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AN EXPERIMENTAL COMPARISON OF ALTERNATIVE METHODS FOR PROMOTING ENERGY CONSERVATION EDUCATION IN HIGH SCHOOLS

By

Martin Gregory Kushler

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ABSTRACT

AN EXPERIMENTAL COMPARISON OF ALTERNATIVE METHODS FOR PROMOTING ENERGY CONSERVATION EDUCATION IN HIGH SCHOOLS

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The purpose of this study was to experimentally evaluate different educational system interventions designed to encourage high school teachers to teach about energy conservation in their classes. Four alternative methods were examined (teacher consultation, energy committee consultation, teacher workshop, and teacher workshop with a "task-oriented" component), along with a no-treatment control group. A total of 111 high schools throughout Michigan were randomly assigned to one of the five conditions.

The results reveal that it was indeed possible to influence high school teachers to teach energy conservation topics. All four experimental conditions recorded significantly higher levels of energy conservation instruction than the control group (approximately three to four times as many hours of instruction per teacher). There were no significant differences between the four experimental conditions, although the two workshop conditions tended to produce the most positive results.

The eventual experimental impacts on the students in the participating schools were also examined, in terms of student energy conservation attitudes and self-report of energy conservation behavior. There was a slight trend toward the experimental groups scoring more positively than the control group on both attitudes and self-reported behaviors, but neither comparison was statistically significant.

These experimental results, together with related correlational analyses, are presented and discussed. Finally, some conclusions and implications for public policy are offered, along with some recommendations for further research.

To Charlene,

the most significant finding in my life

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Special thanks must also go to the Energy Administration of the State of Michigan, for facilitating this research. I hope that such cooperation will serve as a model for other government agencies considering the merits of research and evaluation.

While I'm at it, I should also thank the major league baseball players and owners for their prolonged summer strike, which enabled me to devote weekends and evenings to completing the writing of this document.

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CHAPTER I

INTRODUCTION

The Energy Problem

There can be no doubt about the seriousness of the energy problem faced by the United States. Since the Arab oil embargo of 1973, the adverse economic and social impacts of excessive energy consumption have become painfully obvious. In terms of economic costs, the price of both gasoline and heating oil have risen over 400 percent since 1973, with prices showing no signs of ending their upward spiral. These dramatic price increases and periodic supply interruptions have literally threatened the lives and livelihood of millions of low income Americans as well as substantially contributing to inflation and economic decline or stagnation for most American workers and their families. In addition, the dependence of the United States on foreign sources of supply has produced severe balance of payments problems, which adversely affect the American economy. Further, this dependence on foreign oil, which has grown from 19 percent in 1960 to nearly 50 percent in recent years, also makes the United States vulnerable to a cut off of supply, which would have devastating effects on the well-being of Americans. This latter factor has contributed to a new rise in militarism within the United States, a development whose consequences, while currently unforeseeable, may ultimately be quite tragic. Clearly the energy situation is one of the most serious problems facing this country and demands acute attention.

A Historical Perspective

Prior to discussing a potential means for helping to solve this energy problem, however, it is useful to consider how this situation came about. To begin, the most basic cause of the current problem is simply the history of over-consumption in the United States. The United States, with six percent of the world's population, consumes roughly one-third of the world's energy (Cook, 1971; Department of Energy, 1977). As one might suspect, a great deal of this consumption is waste. Several European countries, for example, sustain equivalent standards of living with only one-half to three-quarters the per capita energy consumption (Darmstadter, Dunkerley & Alterman, 1977).

For years, the United States was able to support this over-consumption because it was itself a prodigious producer of energy. In fact, until fairly recently, the United States was still the largest producer of oil in the world. Two development occurred, however, whose intersection has led to the current dilemma. First, in 1970, after over 100 years of operation, domestic oil production reached its peak and began to decline. It has continued that decline ever since. Meanwhile, consumption continued to grow, which resulted in a doubling of oil imports from 1973 to 1979, at which point the United States was importing nearly 50 percent of the oil it consumed.

The second development, occurring not independently of the first, was the dramatic rise in economic power of the petroleum exporting countries. The Organization of Petroleum Exporting Countries (OPEC) cartel succeeded where many other international cartels for other products had failed, and by the end of 1979 the price of a barrel of oil was 10 to 15 times higher than in 1970. The end result of these developments is that the United States has become embroiled in an energy predicament of unprecedented proportions.

A Word About Production

One obvious approach for solving the United States energy problem would be to increase domestic production to meet the high level of demand. This proposed solution has several features which make it at least superficially attractive and has very recently been given greater prominence with the occupation of the White House by a new administration. First, there is something psychologically pleasing about a dynamic word like "production," whereas "conservation" seems to imply stagnation and sacrifices. Stobaugh and Yergin (1979) illustrate this perception by citing the words of the head of the Texas Railroad Commission: "This country did not conserve its way to greatness. It produced itself to greatness" (p. 173). They go on to discuss a more revealing factor, however, by pointing out that, in great contrast to the energy production sector, there has been virtually no organized economic interest group or constituency tied to conservation (with the exception of the relatively small insulation industry). The result of such factors has been a latent cultural bias, until recently somewhat understated by the nation's leaders, toward "producing our way out of this mess." Whatever the root causes, this bias is a pervasive one and has tended to impede necessary efforts at conservation (Morell, 1981).

But what is the potential for increased production? It is a fact that virtually every new nonrenewable energy source being proposed has substantial economic and environmental costs, as well as long lead times prior to significant production. This is true for synthetic fuels, shale oil, tar sands and even nuclear energy[1]. Unfortunately, space does not permit a detailed review of the limitations of these potential energy sources. There are, however, several good discussions of this subject which the reader is encouraged to examine (e.g., Lovins, 1977; Stobaugh & Yergin, 1979; Hayes, 1979; McCloskey, 1981).

