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ABSTRACT

This document is the outcome of a study designed to investigate the energy-related attitudes of several different groups of science students and science teachers both before, and after working with an energy-environment simulator for approximately an hour. During the interaction with the simulator, the participants decided upon the variables they wanted to include in the study and to interact with each other, such as population growth, personal-energy use, and the distribution of natural resources. The results of the study indicated that significant changes do occur, and suggested that the energy-environmental simulator was responsible, at least in part, for attitudinal changes in several different groups of science students and in-service teachers. The document contains the names of people to contact for a presentation and/or demonstration on "Energy and the Environment." (Author/GA)

THE EFFECTS OF AN ENERGY-ENVIRONMENT SIMULATOR UPON SELECTED ENERGY-RELATED ATTITUDES OF SCIENCE STUDENTS AND IN-SERVICE TEACHERS

by

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ABSTRACT

During the past several years, there has been an increased interest in energy related topics. This interest is apparent in both the professional journals and in the popular news media. Many science teachers are including energy related lessons in their curriculum, and the Department of Energy is allocating significant sums of money to help increase the public's awareness of energy related topics, problems, and possible alternatives available to the consumer.

The purpose of this study was to investigate the energy related attitudes of several different groups of science students and science teachers both before and after working with an energy-environment simulator for approximately one hour. The simulator used in this study was a portable, analogue computer designed to increase the student's understanding of the relationships which exist among several different variables relating to energy demands and the effect that these demands have upon the resources and the environment.

Several groups of science students and in-service teachers were administered a short Likert-type questionnaire designed to test their attitude toward energy related problems. The students were then exposed to a brief lecture/demonstration which utilized the "time machine" to focus upon variables such as the world's energy resources, the demands placed upon these resources by the various countries, and the environmental impact of these demands. The class was then sub-divided into six groups and each group was given a lap board containing twenty-two

control knobs which permitted student interaction with the computer. The students were then instructed to make what they felt would be appropriate decisions relating to energy use and production. The computer was then activated and several variables such as population growth, personal energy use, and the distribution of natural resources began to interact based upon the decisions made by the students. A digital counter indicated the number of elapsed years, and lights and buzzers served as monitors of the available resources. The simulation terminated when the non-renewable fossil fuels were depleted, and the number of elapsed years indicated the degree to which the class was successful in "running the world".

The results of this study suggested that the energy-environmental simulator was responsible, at least in part, for attitudinal changes in several different groups of science students and in-service teachers.

One significant aspect of this study was to demonstrate the value of using this type of simulator in helping to create an academic environment conducive to the study and discussion of energy related topics and problems.

INTRODUCTION

During the past several years there has been an increased interest in energy related topics. This interest is apparent in both the professional journals and in the popular news media. Many science teachers are including energy related lessons in their curriculum, and the Department of Energy is allocating significant sums of money to help increase the public's awareness of energy related topics, problems, and possible alternatives

available to the consumer.

Most of the public awareness programs and science syllabi use education (as opposed to propaganda or other alternatives) as the primary means of increasing knowledge and/or attitudes. This approach is reinforced by Nelson (1) who writes that education is the most effective means available to us of changing values and attitudes to create a new environmental citizenship, in which man will come to understand his role and responsibility as a custodian of life on this earth. In an article concerning three energy-related issues (pollution, energy-resource allocation, and human population density), Whiting (2) also mentions the importance of education and knowledge as being part of the energy crisis solution.

In a study of environmental knowledge and attitudes, Ramsey and Rickson (3) discuss the moderating influence of education (knowledge) upon attitudes. They also suspect that the relationship between knowledge and attitudes is confounded by the stage at which a social movement is found to be.

Several different educational approaches have been used as a means of changing attitudes. A recent study by Quinn (4) was conducted to determine whether value sheets (short lessons accompanied by a series of personally involving questions) cause high school students to change their expression of selected environmental attitudes. He concluded that the value sheets did not change the attitudes of the students in the experimental groups as measured by the attitude survey instrument used. He also found that the pretest was a significant learning experience for the experimental group and the control group in 10 out of 32 items on the attitude survey.

