which corresponds to 55.4 percent. Thus, there was a sizeable increase of 21 percentage points between the pretest and posttest mean scores during the initial phase of the study.

Less than half of the students who took part in the 1979 study contributed to the second phase of the study. The 1984 mean score on the cognitive part of the instrument was 11.83, or 59.2 percent. This indicates that the awareness level increased over the long term even more than the short term, which does not explain the effects of the treatment. The mean, standard deviation, and standard error of the cognitive responses of the School A students on the pretest, 4 day posttest, and 57 month posttest are listed in Table I.

TABLE I

MEAN, STANDARD DEVIATION AND STANDARD ERROR (SCHOOL A)

Test	N	M	SD	SE
Cognitive Pre	15	6.80	1.72	1.48
Cognitive Post (4 days)	15	11.07	3.87	1.64
Cognitive Post (57 mo.)	6	11.83	1.72	1.53

The range of correct responses on the cognitive pretest varied from a low raw score of 4 to the highest raw score of 9, or from 20 percent correct to 45 percent of the items answered correctly by at least one student. The number of items answered correctly on the four day posttest ranged from 4 (20 percent) to 17 (85 percent). The range of the correct responses on the 57 month posttest varied from 8 (40 percent) to 15 (75 percent). A check of the frequency distribution of the pretest versus the posttest scores by School A students on the instrument (Table II) illustrates the improvement on the upper end of the test scores. For example, highest pretest score (9) was surpassed by nine students on the four day posttest.

TABLE II

FREQUENCY DISTRIBUTION (SCHOOL A)

Pretest			4 Day Posttest			57 Month Posttest		
Raw Scores	Percent Correct	Frequencies	Raw Scores	Percent Correct	Frequencies	Raw Scores	Percent Correct	Frequencies
9	45	4	17	85	1	15	75	1
8	40	2	16	80	1	13	65	1
7	35	2	15	75	1	12	60	2
6	30	2	14	70	2	11	55	1
5	25	4	13	65	2	8	40	1
4	20	1	12	60	1			
			11	55	1			
			9	45	1			
			8	40	2			
			6	30	2			
			4	20	1			

Student performance on the instrument based on the number of correct responses to each cognitive item, is presented in Table III. This table summarizes the major results on the cognitive items of the questionnaire, and general trends relating to the effect of the program treatment can be inferred from this data.

The results in Table III show that students increased the number of correct responses on the twenty energy knowledge questions in 16 out of 20 items on the four day posttest. A decrease in correct response percentages occurred in two instances and no change occurred twice. The strength of the percentage increases was noteworthy, as items 1, 2, 4, 8, 9, 13, 14, 15, 17, and 20 illustrate. The highest gain was 60 percentage points, for item 14. The largest decline in the correct response percentage was 13 percentage points for item 6, concerning energy conservation.

The summarized data for the 1984 long term energy awareness reassessment (Table III) do not indicate a functional influence that the presentation of the program may have had over a time period of so many months. The students scored higher overall on the 1984 posttest than on the 1979 posttest; the 1979 posttest was given shortly after the demonstration program was presented. However, based on the six students present for the 57 month posttest, the long term correct response per item actually decreased compared to the four day posttest for half of the questions (4, 7, 8, 9, 11, 14, 15, 17, 19, and 20), while it remained the same or almost the same for three questions (5, 10, and 13). The reason that the 1984 posttest mean is the highest of the three test administered is because of the very high proportion of correct responses for items 1, 2, 3, 5, 6, and 16. Since this level of energy awareness was not evidenced by the four day posttest results, the students must have been affected

TABLE III

PERCENT OF COGNITIVE CORRECT RESPONSES
(SCHOOL A)

Question	Pretest N = 15	Posttest N = 15	1984 N = 6
1	27%	67%	100%
2	27%	60%	83%
3	20%	27%	83%
4	60%	93%	67%
5	73%	100%	100%
6	73%	60%	100%
7	20%	20%	0%
8	27%	60%	33%
9	47%	73%	33%
10	33%	33%	33%
11	47%	67%	0%
12	47%	40%	67%
13	20%	47%	50%
14	20%	80%	67%
15	20%	67%	50%
16	27%	33%	100%
17	0%	27%	17%
18	53%	53%	67%
19	27%	53%	0%
20	13%	47%	33%

by other influences, which is not unexpected considering the passage of time involved between the short term and long term phases of the study.

School A Affective Data Analysis

The results on the attitude section of the instrument generally showed an improvement in positive attitudes toward energy, conservation, and some of the social factors relating to these issues. The pretest mean score was 30.87 and for the four day posttest the mean score was 32.40. The tabulated responses of the 57 month posttest resulted in a mean of 34.5. The above mean scores are listed in Table IV, along with the individual item means for each group of test administrations.

The results as summarized in Table IV indicate that the presentation had a degree of influence on the students based on their four day posttest scores, although the increase in positive attitudes occurred only half the time (items 22, 23, 24, 28, and 30). Similarly, the 57 month posttest results showed a positive increase over the pretest levels, and the direction of the individual item responses were identical to the four day posttest; negative for questions 21, 25, 26, 27, and 29 and positive for the rest of the items.

The 57 month posttest response values were more positive than the four day posttest responses for seven items, 22, 23, 24, 26, 28, 29, and 30. The wide variation between some of the four day and 57 month posttests, as in questions 23, 24, and 26, indicate that other factors besides the presentation treatment were acting upon the long term affective data. Otherwise the four day posttest attitudes should have been higher than the 57 month results, because the students should have recalled the presentation better soon after it, certainly more than almost five years later.