Even in the areas of more conventional fuels, such as coal, oil and natural gas, there are severe limiting factors. The large, easily recoverable deposits of these resources have long since been tapped. Further exploration is both more expensive and more environmentally risky. How much is America willing to pay for energy, in production costs, in increased health risk, and in costs to the aesthetic and recreational value of public lands or the fishing and recreational value of the coastal areas where off-shore drilling is proposed? These are tough questions that must be answered when considering expanded domestic energy production.

The most optimistic of forecasters enthusiastically state that America may possibly yet have oil reserves equivalent to all the oil it has already consumed. A more appropriate way to consider the same forecast might be to say that America has already used up at least one-half of all the oil reserves it will ever have. Assuming that it were possible (and most argue it is not) to simply boost domestic production enough to meet the demand curves of the recent past, even these more optimistic estimates of new oil reserves would be largely depleted in 30 to 40

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[1]It is also interesting to note that even if nuclear energy were expanded, it would do little to solve the major United States energy problem, which is oil. Only about 8 percent of the nation's total oil consumption is utilized for electricity generation and much of that is in small "peak load" generators which must be rapidly brought on and off line. Large nuclear and even coal-fired generators are inappropriate for that use.

years, a mere flicker of time on the human calendar (Bartlett, 1977; Stout & Myers, 1978). Should the United States with six percent of the world's population go on consuming one-third of the world's energy even if it were technically feasible to do so?

The Case for Conservation

It should be quite clear by now that the United States wastes a good deal of energy. Much of the housing stock, commercial properties and practices, and industrial processes were designed and built in an era of cheap and abundant energy. Similarly, many wasteful human habits and behaviors were developed and ingrained during that era. The potential for energy savings is tremendous. After a lengthy and detailed study, the Harvard Business School concluded that energy consumption could be cut 30 to 40 percent in the United States with no drop in the standard of living. They recommended a policy of conservation and development of renewable energy sources as the most appropriate energy policy for the remainder of this century (Stobaugh & Yergin, 1979). Similarly, numerous other studies have shown conservation to be the cheapest, fastest and most environmentally benign way to begin to solve the energy problem (American Institute of Architects, 1972; Hayes, 1976; Federal Energy Administration, 1976; Ross & Williams, 1976; Lovins, 1977; Ross & Williams, 1981).

The old belief that economic growth requires a parallel growth in energy consumption is being refuted (Daly, 1972; Myers, 1975; Schurr & Darmstadter, 1977), and numerous studies have projected that conservation and renewable energy sources will provide greater levels of employment than conventional energy development (Bonneville Power Administration, 1976; Grossmand & Daneker, 1977; Hannon, 1977; Dacy, Kuene & McCoy, 1978; Schachter, 1979). Finally, energy conservation should not be regarded as just a short-term response to temporary energy problems. Despite occasional aberrations, the United States and the world community are moving and must continue to move away from such outdated concepts as "manifest destiny" and unrestrained production, toward a philosophy of "spaceship earth," emphasizing efficiency and controlled growth. Energy conservation is a fundamental and essential component of this necessary transition.

The Role of Psychology

At this point one might ask "where do psychologists fit into all this?" One problem has been that until very recently, the answer would have been "nowhere." As pointed out by various reviewers (e.g., Winett, 1976; Ferber, 1977; Darley, 1978; Morell, 1981; etc.) governmental policies addressing the energy problem have tended to favor technical, production-oriented solutions, emanating from the physical sciences while giving little interest or support to behavioral approaches to energy conservation.

Yet psychologists and social scientists have a great deal to contribute to the solution of the nation's energy problem. Take the residential sector, for example. Counting personal transportation, residential consumption accounts for roughly 35 to 40 percent of all United States energy use and over half of all United States oil use. The potential for impact in this sector is tremendous. As an illustration, the United States Department of Energy publishes a list of low cost/no cost energy saving actions which can be implemented for approximately \$100 and would provide an average household with an estimated 25 percent reduction in energy use. Unfortunately, the unrealized challenge thus far has been to persuade people to adopt these behavior changes and technological modifications. It is here, in relation to the human factor, where social research can help find solutions to a problem that other approaches have failed to solve.

Fortunately, despite the lack of official attention or funding, much research activity concerning this area has occurred within the social science community. Recent reviews by McClelland and Canter (in press), Seligman and Becker (1981), and Stern and Gardner (1981) have been able to point to a growing number of studies featuring the application of psychological research to the field of energy conservation.

Although the funding priority of behavioral conservation research is still unrealistically low (and may in fact be about to decline further), a case can be made that significant progress has been made toward establishing a base of knowledge and research findings in this area. A particularly noteworthy example has been the many field studies on the effects of various types of information feedback to energy consumers, including consumption rates, dollar costs and even weather conditions. Researchers such as Hayes and Cone (1977); Seligman and Darley (1977); Becker (1978); and Winett, Neale and Greer (1979) have found fairly consistent evidence that frequent or continuous feedback can reduce residential energy consumption by as much as 10 to 15 percent. Other encouraging research is also being done in the areas of the effects of pricing and rebates as well as various informational approaches. Some excellent collections and summaries of such work have recently been published (e.g. Anderson & McDougall, 1980).

Finally, Winett predicts, with the necessary emphasis on conservation and renewable sources of energy, and the nature of psychological and behavior change involved in that approach, that psychologists and social scientists will play a greatly increasing role in response to the energy problem.

The Use of the Educational System In Efforts to Solve the Energy Problem

Rationale

One area that has been largely neglected in the national search for responses to the energy problem, though it is ripe for the attentions of social scientists, is the educational system. Although sporadic isolated attempts at energy education have arisen, largely through the efforts of individual educators, the coordinated use of this medium for promoting energy awareness and energy conservation is basically unproclaimed and unresearched.