Crater (5) examined the influence of a summer institute upon attitudes relating to nuclear energy. Specifically, he studied the opinions of 23 high ability science students while they were attending a summer program in Nuclear and Environmental Science. He also surveyed an additional 27 students attending a similar program in mathematics. He used a Likert-type summated rating scale to survey the students' attitudes of nuclear science both before and after attending the summer program. His findings indicated that, in general, these students were very optimistic about the future as it relates to nuclear science. An earlier study of the same general topic by Crater (6) detected a great deal of uncertainty and ambivalent attitudes on the part of college students. Another finding in Crater's later study (5) was that an increase in knowledge of nuclear energy was not accompanied by either a favorable or unfavorable change in attitudes.

One particular program of the U.S. Department of Energy is called, "Citizen's Workshops on Energy and the Environment". It is this program and its effects upon people's attitudes which forms the basis of this study. The Citizen's Workshops are designed to acquaint the public with the complexities of the energy-environment situation, and they have also been used effectively at in-service teacher workshops and in science classes at both the high school and college level. Fazio and Dunlop (7) reported cognitive score gains for college students exposed to a series of six energy-related lectures which utilized the Department of Energy's workshop as the basis for the lectures.

As stated in the Citizen's Workshop Handbook (8), the participants are given an opportunity to face, in a simulated situation, the same kinds

of decisions encountered by real-life policy makers, and to learn more about the complex relationships among energy demands, energy supplies, and environmental pollution. This activity is accomplished through the use of an analogue computer which is designed to serve as an energy-environment simulator. The simulator has been likened to a time machine which allows time to pass at a rate equivalent to 100 years per minute of actual time. The participants decide upon levels of energy production and utilization. The objects of the simulation, as in real life, are to maintain an adequate supply of energy for as long a period of time as possible and to keep the environment as clean as possible.

In addition to the time clock, the simulator utilizes the functional areas of energy supply, energy pools, energy demands, and environmental impact. Further, the participants must make decisions relating to population growth rates, food production, and personal energy demands. These 31 variables are manipulated by the participants from remote panels which are distributed throughout the room. There are an infinite number of outcomes to each simulation, and it is probable that no two groups will ever reach the same results. A diagram of the energy-environment simulator's front panel is included as Appendix A.

OBJECTIVES

The main objectives of this study were to examine six energy-related attitudes (opinions) held by students and teachers and to then investigate the effects, if any, of an energy-environment simulator upon these attitudes.

The problem was examined in terms of the following null hypotheses:

1. There is no significant difference between the mean opinion scores of senior high science teachers before and after working with an energy-environment simulator.
2. There is no significant difference between the mean opinion scores of elementary teachers before and after working with an energy-environment simulator.
3. There is no significant difference between the mean opinion scores of elementary education majors before and after working with an energy-environment simulator.
4. There is no significant difference between the mean opinion scores of arts and science students before and after working with an energy-simulator.
5. There is no significant difference between the mean opinion scores of elementary teachers and secondary teachers prior to working with an energy-environment simulator.
6. There is no significant difference between the mean opinion scores of elementary teachers and secondary teachers after working with an energy-environment simulator.

In addition, the following research questions were examined:

1. What is the general opinion of students and teachers as measured by the six selected energy-related statements?
2. When people do change their opinions (attitudes) after working with an energy-environment simulator, what are

the probabilities associated with these types of changes?

3. What type of response do people give when asked to summarize their point of view concerning the energy situation?

DESIGN AND PROCEDURES

Since a primary goal of this study was to investigate changes in energy-related attitudes resulting from a person's interaction with an energy-environment simulator, it was necessary to develop a mechanism to obtain the required data. After a consideration of the time constraints generally associated with the simulator workshops, it was decided that a short opinion survey would best fit the needs of the study.

Originally this survey contained four Likert-type statements and one open-ended question; however, it was soon expanded by adding two additional statements. The six statements were selected because of their general nature and because of their close relationship to the concepts comprising the simulation. These statements include such things as the influence of population growth rates upon energy-related problems, the rate of technological development, the role of coal in helping to overcome an energy shortage, America's use of worldwide energy resources, and the existance of an energy problem in the world today. (A copy of the entire survey is included as Appendix B.)