TABLE IV

AFFECTIVE MEAN SCORES (SCHOOL A)

Question	Pretest N = 15	4 Days Post-Test N = 15	57 Months Post-Test N = 6
21*	2.53	2.64	2.83
22	3.40	3.47	3.67
23	3.47	3.67	4.50
24	3.00	3.20	3.67
25*	2.47	2.57	2.67
26*	3.47	4.07	3.67
27	4.47	3.80	4.00
28	4.20	4.80	4.67
29	1.73	1.40	1.50
30	1.93	2.47	2.50
Total Group	30.87	32.40	34.50

*Values reversed for these items: a higher score indicates a more negative value assigned to the item.

School B Case Study

The School B sample consisted of 39 students, 22 males and 17 females. The instrument was administered to the students the morning of April 20, 1979. The presentation was given to the students in the afternoon. The posttests were given at 3 day, 25 day, and 57 month intervals. The School B sample was analyzed to provide data that would address the research questions, including data involving the performance of male versus female students on one posttest.

School B Cognitive Data Analysis

The results on the three day posttest at School B showed an important increase in the test performance as compared to the pretest results. The mean score rose from 5.74 (28.7%) on the pretest to 10.79, or 53.95 percent. This is a strong increase in the level of energy awareness between the pre-treatment group and the post-treatment group. See Table V for the means, standard deviations, and standard errors relating to these test results.

Table V

MEAN, STANDARD DEVIATION AND STANDARD ERROR (SCHOOL B)

Test	N	M	SD	SE
Cognitive Pre	39	5.74	2.05	1.60
Cognitive Post (3 days)	39	10.79	3.00	1.83
Cognitive Post (25 days)	39	11.18	2.70	1.83
Cognitive Post 57 mo.)	27	8.11	2.98	1.77

An analysis of variance was performed comparing the mean score differences between the pretest and the three day posttest, to determine how significant the results were. The degree change was calculated to be significant at the .01 level. See Table VI for the results of the analysis of the mean score differences of these groups.

TABLE VI

PRETEST-POSTTEST (3 DAYS) COGNITIVE PORTION (SCHOOL B)

	df	SS	MS	F
Between Groups	1	490.85	490.85	71.76*
Within Groups	76	519.5	6.84	
Total	77	1010.35		

* $p < .01$

The next School B posttest was the one administered 25 days after presentation of the treatment to the students. The scoring of this posttest resulted in a group mean of 11.18, or 55.9 percent (see Table V). This mean is almost double that of the pretest mean of 5.74, so this is strong evidence of the influence of the treatment upon the students almost one month after they attended an energy lecture/demonstration. As far as could be determined, the students did not receive any additional formal energy information at the school during this 25 day period, so if any effects due to research history occurred that affected the student performance on this posttest, they were probably external to any school experiences. Since the mean of this posttest surpassed the mean of the first posttest, the results of this mean score in comparison with that of the pretest are on the same order of significance, which probably means that the treatment was still influencing student responses even if other factors such as history or maturation were involved.

The last School B posttest was administered approximately five years after the treatment. The mean score on this posttest was 8.11 (40.55%) and was representative of the 27 students out of the original study group still presesnt at the school in 1984 (Table V). This group score regressed toward the energy awareness level of the pre-treatment group of students. Although this long term posttest indicates superior awareness levels over the pretest levels, it falls short of equalling an attainable goal of about 55 percent awareness level as was accomplished by the earlier School B posttest groups.

The School B long term posttest results were analysed for significance using an F test at the .05 level of confidence, and the difference of the 57 month posttest mean compared to the pretest mean was found to be non-significant. See Table VII for the summary of this analysis.

The range of student performance on the long term posttest was from 3 (15%) to 11 (55%). This compares to the range of 4 (20%) to 16 (80%) items answered correctly on the pretest.

An item analysis of the correct responses by School B students on the long term posttest revealed results on questions 7, 8, 9, 16, and 17 similar to the School A trends. The correct response percentage for item 7 was 18.5 percent; for items 8 and 9 it was 37 percent; for item 16 it was 33.33 percent and for item 17 it was only 11 percent.

TABLE VII

PRETEST-POSTTEST (57 MONTHS) COGNITIVE PORTION (SCHOOL B)

	df	SS	MS	F
Between Groups	1	89.22	89.22	14.12*
Within Groups	64	404.19	6.32	
Total	65	493.41		

* not significant at the .05 level.

Male/Female Data Analysis

The School B score results on the cognitive portion of the instrument did not yield data indicating a difference on the part of male and female students. Each subsample increased their scores on the three day posttest substantially. The male pretest mean of 5.95 rose to a mean of 11.05 on the posttest. The female pretest mean of 5.82 increased to a mean of 10.41 on the posttest. In this example, the male and females did not show evidence of significant differences when compared to each other as separate groups. The basis for this comparison was an anlysis of variance, which was found to be nonsignificant at the .05 level. The results of this ANOVA are listed in Table VIII and IX.

School B Affective Data Analysis

The comparisons of the results of the School B attitude and opinion responses did not show as strong a relationship between the pretest and posttest score improvements as the cognitive items had. The group mean of the School B students on the pretest was 33.08, and the mean on the

TABLE VIII

ANALYSIS OF VARIANCE SUMMARY TABLE--COGNITIVE PORTION
SCHOOL B MALE PRETEST/FEMALE PRETEST

	df	SS	MS	F
Between Groups	1	.16	.16	.03*
Within Groups	37	193.45	5.23	
Total	38	193.61		

*Not significant at the .05 level.

TABLE IX

ANALYSIS OF VARIANCE SUMMARY TABLE--COGNITIVE PORTION
3 DAY SCHOOL B MALE POSTTEST/FEMALE POSTTEST

	df	SS	MS	F
Between Groups	1	4.8	4.8	.51*
Within Groups	37	347.48	9.4	
Total	38	352.28		

*Not significant at the .05 level.

posttest administered three days after the treatment was presented was 34.56. In both cases these mean scores indicated a favorable or positive view of energy and energy conservation. Table X presents the affective mean group scores and the mean values of each question on the pretest and the series of posttests obtained from School B.