Yet the reasons for targeting energy conservation interventions in this area are several. First, the educational system is obviously a well established organizational network which would be able to reach large numbers of persons at low cost. Second, efforts targeted at high school age youth, for example, could produce immediate energy savings both as a result of their own actions and as a result of actions they might influence their families to take. Third, efforts targeted at students prior to their assumption of full adult roles and responsibilites could help instill an "energy ethic" which could have a lasting impact in terms of wise future decisions concerning energy use. Finally, surveys of the target population, such as that done in 1978 by the National Center for Education Statistics, concluded that America's students were lacking the basic knowledge of energy and energy conservation facts; showed little evidence of being prepared to select practical energy options for the future; and expected to be able to continue to depend on high energy use. For all of the above reasons, the educational system was chosen as an important target for energy conservation research.

Background

The choice of the educational system as a focus of intervention to promote energy awareness and energy conservation appears to be historically appropriate. To begin at the most general level, the educational system is clearly one of the major contributors to the socialization process in the United States and, as such, affects in varying degree almost all attitudes and behaviors observed in its citizens. Concepts of law, justice, economics, citizenship, etc. are all imparted through educational institutions along with the more basic academic subject matter.

Those within the educational field have long recognized the responsibility education has in terms of preparing students to contribute to a better society (Gatewood & Osborn, 1963; Behavioral and Social Sciences Survey Committee, 1969; Berkheimer, 1971; etc.) and that this responsibility goes beyond training students in just the traditional basic skills (Schmuck, Murray, Smith, Schwartz & Runkel, 1975). To quote from the National Science Teachers Association Position Statement on School Science Education for the 70's: "the goal of science education should be to develop scientifically literate citizens with the necessary intellectual resources, values, attitudes, and inquiry skills to promote the development of man as a rational human being" (Berkheimer, 1971, p. 47). Others have gone further in specifying the necessary goals of today's educational system to include the preparation of students to be responsible and effective in their future decision making and to reflect social and environmental awareness in their personal actions and their participation in the political process (Hungerford & Knapp, 1969; Towler & Swan, 1972; Troost & Altman, 1972).

Certainly, if the educational system is chosen as an appropriate vehicle through which to promote large scale social adoption of energy conservation attitudes and practices, such a decision will hardly be unique. Indeed, there are unmistakable precedents for utilizing the educational system to attempt such an intervention. Perhaps the most striking of these were the heavy increase in emphasis placed on teaching the sciences during the 1960s in response to the "space race" and the rapid establishment of environmental education courses and curricula during the 1970s.

<u>Education and Science</u>. In the late 1950s, it became apparent that the United States was trailing the Russians in terms of progress toward space exploration. Without going into any interpretations of other related motivations, suffice it to say that this perceived problem resulted in a national emphasis on the teaching of the sciences in the schools. The need was perceived as so great that the National Defense Education Act of 1958 was passed which greatly increased federal aid to education. The fact that science education was designated by the U.S. Congress as a "critical area" for national defense led to the production of new subject matter, methods, and materials for teaching science (Tanner, 1969). These "reverberations from the space age" led to the development of many new science curriculum materials (Newport, 1965). For example, three major elementary science curriculum projects (the Science Curriculum Improvement Study--SCIS; the Elementary Science Study--ESS; and Science: A Process Approach--S:APA) were developed during the 1960s and tested in numerous studies throughout the country (Grunau, 1972).

(In fact, many of the studies examining techniques of training teachers in these curricula will be cited later in the rationale for the methods to be proposed in this study.) The National Association of State Directors of Teacher Education and Certification (NASDTEC) and the American Association for the Advancement of Science (AAAS) got into the act and suggested new guidelines for the training of science teachers (AAAS, 1963). In 1967, the National Science Foundation began the funding of training of resource personnel for the new science education programs through Leadership Training and Resource Personnel Workshops (RPWs). In the years since, numerous studies of teacher training, curriculum usage, and curriculum impact have been conducted (Grunau, 1972). As for evaluating all of these efforts, such a task is probably not quantifiable. However, in terms of upgrading the emphasis placed on teaching science in the schools and in terms of producing large quantities of scientists, engineers and technicians (and even in terms of the "space race"), the results of the educational initiative appear quite impressive.

Education and the Environment. The second major educational trend to which this review referred, that of the environmental education movement, seems even closer to the hypothesized energy education movement in terms of problem focus and goals. The problem of environmental deterioration had been long known to a relatively few scientists and conservationists but did not really receive national prominence and widespread attention until the late 1960s and early 1970s. Punctuated most visibly by the international observance of "Earth Day" in 1970, the environmental movement generated considerable notice. In the wake of these activities, the concept of environmental education spread into the schools of the United States (Howell & Warmbrod, 1974). In terms of the success of this effort, surveys have shown the growth in the numbers of environmental education programs since 1970 to be considerable (Trent, 1976).

Similarly, the problem of declining energy supplies had also been known to scientists and conservationists long before it received public attention during the oil embargo and resulting "energy crisis" of 1973-74. Perhaps because of this later emergence of awareness, the concept of energy conservation education has not yet received any widespread implementation or even endorsement. In terms of fostering such endorsement and implementation and designing strategies to be implemented, it seems that much can be learned from the experiences of environmental education.

With the emergence of heightened environmental concern in the late 1960s, educators began to explore the possibilities of environmental education programs (Howell & Warmbrod, 1974). With the passage of the Environmental Protection Act of 1970, the Department of Health, Education and Welfare was given responsibility for initiatives in environmental education (Childress & Wishart, 1976). (This might suggest a similar strategy when considering current or future energy legislation.) Subsequently, the field has grown enormously (as cited previously) and even includes its own Journal (e.g. The Journal of Environmental Education).