After the survey instrument was developed and tested, several citizen's workshops were identified so that the participants would include elementary teachers, secondary science teachers, elementary majors, and arts and science majors. Each workshop lasted approximately one hour. At the

beginning of the hour, each participant was asked to respond to the survey. The next 15 minutes involved an introduction to the operation of the simulator (analogue computer) followed by approximately 15 minutes of demonstrations. The remainder of the hour was used by the participants to interact, within a semi-structured setting, with tne simulator.

Interaction was accomplished by the use of "lap boards" which contained several of the computer's essential controls. Approximately 4-6 students shared each lap board and each of these groups represented a "country". Each group was free to manipulate the 31 energy-related variables as it deemed necessary. Through the use of long extension cords these lap boards were "plugged into" the computer which reacted according to the sum of the demands placed upon it by the "countries".

At the end of the hour, each participant was again asked to complete the opinion survey. Codes and/or names were used so that pre and post data could be matched for any given individual. The sign test as described by Siegel (9) was used to determine the probabilities associated with the changes of group attitudes, and t-tests were used to compare mean scores of several groups.

RESULTS

The data in Table 7 was gathered prior to any treatment, and it may be used to answer research question number one. It may be seen from this table that 96% of the people surveyed either agree or strongly agree that there is an energy problem existing in the world today. The data also indicate that most (88%) of the people feel that there is something that

the average consumer can do to help reduce such a problem. However, the people do not seem to understand the role of population growth rates upon the energy situation nor do they understand the time frame needed for new technology (at current rates of development) to become available on a large scale.

The sign-test data in Table 1 are useful in examining the second research question which deals with the probabilities associated with an opinion change once such a change occurs. When examining the data by group, one can see that group two (elementary teachers) has the greatest significance associated with their attitude changes. One can also see that the attitude changes related to Likert-statements one and three have greater significance than do the changes related to the other statements.

When asked to summarize their point of view concerning the energy situation, (research question number three) most of the respondants gave a view which was judged to be a "positive" attitude. For the purposes of this study a "positive" attitude was defined as one which would support sound conservation practices or was, in general, one which would recognize the energy problem and makes comments about working toward an improvement of the situation. Although there were some extreme answers such as, "Energy will last forever" or "The technology of our times has provided us with enough energy to last in my lifetime, and so I am not worried", the majority of the responses were similar to the following 1) "The fact exists that we are going to run out of fossil fuels, so we need to develop an alternative source of energy" 2) "I feel that the energy problem which

exists must be solved by cooperation between the average consumer and the big business complex." 3) "More people need to be made aware of the energy situation from a neutral point of view".

An analysis of each individual's "before" and "after" view of the energy situation indicated that a great majority (over 90%) of the people do not change their general view, even though they may have drastically changed their view of a specific issue as measured by their responses to the Likert-type statements. For those individuals who did change their general view, the change was frequently in a "positive" direction. The sign test probability associated with this change was 0.109.

The data in Tables 2-5 may be used to investigate the first four null hypotheses. These hypotheses are all relating to attitude changes as the result of working with the energy-environmental simulator. With the exception of the elementary teachers who had significant pre-post opinion changes for each Likert-type statement, the rejection of the null hypothesis will depend upon which specific attitude (Likert-type statement) is being considered. However, if one examines the twenty possible cases (totals from Tables 2-5) it may be seen that significant attitude changes occured in fourteen instances (70%).

Hypotheses 5 and 6 compare elementary and secondary teachers with respect to their attitudes both before and after working with the energy-environment simulator. The data from Table 6 does not permit the rejection of either of the last two hypotheses.

TABLE 1 - Sign Test Probabilities associated with the opinion change of four groups of people for each of six Likert-type statements.

Likert Statement Number	Senior High Science Teachers (7-12)	Elementary Teachers (K-6)	Elementary Science Methods Students	Arts & Science College Students
1	.062	.002	Small n	.018
2	.344	.006	.363	.254
3	.008	.001	.006	.018
4	.500	.048	Small n	.291
5	No Data*	No Data*	.274	.006
6	No Data*	No Data*	.006	.151

*Statements 5 and 6 were not included in this survey.