TABLE X

AFFECTIVE GROUP, AND ITEM MEANS (SCHOOL B)

Question	Pretest N = 39	3 Days Post-Test N = 39	25 Days Post-Test N = 39	57 Months Post-Test N = 27
21*	2.72	2.62	3.05	2.44
22	4.15	4.23	4.15	3.30
23	3.54	3.95	3.90	3.74
24	3.44	3.62	3.38	3.33
25*	2.87	2.77	2.51	2.55
26*	2.95	3.41	3.51	2.93
27	3.38	3.62	3.51	3.15
28	4.21	4.79	4.79	4.19
29	2.64	2.21	2.13	2.52
30	3.10	3.28	3.08	3.11
Total Group	33.08	34.56	34.01	31.26

* Values for these items are reversed: a higher score indicates a more negative value.

Pre-Three Day Posttest

An analysis of the results of the affective responses in Table X reveals that the three day posttest attitudes indicated a positive increase over the pretest attitudes in 8 out of 10 items, which is noteworthy. An analysis of variance was performed on the School B pretest and three day posttest to determine the degree of significance involved in the affective mean score differences. There was a positive difference between the pretest and posttest means of 1.48 points, but the result of the F test was not significant at the .05 level. Although the total increase in attitude values was not enough to be statistically significant, the influence of the program treatment on the attitude levels on the three day posttest can be inferred as being worthwhile, based on the increase mentioned above. See Table XI for the summary of the ANOVA results for the three day posttest.

TABLE XI

ANALYSIS OF VARIANCE SUMMARY TABLE SCHOOL B
PRETEST/THREE DAY POSTTEST

	df	SS	MS	F
Between Groups	1	42.71	42.71	3.60*
Within Groups	37	901.48	11.86	
Total	38	944.19		

*Not significant at .05 level.

Pre-25 Day Posttest

The affective results of the 25 day posttest at School B do not compare as favorably with the pretest responses as did the three day posttest data. The trend of the 25 day posttest is inconsistent, with increases in positive attitudes occurring as many times as increases in negative ones, and two responses had the same or nearly the same values.

Pre-57 Month Posttest

The difference between the raw score mean of the affective pretest and the 57 month posttest was 1.76 on the negative side of the scale. The difference was analysed with an analysis of variance to determine the extent of its importance. The results of the *F* test indicated a significant difference between the two means at the .05 level. Refer to Table XII for the summary of the analysis of variance.

TABLE XII

ANALYSIS OF VARIANCE SUMMARY TABLE FOR PRETEST-57 MONTH POSTTEST

	df	SS	MS	F
Between Groups	1	.71	.71	2.63*
Within Groups	37	4.91	.27	
Total	38	5.61		

*Significant at .05 level.

Examination of the 57 month posttest results on the response item analysis in Table X confirms the negative trend of the attitude responses. The responses were more negative compared to the pretest in 5 out of 10 items, similar responses occurred twice, leaving three positive value increases. This posttest therefore, does not give an indication that the demonstration program was the single factor influencing the current energy awareness levels and attitudes of the School B students.

Male/Female Data Analysis

The mean scores of the male and female responses on the affective portion of the pretest were 33.82 and 32.12, respectively (Table XIII). Their scores on the three day posttest rose to 34.5 for the males and 34.65 for the females. Although their individual item mean values did show some variance (Table XIII) the data from their performance on the posttest indicates that the energy program was successfully internalized to a degree by male and female students at about the same rate. This is further borne out by the fact that an analysis of variance performed on the male and female mean score differences on the pretest and the three day posttest resulted in a finding of no significance between their behaviors on the research instrument. See Table XIV and Table XV for the summaries of the ANOVA results.

School C Case Study

The School C data was collected by administering the instrument to a control group of 25 seventh grade students prior to the presentation of the program. These students did not attend the lecture/demonstration, and were retested twelve days after the first testing to obtain reliability data about the instrument, and to obtain baseline data with which to compare the experimental groups. The experimental groups consisted of three intact classes totaling 54 students. The energy program was

TABLE XIII

AFFECTIVE MALE AND FEMALE GROUP AND ITEM MEANS (SCHOOL B)

Question	Female Pretest N = 17	Male Pretest N = 22	3 Days Female Posttest N = 17	3 Days Male Posttest N = 22
21	2.47	2.91	2.47	2.73
22	3.94	4.32	4.41	4.05
23	3.59	3.55	4.00	3.91
24	3.24	3.77	3.59	3.64
25	2.76	2.96	2.71	2.82
26	2.65	3.18	3.00	3.73
27	3.24	3.45	3.59	3.64
28	4.29	4.14	4.94	4.68
29	2.88	2.32	2.41	2.05
30	3.06	3.18	3.29	3.27
Total Group	32.12	33.82	34.65	34.50

TABLE XIV

ANALYSIS OF VARIANCE SUMMARY TABLE--AFFECTIVE PORTION
SCHOOL B MALE PRETEST/FEMALE PRETEST

	df	SS	MS	F
Between Groups	1	25.07	25.07	1.96*
Within Groups	37	473.76	12.80	
Total	38	498.83		

*Not significant at .05 level.

TABLE XV

ANALYSIS OF VARIANCE SUMMARY TABLE POSTTEST
MALE/POSTTEST FEMALE

	df	SS	MS	F
Between Groups	1	14.73	14.73	1.36*
Within Groups	37	387.92	10.48	
Total	38	402.65		

*Not significant at .05 level.

presented and the experimental groups were administered the instrument three days after the date of the lecture/demonstration. Long term reassessment of the students' levels of energy awareness was not possible at School C.

School C Cognitive Data Analysis

The control groups' mean scores on the research instrument were combined so that a mean of 7.56 represented the baseline data. This compares with a mean of 9.71 for the 4th hour class, 8.47 for the 5th hour class and 8.94 for the 7th hour class. The mean, standard deviation and standard error of each group's performance on the instrument is summarized in Table XVI.