In terms of strategy and content, the discipline of environmental education early on seemed to place particular emphasis on providing information to students about the environment, pollution, and the ecological system (Knapp, 1972; Howell & Warmbrod, 1974). This strategy has come under fire by many educators, however, who say that environmental education must also include emphasis on helping students develop environmentally sound attitudes, values and action skills (Stapp, 1970; Knapp, 1972; Howell & Warmbrod, 1974). In the words of Stapp:

> "...for environmental education to achieve its greatest impact, it must: 1) provide factual information which will lead to understanding of the total biophysical environment; 2) develop a concern for environmental quality which will motivate citizens to work toward solutions to biophysical environment problems; and 3) inform citizens as to how they can play an effective role in achieving the goals derived from their attitudes" (p. 31).

Paralleling this view, Hungerford and Knapp (1969) suggest that schools:

> "...should provide a sound environmental education, the goals of which should be the production of a citizen who is personally involved in decisions and practices regarding resource use and management, and whose values are sympathetic to such resource use" (p. 29).

Similar support for including an emphasis on awareness, attitudes, and positive personal and political actions in the goals of environmental education can be found in Swan (1969); Towler and Swan (1972); Troost and Altman (1972); Roth (1973); and Allen, Lattart, Dawson and Patterson (1977). Indeed, this more comprehensive approach seems well suited for the difficult social task of protecting the environment. For similar reasons, a comprehensive approach, including information provision, attitude formation and action skills training, also seems appropriate for energy conservation education.

Education and Energy Conservation. It seems likely that to have any impact on the serious and complex energy problem, the educational strategies adopted must have a broad range of goals such as those outlined above. To begin with, in spite of all the publicity surrounding the "energy crisis," surveys reveal that there is still an amazing lack of knowledge and a high incidence of mistaken beliefs concerning both the nature of the energy problem and the impact of various energy consumption behaviors (e.g. Rappeport and Labaw, 1975, found that 54% of those surveyed believed that keeping a light bulb on continuously uses less electricity than turning it on and off several times during that period; or, similarly, 50% believed that showers use more hot water than baths.) Indeed, Sheafer (1975) feels that "it is an information gap rather than a technical lack which prevents us from realizing some of the potential benefits that would accrue from better management of energy and resources" (p. 1), and that education can play a central role in lessening this information gap.

Attitudes are also an important element in the energy conservation education effort. For example, Pettus (1976) agrees with the goal of information provision and states that citizens must have the knowledge to make sound judgments but adds that students must also be encouraged to develop their beliefs, attitudes and values in order for this education to be effective. Others in the educational field also support this view (Swan, 1969; Hungerford & Knapp, 1969; Roth, C., 1971; Roth, R., 1973). Recent evidence gathered by the Energy Administration of Michigan, in what is probably the most comprehensive research in this area to date, suggests that student attitudes may be an area much in need of intervention. Surveys of over 100,000 high school students in Michigan and in eight other states nationwide have revealed that today's youth in general do not have strong attitudes about energy conservation and are undecided about many issues concerning energy conservation (Stevens, et al., 1978; Kushler & Jeppesen, 1981).

In addition to attitudes, however, the training of students in the skills necessary for action is also an important component of energy conservation education. This seems to be important both in the area of direct energy conservation behaviors (Rappeport & Labaw, 1975; Leedom,

1979) and in indirect areas such as political activity (Hungerford & Knapp, 1969; Towler & Swan, 1972; Troost & Altman, 1972). Indeed, the importance of citizen political activity is crucial according to Common Cause (1978) if effective legislation dealing with the energy problem is going to pass Congress. (Recognizing this fact and the importance of the energy problem, Common Cause has called for a National Energy and Conservation Education Act similar to the National Defense Education Act of 1958.)

Targeting the Intervention of Teachers

The easiest and most direct way to reach large numbers of students is through an intervention directed at teachers. Consequently, various forms of teacher training are generally utilized to implement innovations in educational methods or curricula (Cooper, 1972). Aside from the not inconsequential weight of common sense supporting this strategy, there are also testimony and evidence indicating the usefulness of targeting change efforts at teachers in promoting energy conservation. For example, in a related field, the teachers' attitudes toward science have been found to be positively related to their ability to teach science effectively (Schwirian, 1969). The American Association for the Advancement of Science has developed, as a major guideline for the preparation of science teachers, the need to develop positive attitudes toward science (Cooper, 1972). In turn, it has been found that science teachers' attitudes strongly influence pupil attitudes toward topics, ideas, and materials (Wick & Yager, 1966; Aiken & Aiken, 1969; Pickering, 1970). Finally, the literature reveals that a wide variety of persuasive strategies, including as little as the use of written materials, can have significant effects on science teachers' attitudes toward topics related to science education (Hughes, 1971; Liddle, 1971). Hence, this study will adopt the general strategy of attempting to influence high school student attitudes and behaviors by targeting several intervention strategies at high school teachers in an experimental design. (The supporting literature for the strategies to be used and the description of the actual intervention modes will be presented in later sections.)

Before describing the actual intervention strategies to be utilized in this study, this report will briefly provide an overview of previous energy conservation education research. In particular, an earlier intervention program in Michigan, the results of which greatly contributed to decisions concerning the focus of the current study, will be detailed.

Previous Energy Education Research

Unfortunately, information about educational impact on energy conservation attitudes and behaviors of youth is very scarce. Although a fair amount of study of environmental attitudes has occurred, relatively little research has been published concerning the attitudes of youth toward energy and energy conservation. Those studies that have been reported, however, although somewhat limited in scope, are useful to consider. Some of these are briefly described below.

Ayers (1977) used a 17-item Likert-type questionnaire, developed by the Pennsylvania Department of Education, to measure the attitudes of fifth, sixth and seventh grade students toward electrical power generation and its environmental impact. A total of 496 students completed the instrument. Ayers found that the students had some understanding of the long term problems associated with the energy shortage, including the problems associated with producing electricity from nuclear and fossil fuels. Ayers also reported that females and older students tended to be more cautious in their feelings about the production of electricity.