TABLE 2 - Paired t values calculated from pre and post-treatment opinion surveys for Senior High Science Teachers

Group		$\bar{x}$	s	t
		Statement Number One.		
Pre	17	4.41	0.51	
Post	17	4.71	0.47	3.35*
		Statement Number Two		
Pre	17	2.41	0.94	
Post	17	2.35	1.17	0.94
		Statement Number Three		
Pre	17	2.82	1.24	
Post	17	2.35	1.11	2.95*
		Statement Number Four		
Pre	17	2.59	1.12	
Post	17	2.65	1.73	0.72

*$p < .05$ (one-tailed test)

TABLE 3 - Paired t values calculated from pre and post-treatment opinion surveys for Elementary Teachers.

Group		$\bar{x}$	s	t
		Statement Number One		
Pre	43	4.23	0.72	
Post	43	4.53	0.63	3.18*
		Statement Number Two		
Pre	43	2.23	1.00	
Post	43	1.98	1.08	2.01*
		Statement Number Three		
Pre	43	3.00	1.07	
Post	43	2.02	0.83	6.26*
		Statement Number Four		
Pre	43	2.47	1.20	
Post	43	2.07	1.16	2.42*

*p < .05 (one-tailed test)

TABLE 4 - Paired t values calculated from pre and post-treatment opinion surveys for Elementary Science Methods Students.

Group		$\bar{x}$	s	t
		Statement Number One		
Pre	19	4.58	0.51	
Post	19	4.79	0.42	2.19*
		Statement Number Two		
Pre	19	1.63	0.60	
Post	19	1.68	0.95	0.22
		Statement Number Three		
Pre	19	2.53	0.96	
Post	19	1.79	0.92	2.58*
		Statement Number Four		
Pre	19	2.00	0.82	
Post	19	1.74	0.73	2.04*
		Statement Number Five		
Pre	19	4.11	0.94	
Post	19	4.05	1.03	0.20
		Statement Number Six		
Pre	19	3.11	1.05	
Post	19	2.16	0.96	3.51*

*$p < .05$ (one-tailed test)

TABLE 5 - Paired t values calculated from pre and post-treatment opinion surveys for Arts and Science college students.

Group	n	$\bar{x}$	s	t
		Statement Number One		
Pre	25	4.08	0.76	
Post	25	4.40	0.71	2.32*
		Statement Number Two		
Pre	25	1.92	0.81	
Post	25	1.80	0.65	1.00
		Statement Number Three		
Pre	25	3.36	0.70	
Post	25	2.68	1.03	2.80*
		Statement Number Four		
Pre	25	2.12	0.97	
Post	25	2.08	1.00	0.00
		Statement Number Five		
Pre	25	4.16	0.75	
Post	25	4.64	0.49	2.86*
		Statement Number Six		
Pre	25	2.64	0.86	
Post	25	2.24	0.66	1.85*

*$p < .05$

TABLE 6 - A summary of t test values for the opinion survey comparisons between Elementary and Secondary Teachers.

Statement	Elementary Teachers (n=43) $\bar{x}$	s	Secondary Teachers (n=17) $\bar{x}$	s	*t-value
Pre-Treatment					
1	4.23	0.72	4.41	0.51	1.09
2	2.23	1.00	2.41	0.94	0.66
3	3.00	1.07	2.82	1.24	0.53
4	2.47	1.20	2.59	1.12	0.37
Post-Treatment					
1	4.53	0.63	4.71	0.47	1.21
2	1.98	1.08	2.35	1.17	1.13
3	2.02	0.83	2.35	1.11	1.11
4	2.07	1.16	2.65	1.73	1.27

*$p < .05$ when $t \geq 2.07$

TABLE 7 - A summary of the responses made by approximately 130 people to six Likert-type statements.

Statement	% Disagree or Strongly Disagree	% No Opinion	% Agree or Strongly Agree
1. There is an energy problem existing in the world today.	3	1	96
2. Even if an energy problem exists, there is very little that the average consumer can do to help reduce the problem.	88	1	11
3. At current rates of research and development, new technology will soon (25 years or less) provide us with safe, large-scale solutions to the much discussed energy problem.	34	16	50
4. Population growth rates have only a small influence on energy-related problems.	69	1	30
5. Americans use more than their "fair share" of the world's energy resources.	5	11	84
6. The use of coal could be a long-term solution to the energy problem.	43	14	43

DISCUSSION AND CONCLUSIONS

The focus of this study has been upon the changes of attitudes of four groups of people (elementary teachers, secondary science teachers, elementary majors, and arts and science majors) after having worked with an energy-environment simulator for approximately one hour.