TABLE XVI

MEAN, STANDARD DEVIATION AND STANDARD ERROR (SCHOOL C)

Test	N	M	SD	SE
Cognitive Control	18	7.83	2.40	1.83
Cognitive Control (Retest)	18	7.28	2.41	1.84
Cognitive Post (3 Days) 4th Hr.	21	9.71	2.62	1.86
Cognitive Post (3 Days) 5th Hr.	17	8.47	3.03	1.77
Cognitive Post (3 Days) 7th Hr.	16	8.94	2.90	1.72

The three experimental group means exceeded the control group mean by a range of from 4.2 to 10.75 percentage points. The highest raw score attained by the control group was 13 (65%) out of 20 items answered correctly, and the lowest was a score of 2, or 10 percent. The highest score of any of the experimental groups was a 17, the lowest was a 3, and the corresponding percentages ranged from 85 percent down to 15 percent.

To investigate the importance of the improvement in the mean scores some statistical methods were employed. An $\underline{F}$ test was performed on each of the three experimental groups, comparing their data to that of the control group. The .05 level of confidence was used.

The results of the comparison of the mean of the baseline data to that of the 4th hour class indicated that a significant difference existed, at the .01 level. The summary table of the analysis of variance for this comparison is listed in Table XVII.

TABLE XVII

ANALYSIS OF VARIANCE SUMMARY TABLE--COGNITIVE PORTION SCHOOL C BASELINE/4th HOUR POSTTEST (3 DAY)

	df	SS	MS	F
Between Groups	1	63.32	63.32	9.82*
Within Groups	55	354.5	6.45	
Total	56	417.82		

*P < .01

Similarly, $\underline{F}$ tests were used to analyze the importance of the differences in the means for the 5th and 7th hour classes. The differences of their mean scores and that of the control groups was not found to be significant at the .05 level. The results of these analyses are summarized as Tables XVIII and XIX.

Noticeable trends in the responses occurred. The pretest (control) group had the most trouble answering questions 8, 9, 10, 15, 17, 19, and 20. The experimental group also found some of these items difficult to answer correctly.

School C Affective Data Analysis

Since each sample was not pre-tested separately at School C, the attitudes of the individual members of the fourth, fifth, and seventh hour classes were not assessed prior to the presentation of the treatment. A special constraint was operating at School C, since there was no way to accurately expect the control group and experimental groups to be equivalent in their pre-treatment attitudes relating to energy.

Table XX lists the affective mean scores of the various groups of School C students who completed the instrument. The control group mean was 31.81, the fourth hour class mean was 32.72, the fifth period mean class was 33.58, and the seventh hour class had a mean of 32.47. If an assumption is made that the three School C experimental groups would have had pre-treatment attitude levels matching the control group's mean, then a pattern of post-treatment attitude improvement would be present similar to the other case studies. As has been mentioned, however, there is some question whether or not this assumption would be appropriate for the attitude portion of the instrument. Therefore, the School C affective mean data is listed only for informational purposes concerning the students' feelings about energy at a given point in time,

TABLE XVIII

ANALYSIS OF VARIANCE SUMMARY TABLE--COGNITIVE PORTION
SCHOOL C BASELINE/5th HOUR POSTTEST (3 DAY)

	df	SS	MS	F
Between Groups	1	11.14	11.14	1.56*
Within Groups	51	364.87	7.15	
Total	52	376.01		

*Not significant at the .05 level.

TABLE XIX

ANALYSIS OF VARIANCE SUMMARY TABLE--COGNITIVE PORTION
SCHOOL C BASELINE/7th HOUR POSTTEST (3 DAY)

	df	SS	MS	F
Between Groups	1	8.31	8.31	1.21*
Within Groups	50	342.69	6.85	
Total	51	351.00		

*Not significant at the .05 level.

TABLE XX

AFFECTIVE MEAN SCORES (SCHOOL C)

Question	Control N = 18	4th Hour Posttest N = 19	5th Hour Posttest N = 17	7th Hour Posttest N = 16
21	2.71	2.89	2.71	2.47
22	3.50	3.47	3.82	3.75
23	3.40	3.84	4.53	3.88
24	3.10	3.63	3.29	3.75
25	2.70	2.68	2.00	2.38
26	3.06	3.58	3.41	3.63
27	3.22	3.11	3.76	3.50
28	4.06	4.26	3.76	4.25
29	2.78	2.00	2.59	1.80
30	3.28	3.26	3.71	3.06
Total Group	31.81	32.72	33.58	32.47

and not for purposes of evaluating the energy demonstration program's effectiveness at this school.

The students at School C placed a high positive value on the item stating that most energy conservation measures are a matter of common sense. Also, scoring high was the belief that Americans need to use energy more wisely. These responses had a fairly high value on the control group pretest, and this trend became more pronounced on the part of the experimental groups after they received the treatment.

For purposes of clarity, the major results of the research are summarized.

Summary of General Study Trends

Cognitive Trends

The School B student responses indicated the lowest pre-treatment energy knowledge levels as measured by the instrument used in the study. These same students increased their energy awareness performance levels on the instrument by a greater margin than the other two schools and had the highest single posttest mean score, 11.18 (55.9%) on the short term phase of the study. This score represents an almost 100 percent increase in correct responses in the pretest and 25 day posttest performance.

The School C students had the highest pre-treatment cognitive performance on the instrument during the initial phase of the research. The experimental groups at School C had the lowest cognitive post-treatment test results.

Important differences on the part of the male and female cognitive pretest awareness levels were not found. Both groups appeared to react in the same positive way to the presentation treatment.

School A students performed better than the School B students on the long term posttest involving the cognitive section of the instrument, but other factors may have been operating besides the treatment.

Affective Trends

The variability of the three samples regarding the pre-test attitude levels was minor, with group mean values ranging from 30.87 at School A, to 33.08 at School B, and 31.81 at School C. All three student groups increased their affective mean scores somewhat after attending the lecture demonstration. The highest short term group mean increase in affective scores which occurred after the treatment was achieved by the School B students, followed by the School C fifth hour group.