Fazio and Dunlop (1977) surveyed undergraduate non-science majors in an attempt to measure general background knowledge of energy-related matters. Similar to the previously cited study by the National Center for Education Statistics, they found that students had a poor knowledge of energy facts and concepts (although they reported that the use of energy workshops resulted in significant cognitive gains). It is interesting to note that other authors, in the closely related field of environmental education, have similarly found various educational interventions to be useful in increasing students' positive attitudes toward the environment (e.g. Hounshell & Ligget, 1976; Aird & Tomera, 1977; etc.).

Collins, et al. (1979) examined the effects of an educational intervention on the attitudes of younger students toward energy conservation. They studied the impact of a nine day energy conservation field trip program on 431 youths in grades four through six and discovered significant gains in positive attitudes toward energy conservation. In addition, they found that the amount of attitude change was not related to sex, grade level or community type.

Kuhn (1979) presented the results of a study he conducted in which 413 high school students (grades 10-12) were surveyed with an opinionnaire concerning energy-related issues. He reported a number of interesting findings, particularly involving differences between males and females. He found that females tended to be more positive toward conservation, both in terms of recognizing the importance of individual efforts to conserve as well as in the necessity for government regulation to encourage conservation. In contrast, males were more likely to show faith in technology as a solution to the energy problem, including being more positive toward nuclear power. Interestingly, in investigating some related issues, Kuhn found that, although males were more likely to report that they attempted to keep informed on current issues, there was no significant difference in the extent to which males and females reported considering the future implications of their decisions. Kuhn also found that students who rated themselves as better informed tended to be the most strongly supportive of policies consistent with sound energy conservation and resource development programs.

Finally, one of the most comprehensive efforts in this area was the nationwide study by the National Center for Education Statistics (1978). As mentioned earlier, this study found that student awareness of energy and energy conservation facts was quite low. Furthermore, it is interesting to note that the study found that students seemed to be obtaining what information they did have about energy from the media rather than through schooling. The consultants conducting the study recommended a broad-based effort toward the infusion of energy facts and information into existing school curricula.

In summary, however, with a few exceptions, there has been a general lack of information about the energy conservation attitudes and behaviors of high school students. Furthermore, there is a great lack of evaluation information concerning the energy education curriculum materials being produced in this country (Miller, 1979). Together these factors make the current study both more difficult and more timely.

One notable exception to the general lack of energy education research, however, is a recently completed effort by the Michigan Energy

Extension Service (MEES). Because of the magnitude of this project and its degree of impact upon the current study, this earlier MEES effort will be described here in some detail.

The Michigan Energy Extension Service Pilot Project

In August of 1977, the Department of Commerce, through the Michigan Energy Administration, received a $1.1 million grant from the U.S. Energy Research and Development Administration. This award was one of ten similar grants given to ten pilot states around the country (Michigan, Wisconsin, Washington, Wyoming, New Mexico, Texas, Alabama, Tennessee, Pennsylvania, and Connecticut). The Michigan Energy Extension Service (EES) pilot program was designed to educate Michigan residents about the need for and methods of energy conservation and utilization of renewable energy sources.

The Youth component of this grant made Michigan's proposal unique among the ten states selected. One of the major objectives of the Youth Program was to create an "energy conservation ethic" in 50,000 high school age students. More specifically, the EES Youth Project has also attempted to examine the relative effectiveness of various strategies in terms of influencing attitude change and energy consumption.

The actual field operation of the EES Youth Project was contracted to the Cooperative Extension Service of Michigan State University with a subcontract to the Science and Math Teaching Center, also at Michigan State University.

The pilot was launched in January 1978, in four regions (covering 15 counties). The regions were chosen to include representative samplings of urban, suburban and rural populations, which included areas of agriculture, industry, tourism and government.

Coordinators were hired to implement the program in those four regions. Although there were activities common to all regions, each region had a major thrust of its own. The approaches varied from teacher workshops to assembly programs, and from participation drama presentations to students educating other students or adults (Teen Awareness Teams).

The overall plan of the Youth Program pilot was to "try out" several strategies during the first school year (Phase I) of the project and, upon identifying the most successful strategies, restructure a more effective program to test during the second school year. The strategies utilized in this first phase of the Youth Energy Project are described below.

Teacher Workshops. The teacher workshops were developed and conducted by the Science and Math Teaching Center at Michigan State University. The workshops consisted of a series of three, one-day workshops (spread over several weeks). Participants were initially provided with background information regarding energy along with curriculum materials to use with their students to help them develop an energy conservation ethic. Teachers had the opportunity to use the materials and then return to the workshops to review any problems or questions that might develop in the classroom.

Drama Program. The drama program was developed by two Michigan State University professors. There were three stages to the one-day presentation: the "drama," the workshops, and the "No Drive" campaign.

During the "drama," six graduate students presented several scenarios depicting life in the future. A future without energy, but still with "modern" technology (painless dentistry without benefit of electrical drills, the beauty parlor without electrical hairdryers and curling irons, power lawn mowers replaced by sheep, the once a month traveling shower team, etc.).

The "No Drive" campaign was a contest that stressed car pooling. The objective of the "No Drive" campaign was to reduce the number of cars being driven to school by students and faculty. The contest spanned a one-week period. On the day of the "drama," all cars in the parking lot were counted; at the end of the contest, cars were counted again. The school with the least number of cars in all school parking lots on the final day of the contest was judged the winner. As an incentive, a cash prize of $500 was awarded to the winning school to purchase a prize that would benefit the student body.

Following the "drama," the MSU actors conducted individual workshops with groups of 20 to 30 students. The students attending the workshops were given a packet of ideas for involving the rest of the student body and faculty in the "No Drive" campaign. Among the possibilities described by the leaders were: brief skits or pantomines based on energy-related sayings or proverbs (e.g., Haste makes waste; Better "safe" than sorry; Driving is fun with one, but great with eight; etc.); P.A. accouncements; posters; buttons; etc. Students were asked to post a "ride board" as a way of encouraging everyone to participate in car pools or public transportation.