The data indicate that significant changes do occur as a result of the one hour presentation. Since the simulator was the focus of the presentation, it is reasonable to conclude that it was responsible, at least in part, for the attitudinal changes which occured. As Quinn (4) demonstrated, the use of a pretest may itself become part of the learning experience. However, pilot studies have indicated that this is not a major factor in this study. Further, Crater (5) has demonstrated that an increase in knowledge does not automatically result in increases or decreases in attitude scores. In fact, he reported that an increase in knowledge of nuclear energy was not accompanied by either a favorable or unfavorable change in attitude.

The data also suggest that when examining attitudes it is necessary to distinguish between a general attitude and a specific attitude relating to a very narrow topic. In this study the treatment did not cause any significant changes in general attitudes; however, changes in attitudes relating to specific issues after the treatment were very common. Further, the sign test data suggest that the probabilities associated with opinion changes are closely related to the nature of the specific issue.

As pointed out in the results, the elementary teachers had the greatest significance associated with their attitude changes. The reason for this is not certain; however, it has been suggested that familiarity with the issues may be an important factor. Future studies will investigate this general

question.

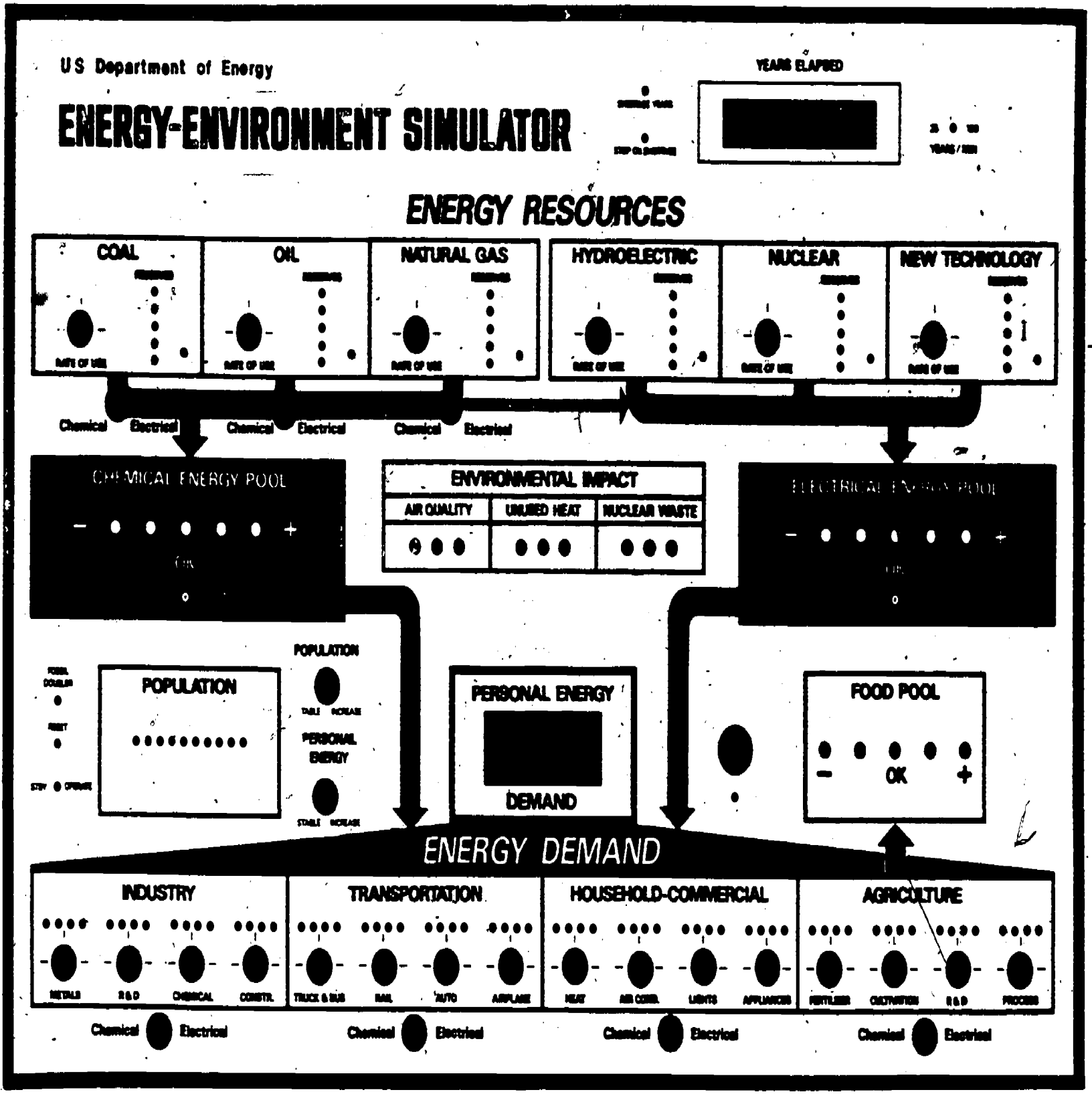
Although many of the elementary teachers taught some science, they did not consider themselves science teachers. For the most part, their science background was limited to one or two science courses which they took in college. The secondary teachers were all certified to teach science, and their background in that area was extensive. It was interesting to note that even with this major difference, the treatment had virtually the same effect upon both groups of teachers. Further, their pre-treatment attitudes were not significantly different nor were their post-treatment attitudes significantly different from each other. If this "trend" (to affect people with significantly different backgrounds in science in much the same manner) continues, it would increase the potential use of this type of presentation.