Long term trends were available only for Schools A and B. Results were conflicting, as School A students increased their long term attitude scores notably, while School B students had a significant reduction in their performance. A logical expectation concerning the long term research would be that the long term performances would be lower than the short term results. Because the School A longevity group mean score increased substantially over the short term scores, and because some School B long term item responses indicated an ambivalence not present in the short term responses, no conclusion about the long term effect of the energy awareness program can be made regarding this category.

CHAPTER V

SUMMARY

The purpose of this study was to evaluate the effectiveness of an educational program designed to raise the awareness and understanding levels of the Oklahoma public about energy, to determine if it had positive short term and long term influences on typical public school audiences. Three schools located in three different counties in north central Oklahoma agreed to provide research subjects for the study.

The research was conducted in two phases. The first phase took place in the latter part of April and the first part of May, 1979, and was done to obtain short term information about the effectiveness of the demonstration program. The second phase of the research was undertaken in January of 1984 to assess the current energy awareness levels of the original research subjects still present at the schools. This second segment of the research was done in an attempt to determine if the demonstration program was still influencing the students. In addition, the retesting was accomplished to determine if any student deficiences in energy knowledge or attitudes were still present.

The specific samples originally present in each school consisted of 15 seventh grade students in School A, 39 seventh grade students in School B, and 79 seventh grade students in School C. At the time of the final assessment of the energy attitude and awareness levels which the students exhibited as high school seniors, only 33 students from the original sample population were still available.

A series of three individual case studies was used to evaluate the Energy Awareness Demonstration Program, which was an interdisciplinary lecture/demonstration multimedia program. Student knowledge and attitude levels concerning energy use, production and conservation were assessed using an instrument designed by the author. This Energy Awareness Questionnaire consisted of two segments. Part I contained 20 cognitive style question on energy. Ten affective statements requesting responses ranging from "strongly agree" to "strongly disagree" comprised Part II of the instrument. The Energy Awareness Demonstration Program was used as the treatment in this research, and was presented to each of the sample schools.

School A Case Study

During the first stage of the research, a pretest-posttest design was employed at School A because of its small size which precluded the use of control groups. The instrument was administered to the students at School A on the morning of April 30, 1979, by their teacher. The lecture/demonstration on energy was presented that afternoon by the author. Four days later the teacher again administered the instrument. The results of both tests administrations were transferred to data cards to aid in computer scoring.

The long term reassessment of the energy knowledge and attitude levels of the six remaining School A subjects was completed in January, 1984. Responses on the questionnaire were hand graded.

The results of the School A data indicated that the Energy Awareness

Demonstration Program resulted in mean score increases on the posttest, as compared to the pretest results. The strength of these increases varied; the cognitive results showed a strong relationship while the mean increases on the short term affective portion questions indicated a lesser but still notable positive influence.

Long term trends were inconsistent in that higher than expected results were involved, indicating that other factors were influencing the data. This was to be expected due to the lack of control for other variables. The long term reassessment brought out several student deficiencies relating to energy knowledge, and this information could be used to improve the energy demonstration program.

School B Case Study

School B also had limited class sizes so a pretest-posttest design was initiated there on the morning of April 17, 1979. A teacher administered the pretest to 39 students and later that afternoon the author presented the energy lecture. Three days later the teacher readministered the questionnaire. Twenty-five days after the presentation the students again completed the instrument. The first posttest provided data on gender so that male/female performance could be compared.

A 57 month interval separated the initial and secondary research phases. Questionnaires were completed in January, 1984 by 27 individuals from the original study sample. An attempt to obtain gender characteristics of the 1984 sample was unsuccessful.

Results from this case study indicated that the program was successful in improving the performance of the School B students on the test instrument, as the mean score almost doubled between the pretest and the

25 day posttest. The three day posttest exhibited very strong indications of the program's influence, and the affective scores on this test administration also underwent a positive change.

The responses at School B by females and males did not indicate significant differences in their respective knowledge levels or attitudes. Additionally, both groups responded in about the same manner as a result of attending the energy/lecture, that is, they improved by essentially the same margins, according to _F_ tests performed to analyze the data.

The 57 month cognitive posttest resulted in a mean score that was higher than the pretest but lower than the two previous posttests, and trends similar to the deficiences pointed out by the School A students cast doubt about the actual influences the treatment may have had on this posttest. This data could be used in improving the program, however,

Long term affective results illustrated a negative change that was significant; however, other factors appeared to affect the long term data, so the findings are not definitive.

School C Case Study

School C was large enough to provide a control group for the study. It was desired to change the research design at this school so that a pretest administration would not have the potential for affecting the results by way of a practice, or sensitizing effect. A design similar to the separate sample pretest-posttest design was employed, by which the control group would provide the basis for comparing the results of the experimental group.

The control group of 25 students was administered the instrument prior to the date of the presentation, but the treatment was withheld from them. Faculty at School C administered the instruments and the author presented the energy talk.

The control group, numbering 18 students due to absenteeism, was retested 12 days after the presentation. The presentation was given to the experimental group consisting of 54 students from three separate classes on April 24, 1979. Three days after the lecture program was hosted by the school the experimental groups completed the questionnaire. This completed the cycle of research at School C, as an attempt to obtain useable long term data there was unsuccessful.

The results of the School C program evaluation indicated that the demonstration program was successful in improving the performance of seventh graders on an energy knowledge instrument. One group, the fifth hour class, improved its performance significantly on the posttest as compared to the control group baseline data. The other two classes likewise showed an improvement based on attendance at the lecture/demonstration, although their improvement was not as pronounced as the fifth hour class.