"Energy Today and Tomorrow" Assembly Program. The Energy Today and Tomorrow program was developed by Oak Ridge Associated Universities. The program, presented by a specially trained science teacher, covered what energy is; fuels and methods used for producing electricity; possible future ways to make electricity; where and how energy is used;

the environmental, social and economic problems associated with energy use; and ways to conserve energy. The program was designed for large assembly presentations and came complete with catchy technological displays and demonstrations.

Teen Awareness Teams. The Teen Awareness approach was an adaptation of cross-age tutoring. A team, composed of from three to five students and an adult facilitator, received training in the areas of group problem solving, energy information, and presentation skills. At the conclusion of the training, the teams developed presentations for elementary, junior, and senior high students and for school boards, PTA's and local community groups.

Students from schools where the above strategies were used were tested on two different occasions. A pre-test was held in February, 1978 and an identical post-test was administered during the last week of the 1977-78 school year. Students were asked to complete a pencil and paper measure, which included demographic, attitudinal and self-reported behavior data.

A limitation of the evaluation was that only a subset of schools (due to procedural problems, uncooperative principals, etc.) completed both the pre- and post-test as intended (approximately 43% of the 30 schools targeted for pre-post evaluation). Another 58 schools were intended to be examined on a post-test only basis. Sixty-six percent of these schools were in fact post-tested. Fortunately, mortality differences between conditions were not significant. While this discrepancy threatens the experimental precision of the pilot study, the extremely large sample size still allowed for some sound analyses which are seldom seen in this type of governmental program.

Summary of the Evaluation Results for Phase I

Initially, the results of Phase I were analyzed using a one-way analysis of variance for the four experimental groups and the control group. This was felt to be the appropriate initial point of analysis since schools were the unit of analysis which was randomized. At this level of analysis, there were no significant differences between the conditions ($p = .11$). It did appear that the Teen Awareness Team condition scored the highest. However, this was probably due to the confounding of region with condition. (All Teen Awareness Teams took place in the Upper Peninsula, which scored significantly higher than the Lower Peninsula at pre-test).

Since a major purpose of this demonstration program is really exploratory investigation of the various strategies, and since it was felt that such a large scale field experiment could reveal a wealth of information, further and more detailed analyses were pursued using the individual student respondent as the unit of analysis. Here some very interesting results were revealed.

The most consistent and statistically supportable finding was that students from schools who had received the Energy Today and Tomorrow Program were significantly less positive ($p < .001$) toward energy conservation than students from schools which had not received that program (i.e., a comparison of Energy Today and Tomorrow vs. "anything else," including schools which got nothing). This was tested on a sample of 18 schools (approximately 4400 students) receiving the assembly program and 32 schools (approximately 9000 students) not receiving the program. Because this finding was potentially politically unpopular (this assembly had been endorsed by both state and federal energy officials and heavily promoted by utility groups), further steps were taken to substantiate this finding. Upper Peninsula schools (none of which received the assembly) were removed from the analysis because the pre-test showed that the region was significantly more positive toward energy conservation initially. Also, significant covariates with attitude (i.e., sex, grade, age, whether or not youth owns a car, whether or not youth had taken an energy class) were statistically controlled. Still, the Energy Today and Tomorrow students were significantly ($p < .001$) less positive than those not seeing the program. In addition, it was even demonstrated that there was a positive relationship ($p < .01$) between the number of days since the program was seen and attitude (i.e., the longer the time elapsed since the program was seen, the more favorable attitudes were toward energy conservation, as though the deleterious effects of the program wore off over time). Finally, a single school ($n = 150$ students) was examined in a pre-post strategy, with the post-test occurring immediately after the assembly (a strategy which should maximize the chances of observing positive effects). In this situation, the pre and post-test means were virtually identical, indicating absolutely no impact by the assembly on the attitudes toward energy conservation.

Unfortunately, the other major treatment conditions could not be as rigorously examined as the one discussed above. For example, the drama program began with a much smaller sample of seven schools, only one of which took the post-test. Hence, true inter-group comparisons were not really possible for this condition. (The one school tested, with an n of 178 students, showed a mean score just higher than the overall mean score of the Energy Today and Tomorrow schools, but this difference was not statistically significant.) The schools which cooperated in the "No Drive" campaign contest, which was part of this condition, reported an overall 13% reduction in the number of student cars driven to school during the contest week. However, only two of the seven schools could be convinced to participate in the contest, even though a $500 award was to be given to the winning school. Hence, the drama condition was judged to be fairly ineffective (although the quality of data supporting this judgment is somewhat limited).

Because the favorable results of the Teen Awareness Team condition appears to be confounded with regional effects (as described above), that condition was also more closely scrutinized. Upon closer examination, it was discovered that only 1% of those students posttested in the Awareness Team region had reported seeing an energy presentation by fellow students. Hence, it seemed quite obvious that the higher scores observed in that region were not due to the effects of the treatment but were quite likely due, as suspected, to previously existing regional differences. To further test the potential effectiveness of that type of treatment, however, all students who reported seeing an energy presentation by fellow students in all the regions were contrasted with those students who reported that they did not see such a presentation. There was not only no significant difference between the groups in attitude, but the two mean scores were almost identical. Finally, it was assumed that at least those participating in a Teen Awareness Team would have significantly more positive attitudes than their peers. This question was examined in a small sub-study conducted by one of the EES staff (see Leedom, 1979).

The results indicated that, although the participants in a Teen Awareness type group were more positive in attitude than a randomly assigned control group, the differences were not statistically significant. In summary, it was found that the Teen Awareness Team condition was not a particularly useful strategy, either in terms of breadth of contact in a region or in terms of effect on those contacted.