Finally, the data indicate that teachers and college students are very aware of the energy problem. Further, they feel that individuals can be part of the solution. It would appear that these groups of people could be of great service to the country by "spreading the word". However, many of them (even the science teachers) have attitudes which suggest the need for additional training in the area of energy-environment problems and possible solutions. One possible method of achieving this end would be through the use of an energy-environment simulator in an expanded training session. Additional thought toward this and other approaches is recommended.

Appendix C contains the names of people in your area to contact for a presentation and/or demonstration.

APPENDIX A

NORCUS



ge and University Association for Science
, Richland, WA 99352 • Telephone 509/943-3176

APPENDIX B

Male _____ Female _____ Science Teacher? _____

ENERGY OPINIONS

Instructions: For each statement please circle the term which best describes the degree to which you agree or disagree with the statement.

1. There is an energy problem existing in the world today.

   STRONGLY DISAGREE DISAGREE NO OPINION AGREE STRONGLY AGREE

2. Even if an energy problem exists, there is very little that the average consumer can do to help reduce the problem.

   STRONGLY DISAGREE DISAGREE NO OPINION AGREE STRONGLY AGREE

3. At current rates of research and development, new technology will soon (25 years or less) provide us with safe, large-scale solutions to the much discussed energy problem.

   STRONGLY DISAGREE DISAGREE NO OPINION AGREE STRONGLY AGREE

4. Population growth rates have only a small influence on energy-related problems.

   STRONGLY DISAGREE DISAGREE NO OPINION AGREE STRONGLY AGREE

5. Americans use more than their "fair share" of the world's energy resources.

   STRONGLY DISAGREE DISAGREE NO OPINION AGREE STRONGLY AGREE

6. The use of coal could be a long-term solution to the energy problem.

   STRONGLY DISAGREE DISAGREE NO OPINION AGREE STORNGLY AGREE

7. Please write <u>one sentence</u> which you feel represents and summarizes your point of view concerning the much-discussed energy situation.

APPENDIX C

on Energy and the Environment

Citizens' Workshops are educational programs that give citizens an opportunity to learn more about energy and environmental needs and problems. Participants get a chance to try their hand at solving some of the energy-environment problems facing the nation today by using an Energy-Environment Simulator.