The affective School C data was useful in assessing the attitudes the students had toward energy use and conservation. Due to the variables involved in assigning attitude values to persons other than the originating individuals, no attempt was made to compare the control group's attitudes to those of the experimental group. Item responses by the various School C groups indicated that all of the groups were probably homogeneous, in which case the improved attitudes on the part of the treatment groups as compared to the control group are probably noteworthy.

Conclusions

This evaluation was undertaken to determine answers to the following research questions:

1. Did the material presented in the Energy Awareness Demonstration Program result in improved student knowledge about the energy situation?

The majority of the results of this study indicated that the Energy Awareness Demonstration Program resulted in substantial amounts of improved student knowledge about the energy situation.

2. Did the material presented in the Energy Awareness Demonstration Program result in improved student attitudes concerning the energy situation?

Based on the majority of research findings appropriate for investigating attitude changes, the material presented in the Energy Awareness Demonstration Program resulted in improved student attitudes regarding the energy situation.

The findings of this study indicate that, among the sample population of a selected public school in north central Oklahoma, no important differences existed on the part of male and female students regarding energy knowledge and attitude levels. The potential for equal interaction exists on the part of the males and females in regard to energy education programs such as the Energy Awareness Demonstration Program.

The results of this study indicate that it is easier to change student perceptions about energy facts and concepts than it is to change student attitudes concerning energy use and conservation.

Recommendations

It is recommended that any future evaluations of the Energy

Awareness Demonstration Program be expanded to include larger sample sizes so that more generalized conclusions can be made.

The reliability of the instrument would probably be improved by adding more items. The decision to keep the research tool short was a conscious one based on several factors. A moderate increase in the test length would probably be beneficial.

Based on the experiences in this research, further refinement in the wording of some of the research instrument questions for purposes of clarity is recommended.

Certain items on the instrument indicated that there is a lack of knowledge on the part of the students; this trend occurred when they were junior high school students as well as when they were seniors. The fact that their energy knowledge levels were low at a time when they were at the end of their K-12 public education instruction suggests that they needed to have these deficiencies addressed prior to this. Also, the energy awareness program benefits appeared to have lessened with the passage of time, as would be expected, and other instructional mechanisms are needed to reinforce and/or address these problem areas. It is recommended that programs similar to the energy awareness program as well as traditional formal classroom instruction using teachers trained at energy education workshops be continued.

Attitude changes on the part of the students in this research were not as dramatic as the cognitive item changes. But a larger impact may result from the less sizeable changes in positive energy attitudes because persons who believe there is a need for energy conservation will have greater success in reducing energy consumption than those who may know how to save energy but neglect to do so. Therefore, it is recommended that efforts to engender positive energy attitudes continue.

This study has touched on some of the positive effects of a one event educational program, and the program can be inferred as being very worthwhile and of high quality. The federal and state financial budget constraints of the 1980's has resulted in funding cutbacks for many educational programs, including, in the fall of 1982, funding for the Oklahoma Energy Awareness Demonstration Program. If the past use of energy in this country has any messages for us, as this study has pointed out, the time may come when new priorities will have to be set in terms of the goals of education.

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APPENDIX A

ENERGY AWARENESS DEMONSTRATION PROGRAM OBJECTIVES AND STANDARDIZED PRESENTATION

OBJECTIVES AND OUTLINE OF PRESENTATION

Introduction--Energy Talk

1. Definitions: energy the ability to do work.
   - A. Kinds of Energy:
     1. Potential energy (resting brick or ball or balloon)
     2. Kinetic energy (energy in motion; move brick or bounce ball or release balloon).
     3. Forms of energy conversion: mechanical, electrical, chemical, nuclear, and heat energy
   - B. Energy Efficiency.
     1. Measure height ball bounces with yardstick.
   - C. Thermodynamic Laws (Chart--"good news and bad news").
     1. Law #1: Energy neither created or destroyed.
     2. Law #2: Any use of energy (conversions) results in some energy becoming unavailable for practical use.
   - D. Exer-cycle (human conversion of energy).
     1. Using muscle energy results in heat, perspiration, and hunger (food as energy/metabolic need/calories).
     2. Low efficiency of energy conversions from muscle power.

2. U.S. Energy Resources/Consumption Patterns (chart/slides)
   - A. Finite Supplies: Supply Problems/Recovery Problems.
     1. Petroleum: (vial sample) Typical uses:
        - a. Heavy use: Petro-chemicals; medicines; fertilizer; plastics; synthetic clothes.
        - b. Fuel properties: engines, boilers.
        - c. Production/Exploration.
     2. Natural Gas: (sample) Typical uses:
        - a. Fuel properties: boilers.
        - b. Production/Exploration
     3. Coal: (sample) Typical uses:
        - a. Fuel properties: boilers.
        - b. Production/Exploration
        - c. Environmental problems
     4. Hydroelectric: Use
        - a. Limitations
        - b. Environmental problems
     5. Nuclear: Use
        - a. Fission/process
        - b. Safety factors--outside
        - c. Safety factors--offsite (wastes)

3. Oklahoma Energy Resources/Consumption Patterns
   - A. State's Mineral Wealth

B. Production Rankings

4. Current Energy Problems, Affect all Levels of Society

   A. Supply/Demand

   B. Imports are harmful due to: national security, employment picture, inflation/stagnation ("stagflation"), economic growth (Gross National Product), trade deficits, currency devaluations.