As for the teacher training condition, the primary evaluation emphasis of the developers of these workshops was on the subjective assessments of the participants about the workshop itself. From this standpoint, the workshop personnel were convinced that the participants, in general, "liked" the workshops. In terms of real outcomes, however, only the post-test attitude scores for the schools from which the teachers had come were available. These results showed no significant differences from the other conditions examined. However, these scores were based on what is essentially a school-wide testing of students. No direct targeting of testing to students who had actually had these teachers was possible. Thus, since only one to five teachers from any given school attended the workshops, one could expect a fairly diluted effect on the post-test even if the actual effect for those teachers' classes had been high. Hence, the actual effectiveness of this condition was not adequately tested.

However, one additional correlational finding that emerged from the study does tend to provide support for a teacher-oriented strategy such as a workshop. Briefly stated, the results reveal that students who have had an energy conservation related unit in their classes have significantly more positive attitudes ($p < .001$) than those who have not. Further, this result holds up across all grades (9th through 12th), sex, treatment condition and region. Hence, to the extent that a teacher workshop can influence teachers to teach more energy conservation units, a workshop strategy can be an effective one. Unfortunately, no data on teaching behavior was gathered during this project. However, the results of a similar workshop study (Chapman, 1978) indicate that a significantly higher proportion of workshop participants did teach energy conservation units than a matched control group.

A final set of results of great interest was obtained in a small sub-study conducted by EES (Leedom, 1979), in which the particular strategy of "task oriented" activity was compared to information only and to control groups in a randomized experiment. ("Task oriented" is here defined as a "hands on" type of activity where the students involved actually engage in energy conserving behaviors such as insulating, caulking, lowering thermostats, etc. as a part of the program, as opposed to more traditional information oriented programs such as reading about energy conservation, watching a film, going on a field trip, etc.) To briefly summarize, the "task oriented" group was significantly more positive toward energy conservation ($p < .0005$) at post-test than the other two groups. The information only group was more positive than the control group, but the difference was not statistically significant. These results would seem to suggest the importance of actually behaviorally involving students in energy conservation as a part of an attempt to increase their positive attitudes toward energy conservation.

Discussion and Recommendations for Future Educational Efforts

The first policy decision in terms of planning for future programming was to drop from consideration the Energy Today and Tomorrow

Program. Indeed, this program was thought to be so ineffective and even detrimental to the cause of furthering energy conservation, that the negative evaluation findings were forwarded to state and federal Energy Department personnel and also to utility representatives in Michigan (who are major sponsors of that program). In retrospect, the results observed are not that surprising. The Energy Today and Tomorrow Program has a heavy emphasis on the use of technology (particularly on the use of controversial nuclear power) and might well be expected to produce a feeling that "modern technology will provide," hence lessening the perceived need for conservation.

A second policy decision was to drop the drama program as a treatment mode. Although the results from Phase I are based on a fairly small base of data, those that exist are not encouraging. Furthermore, in subjective ratings of enjoyment, students tended to rate the drama program low.

A third policy decision, related to the first two, was to forego the use of large scale assembly type programs. The failure of the two large scale approaches used in Phase I led to a discussion among EES planners which concluded that efforts might better be directed toward narrower but more intensive channels of communication.

A fourth policy decision, stemming from the encouraging correlational results discussed previously, was to focus primary emphasis on influencing high school teachers to provide more energy conservation instruction in their school classes. As will be outlined in a moment, several different strategies were proposed for furthering this goal.

A fifth policy decision, originating from the results of the Leedom study discussed above, was to attempt to encourage teachers to involve students in "task oriented" energy conservation activities. Also, it was planned to evaluate the effectiveness of whether or not a student actually participated in a "task oriented" energy conservation activity.

A sixth policy decision, stemming both from the partial success of the "No Drive" campaign component of the drama strategy and from an unwillingness to completely forsake a school-wide involvement type of strategy, was to attempt to design a treatment condition that would foster "no drive" type of school activities as well as encourage a more comprehensive representation of the whole school (as opposed to just individual teachers and their classes). One perceived fault of the "No Drive" campaign attempt in the drama condition was that it focused only on driving, which is an activity of great importance to this age group. Hence, it was recommended that future efforts provide a wider range of energy conserving activities in which schools could engage.

Strategies To Be Used In This Study

As a result of the Phase I evaluation and recalling the literature on environmental and energy education discussed previously, it was decided to focus the current study upon various intervention strategies operating through teachers. Specifically, four basic treatment conditions were proposed for this project (a teacher consultation strategy; a school energy conservation committee strategy; a teacher workshop strategy; a teacher workshop including "task oriented" training strategy). Each of these strategies has both support from the literature as well as empirical support from the results of EES studies. (The Method section will discuss specific details of the treatment modes.)

<u>Teacher Consultation</u>

The use of an outside consultant or "change agent" to effect change within an organization is widely practiced within the social science fields (Havelock, 1971; Mannino & Shore, 1971; Fairweather, Sanders, & Tornatzky, 1974). Indeed, the practice of utilizing a consultant or resource person from outside the immediate organization is a traditional and widely used method of effecting change within educational institutions (Schmuck & Runkel, 1972; Havelock, 1973; Schmuck, et al, 1975).

Consultants are particularly valuable because of their specialized knowledge about the subject area of interest. This is especially true in situations where new curricula or innovative approaches are being designed and the typical on-line teacher has little or no exposure to them. Indeed, a weak knowledge base concerning new educational practices is regarded as a major factor retarding educational change (Carlson, 1965). Furthermore, writers within the educational field have targeted a lack of consultants and resource personnel as a particular barrier to change in the public schools (Vannan, 1970; Carlson, 1970).

In a closely related subject area, Kleinman (1965) found that the greatest stumbling block to the successful operation of effective science programs was the reluctance of teachers to teach science because of the inadequacy of their science knowledge and background. She recommended the use of consultants for teachers to help remedy that situation. A similar or perhaps worse situation of perceived inadequacy of knowledge and background is likely to exist in the extremely new subject area of energy and energy conservation. Hence, just as Shinpoch (1969) recommended the use of consultants to develop teacher knowledge and skills in order to facilitate implementation of improved science programs, one can now recommend the use of trained consultants to reach teachers with the knowledge and persuasion necessary to facilitate the teaching of energy conservation.