THE ENERGY-ENVIRONMENT SIMULATOR

The Energy-Environment Simulator is a specially designed analog computer that simulates real-world conditions. Energy resources, energy demands, and environmental effects are programmed into the electronic device. As the clock speeds time by at the rate of a century a minute, participants must make decisions about the allocation of energy resources. They do this by operating controls on remote panels in response to the changing situation. The simulator constantly translates these commands into new conditions. The sequence continues until all the fossil fuels are exhausted—and the game ends.

THE WORKSHOPS

The workshops now being scheduled have as many as three parts: (1) a slide orientation dealing with the basic facts related to energy problems; (2) a decision-making game played by participants using the Energy-Environment Simulator to observe the effects of a wide range of decisions involving energy use and environmental protection; and (3) a feedback session where questions raised by the program are discussed.

PLANNING A WORKSHOP

Any organization may plan a workshop, which will be scheduled when equipment and personnel are available. The ideal number is 25-35 participants, which gives each person a chance to work with the Energy-Environment Simulator. More participants can be accommodated, however, and the program has been conducted for as many as 1600. There is no cost for participating in workshops but occasionally a sponsoring organization may be asked to pay the workshop leader's transportation and expenses. Each workshop may last from 1 to 3 hours, depending upon the type of program and the amount of time it takes for the discussion. Abbreviated programs can be arranged where time is limited. In service clubs, for example, that meet during the noon hour, the program may simply consist of a brief discussion and a demonstration of the Energy-Environment Simulator.

SPONSORSHIP

Citizens' Workshops are operated for the U.S. Department of Energy by selected educational and research institutions. The activities of these institutions are coordinated by the Northwest College and University Association for Science located in Richland, Washington. One of a number of public information programs sponsored by the DOE, Citizens' Workshops are designed to create an awareness of current energy problems, possible solutions and environmental consequences. Leaders are encouraged to present facts in a responsible manner and to avoid the advocacy of special "solutions" or "causes." With an emphasis upon the broad perspective, Citizens' Workshops are concerned with the total energy picture.

HOST REQUIREMENTS

Local organizations wishing to sponsor a workshop are asked to provide a suitable place for the workshop and to support the program by encouraging its members to participate. Since timely publicity will amplify the educational effect of the workshop, sponsors are requested to assist in publicity arrangements such as contacting the media, scheduling interviews with the workshop leader, and arranging local coverage. The workshop leader will furnish publicity materials.

Citizens' Workshops on Energy and the Environment

Citizens' Workshop
To arrange for a Citizens' Workshop presentation, contact the workshop leader nearest you. (The workshop leader nearest to you may be in a neighboring state.)

Additional assistance is available from:

DR. JOHN YEGGE
DR. GARY SCHOEPFLIN
NORCUS
100 Sprout Rd.
Richland, WA 99352
(509) 946-3588

or

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Mr. WALLY DRISCOLL
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Ricks C.
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Mr. ROY TAYLOR
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REFERENCES

1. Nelson, G. "Transforming Man's Attitudes Toward the World." In J. Gudmundsen [Ed.], This Fragile Earth. Wisconsin Department of Public Instruction Newsletter 24:4, 1970.

2. Whiting, P. "Biology and Politics." American Biology Teacher 39:107-108; February 1977.

3. Ramsey, Charles E. and Roy Rickwon. "Environmental Knowledge and Attitudes." Journal of Environmental Education 8:10-18; Fall 1976.

4. Quinn, R.E. "Using Value Sheets to Modify Attitudes Toward Environmental Problems." Journal of Research in Science Teaching 13:65-69; January 1976.

5. Crater, Harold L. "What Opinions Do High School Students Hold About Nuclear Science?" School Science and Mathematics 77:495-501; October 1977.

6. Crater, Harold L. "Opinions of College Students About Nuclear Science." The Science Teacher 39:33-34; December 1972.

7. Fazio, Frank and David L. Dunlop. "The Development of an Energy-Environment Assessment Instrument." Paper presented at the National Association for Research in Science Teaching Convention, Cincinnati, March 1977.

8. Department of Energy (formerly Energy Research and Development Administration). Citizens' Workshop Handbook: Energy and the Environment; Distributed by the Northwest College and University Association for Science, 100 Sprout Road, Richland, Washington 99352.

9. Siegel, Sidney. Nonparametric Statistics for the Behavioral Sciences, McGraw-Hill Book Company, New York, 1956.