   C. Wasteful energy use; "throwaway" society.

   D. Energy crisis a long term and ongoing problem.

5. Solutions to Energy Problem, No Single Solution.

   A. Alternate Energy Sources, Two Leading Sources:

      1. Solar (examples: cells and collectors)
         a. Advantages: non-polluting, non-finite, free
         b. Disadvantages: low intensity, storage problems, intermittent source, costs
      2. Windpower (model)
         a. Windpower actually a solar source
         b. Advantages: non-polluting, non-finite, free
         c. Disadvantages: technical problems (DC to AC), legal questions, costs,"scenery pollution"

   B. Future Sources not yet as far Along as Solar and Windpower, or on such a Large Scale:

      1. Oil Shale
      2. Tar Sands
      3. Biomass Conversion (cellulose and Biogas)
      4. Recyling/Pyrolysis/Wastes
      5. Tidal Energy
      6. Nuclear Fusion
      7. Hydrogen Fuels

6. Problems with Alternate Sources in General

   A. Long Research and Development Lead Times

   B. Cost Effectiveness at Time of Marketing

7. In the Meantime, What can be done to Reduce Crisis?

   A. Use less energy (conservation); goal of 5 percent reduction in energy use in Oklahoma by end of 1980.

8. Energy Conservation

   A. Definition--"Wise Use"

   B. Important Qualities of Conservation

      1. Low investment (current technologies)
      2. Low cost measures that result in high returns
      3. Non-fossil fuel

   C. Consumers are the basis of energy use decisions

   D. Conservation measures mostly a matter of common sense

9. Ten Conservation Measures; Ways of Saving Energy in:

   A. Schools--Availability of Workshops

   B. Cars (slides), Walk or Bicycle when Possible

      1. Car pool
      2. 55 mph saves lives as well as energy

   C. Homes (slides)

      1. Passive solar housing design; close/open drapes as required
      2. Thermostat settings
      3. Turn off appliances, lights, stereos when not in use
      4. Energy efficient appliances, EER numbers
      5. Lighting: demonstration
         a. Florescent lights
         b. Vapor lights--sodium and mercury
      6. Water heater energy savings:
         a. Lower temperature setting
         b. Install solar water heater
      7. Weatherstrip/caulk air leaks (display)
      8. Insulate: "thermograms" (infra-red detector)
      9. Wood-burning stoves/fireplaces
      10. Availability of energy audits for residences

10. Population is Related to Energy Use

    A. Energy Clock: Population increases; BTUs consumed

    B. U.S. Population and Energy Use: 1/6 of world's population uses 1/3 of the world's energy

    C. U.S. as Exporter of Goods and Raw Materials, a Supplier as Well as a Consumer

11. Spaceship Earth: Whole world inter-related and inter-dependent

Questions

Closing Remarks

Five Minute Sample of the Standardized Presentation

Good morning! My name is Leon Kot, I am from Oklahoma State University, and I am very glad to be here with you this morning. Our presentation is called an Energy Awareness Demonstration Program, and I am going to talk about energy and why its such an important subject on a lot of people's minds today. The reason you students are important in regard to the current crisis affecting energy in our country and the world, is because everyone here in this room uses energy, and everyone can do something about helping America out of the energy crisis. We can all use less energy; and perhaps someone in this room will one day make an energy discovery or invent something that will result in an important change in the way people go about using energy.

We adults have had our chance to leave our world a little better off than the shape it was in when we found it, in terms of energy use and other things. But I must say that, frankly, we blew it. And now the next generation, you people here, will have a lot harder time maintaining the quality of life we have become accustomed to in this state, and in this country, at least regarding cheap and abundant energy sources and availability.

But I do not want to sound too pessimistic! While this presentation is designed to challenge you to decrease wasteful energy uses, we also hope it will give you a glimpse of some of the many opportunities which the current energy shortages may provide in the way of future careers in the energy exploration, development and marketing fields, which are undergoing continual technolgical change.

First let me say, that during the program if any of you think of any questions to ask about something I bring up concerning energy, at the end of the talk we will have some time to answer questions, so remember them for later, if you will. Also, I will request volunteers from the people in the audience to answer a few questions or come up on stage to assist in some demonstrations. So I would really appreciate any help you can give me, OK?

In order to talk about energy we must first define it. Does anyone want to offer a definition for energy? (pause for possible responses) No? Well, very simply stated, energy is the ability to do work. And there are two main kinds of energy: potential energy and kinetic energy.

Potential energy is like the name implies: there is a potential for energy to be used. For instance, this brick that is at rest on the table can be said to have potential, or stored, energy. But if I pick it up, which by the way, takes muscular energy on my part, if I pick it up and throw it, it would then have energy in motion, which is called kinetic energy. So let me bring out some of the potential energy stored in this brick, (the brick is a piece of foam rubber made to look like a standard red housing brick. It is tossed to a previously selected student volunteer who, rather than catching it, lets it hit the floor. Instead of the expected noisy crash the brick merely bounces softly). What did you two flinch for? You just do not trust me, do you? As we have seen, even a "fake" brick that is lighter than a real one, possesses potential and kinetic energy. Could I have the brick back, please? (Brick is returned) Thank you.

There are various forms of energy uses or conversions. Energy conversions are the different ways energy is used or transformed. Some examples of the different forms of energy conversions are: mechanical, chemical, electrical, heat, and nuclear. Does anyone know an example of a common energy machine that uses mechanical energy? (pause for a correct response) A car? Yes, it illustrates mechanical energy. What other forms of energy conversions are involved in getting energy or power from a car? (pause) How about heat energy? Cars use internal combustion engines, and a by-product or waste product of a car engine is heat--the engine gets hot when its running, does it not? Another form of energy a car uses is the chemical conversion of the gasoline into the power that propels the automobile. Is there any other form of energy conversion which is involved in operating a car? (pause) How about electrical transformations? (a student responds affirmatively) Right; cars do utilize electrical energy, such as the battery, and in the transmission of the elctrical sparks to the cylinders by way of the distributor, coil, and spark plug wires. The last conversion process I mentioned is nuclear energy transformations. Nuclear energy conversions involve the energy present in atoms, usually of radioactive elements like uranium or plutonium. An example of a nuclear energy resource would be the production of electricity from a nuclear energy utility.

Another concept of energy I would like to introduce at this time is energy efficiency. Let me use this "superball" to demonstrate a simple example of energy efficiency. I will use a yardstick to measure the height the ball bounces. (ball is dropped and measured) Notice the ball bounced back to about three-fourths of its original height; let me show you again. (process is repeated) So we can see that the ball had an energy efficiency of about 75 percent, because three-fourths is the same thing as 75 percent.

This "superball" is very efficient in transforming its potential energy into kinetic energy. In fact, if all of the energy conversions in use today were 75 percent efficient we might not be in the midst of an energy crisis. But most of our energy processes in use today waste energy, and this lost energy is due to several things. One reason is that our past use of energy was not very wise because energy costs were cheap and we could afford to waste a lot of energy. But the main reason we do not get more kinetic energy out of the potential energy in our energy sources or fuels is because of the natural laws governing energy use.

These natural laws are referred to as the thermodynamic laws or the laws of conservation of energy. (pointing to chart) There is good news and bad news about how these thermodynamic laws affect energy efficiency. The first law of thermodynamics states that energy is neither created or destroyed. This sounds like good news. However, the bad news is that whenever energy is used or converted from one form to another, some of it becomes unavailable for use, which is stated as the second law of thermodynamics. This unavailable energy may be displaced as heat, or pollutants, or as chemical molecules; for example, a car engine froms water when the qasoline is burned in the combustion process, carbon monoxide and other pollutants are also formed, and much heat is generated. The second thermodynamic law results in a car engine having only about a 20 percent energy efficiency. Many of our modern energy conversions are not overly efficient, and it takes a lot of raw energy to yield a small amount of usable energy because of the natural laws that exist in the universe.

APPENDIX B

ENERGY AWARENESS QUESTIONNAIRE

ENERGY QUESTIONNAIRE

Part I

Directions: Answer the following questions by circling the letter of the best response. Circle only one answer for each question.

1. The energy shortage is a problem at which social level?

   A. Individual person B. State level C. National level D. All of these

2. What is the major source of air pollution in America today?

   A. Industrial plants B. Plants that generate electricity C. Automobiles D. Diesel engines

3. The best answer to our energy problem is:

   A. Solar power B. Wind power C. Bioconversion D. Energy conservation E. All of these

4. Which fossil fuel is the most heavily consumed (used) in the U.S.?

   A. Petrolum B. Natural gas C. Coal

5. Which fossil fuel is consumed (used) the least in the U.S.?

   A. Petroleum B. Natural gas C. Coal

6. Energy conservation is important to all Americans because:

   A. We can no longer afford to waste energy.
   B. Energy consumption has doubled in recent years.
   C. The energy sources we use the most are in shorter supply.
   D. All of the above.

7. America now imports how much of its petroleum needs?

   A. 25-30% B. 30-35% C. 35-40% D. 40-45% E. 45-50%

8. American's population makes up about how much of the world's population?

   A. 4% B. 6% C. 8% D. 10%

9. American's consume (use) about how much of the world's energy?

   A. 10-20% B. 20-30% C. 30-40% D. 40-50%

10. Of the following statements, which is not a correct answer or reason for the rapid increase in the use of electricity in recent years?

    A. In many ways electricity is a very convenient form of energy.
    B. Electricity can be stored very effectively.
    C. Electricity can be easily transported and converted to usable forms.
    D. Rate costs of electricity.

11. Solar energy has several disadvantages (faults). Which of the following are disadvantages (faults)?

    A. It is of low power B. It can not be easily stored C. It is not a steady source D. All of these

12. Which is a disadvantage for developing the western U.S. coal reserves?

    A. Abundant reserves are available.
    B. The sulfur content is low.
    C. Environmental problems.
    D. They can be surface mined (strip mined).

13. Which is the biggest energy user in the U.S.?

    A. Commercial sector B. Industrial sector C. Residential (Homes) D. Transportation

14. Conservation is an important part of energy planning because:

    A. It is a low investment procedure.
    B. It is a low cost procedure.
    C. It is not a fossil fuel resource.
    D. All of the above.

15. The Nuclear power process currently in use in the U.S. is:

    A. Fission B. Pyrolysis C. Breeder reactor D. Fusion

16. Currently, what part of society makes most of the decisions about the way energy is used?

    A. Individual consumer B. Federal Government C. Oil & Gas companies D. None of the above

17. Petroleum and natural gas supplies are currently used for what percent (%) of America's energy needs?

    A. 40-50% B. 50-60% C. 60-70% D. 70-80%

18. Oklahoma may be a potential supplier of which alternate energy sources?

    A. Solar B. Wind C. Geothermal D. A and B E. All of these

19. Among the states in the U.S. producing crude oil, where does Oklahoma rank?

    A. 1st B. 2nd C. 3rd D. 4th E. 5th

20. Among the states in the U.S. producing natural gas, where does Oklahoma rank?

    a. 1st B. 2nd C. 3rd D. 4th E. 5th

Part II

Directions: For the following statements, use the answer key below. Mark the letter of the choice that voices your opinion in front of the question.

Example:

________ 20. I believe there really is an energy crisis.

A = Strongly Agree
B = Agree
C = No Opinion
D = Disagree
E = Strongly Disagree

________ 21. Modern technology will solve the energy crisis so that future energy shortages will not be a problem.

________ 22. The 55 mile per hour speed limit helps save energy and should be obeyed.

________ 23. Most energy conservation measures are a matter of common sense.

________ 24. The basic economy of the U.S. is largely dependent upon the cost of energy.

________ 25. Energy conservation is the answer to our energy shortages.

________ 26. We will never run out of convenient forms of energy, but will only have to pay higher prices for them.

________ 27. Population growth is directly related to energy usage.

________ 28. Americans need to use energy more wisely.

________ 29. Nuclear power is a safe energy process today.

________ 30. I have changed my habits concerning energy use since the energy crisis occurred.

V

VITA

Leon Stanley Kot, Jr.

Candidate for the Degree of

Doctor of Education

Thesis: AN EVALUATION OF THE OKLAHOMA STATE ENERGY AWARENESS PROGRAM AT THE SEVENTH GRADE LEVEL

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