School Energy Committee

All of the above discussion on the use of consultants is equally applicable to the regional EES coordinator's role as consultant to the school energy committees to be used in this study. In addition, however, there are also particular rationales for the use of a committee type strategy rather than just consulting with teachers. For example, in the literature on organizational change, there is much support for the strategy of targeting change efforts toward not just single individuals but also representative members from within the organization (Fergus, 1973; Fairweather, Sanders & Tornatzky, 1974).

In the educational field in particular, there is much support for such a "team" approach. As far back as in the late 1940's, Lippitt (1949) contrasted individual training of teachers with the training of teachers in teams from the same school and found in a six month follow-up study that the team trained teachers were much more active in utilizing the desired curriculum. Similarly, Cartwright (1951) pointed out the fallacy of attempting to train the individual teacher outside the school and then return the teacher to the institution where, with no peer support system, sustained change efforts are unlikely. Thus, he advocated the training of teams of teachers within the school. As an example of this peer group effect, Mahan (1971) found in a survey of 517 pilot and demonstration teachers, that they rated the assistance of fellow teachers as almost as valuable as the basic guidance provided by the curriculum syllabus and nearly equivalent to the impact of the original training session itself.

If the interaction with supportive fellow teachers can help facilitate the utilization of new teaching methods, it stands to reason that incorporating other school personnel in this effort could also be beneficial. Crosby (1969) supports this approach and recommends involving teachers, supervisors, and the principal in training efforts within a school. Mahan (1971), himself a long time science curriculum consultant, included in his suggestions for successful installation of science curricula the guidelines that teachers, administrators, and principals should all be required to participate in training activities. Considerable other support exists in the educational community for such a team approach (e.g., Baldridge & Deal, 1975; Fullan & Pomfret, 1977).

In response to the serious energy problem, the North Carolina Department of Education (1976) carried the team concept one step further by recommending the formation of committees within the school comprised of teachers, administrators, students, and representatives from other interest groups (e.g., cafeteria, transportation, athletics, etc.) in an effort to create school-wide activity in the area of energy conservation. More recently, the organization of Michigan School Business Officials (1978) recommended a similar strategy for launching energy conservation efforts in Michigan schools. These latter comprehensive approaches to educational teams provide the impetus for the "school energy conservation committee" strategy to be used in this study.

Teacher Workshops

Teacher training workshops are one of the most widely used strategies for facilitating adoption of curriculum innovations (Cooper, 1972). Workshops can be quite successful in increasing teacher knowledge of a subject area (Hilgent, 1968) and have been used quite extensively to help develop teacher knowledge and skills in the science area (Shinpoch, 1969; Cooper, 1972). Fowler (1960) evaluated a teacher training program in general science and reported a considerable gain in participants' knowledge following the workshop. Merkle (1970) evaluated a training workshop conducted for 30 science teachers and reported significantly positive effects on teacher knowledge about and attitudes toward a new curriculum package and on something which he termed "change agent skills" (p. 122).

Recalling what was discussed earlier in terms of the importance of teachers' competency and confidence in teaching new subject areas, these results would seem to suggest the usefulness of workshops in facilitating the teaching of energy conservation. Further, other research suggests that workshop training can indeed be successfully transferred to the classroom. For example, in addition to knowledge and attitude changes, Merkle also reported subsequent behavioral changes by the teachers in their classrooms although no statistics were provided. However, Moon (1969) found that teachers receiving training and materials at a science workshop were significantly different than the control group in demonstrating the desired classroom teaching behaviors and in stimulating pupil inquiries. Similarly, Wasik and

Nicodemus (1969) used classroom observation of trained and control groups of teachers and discovered the experimental group was more successful in implementing the curriculum materials and in fostering student participation.

Finally, it is important to note that workshops can be perceived as both important and enjoyable by participating teachers. Mahan (1971) surveyed teachers participating in an in-service workshop and found that they rated the workshop as the most important resource for implementing curriculum change. Moreover, at the conclusion of the installation year, a random sample of demonstration school teachers rated the workshops as "absolutely necessary" for curriculum installation (p. 11). As for the variable of teacher enjoyment, a series of energy conservation education workshops sponsored during 1977-78 by the Michigan Energy Extension Service consistently received high marks in subjective assessments by participating teachers (Stevens, 1978).

In summary, it appears that teacher workshops can be useful in improving teacher knowledge and skills, that workshop related improvements can translate into classroom changes, and that teachers can have high opinions of workshops. Hence, teacher training workshops will be used as major treatment modes attempting to facilitate the teaching of energy conservation in this study.

"Task-Oriented" Training

The training of teachers to utilize task-oriented learning (i.e. having students actually perform energy conservation tasks as opposed to simply reading, writing, or hearing about energy conservation) will be incorporated into one of the workshop treatment modes. As with the other major intervention strategies, there exists much support for this particular strategy.

One of the most thorough examinations of this concept is by Breer and Locke (1965). Their primary contention is that actually performing a task causes an individual to develop beliefs, values and preferences specific to that task. In other words, task experiences are a major source of a person's attitudes. Further, following a series of seven experiments concerning a wide range of attitude and task dimensions, Breer and Locke postulated that the effects of task performance can generalize both laterally (to other task situations) and vertically (to a higher level of cultural beliefs, preferences and values). If this is so, then a strategy of having students perform specific energy conservation tasks may be used in building more broad-based attitudes and behaviors favorable to energy conservation.

Cognitive dissonance theory (Festinger, 1957) would also be supportive of this task oriented strategy. Simplistically stated, dissonance theory proposes that, under normal circumstances, a person will strive to maintain compatability between his/her actions and attitudes. Therefore, a person observing him/herself performing energy conservation behaviors will tend to adopt favorable energy conservation attitudes. Of course, according to this theory, the magnitude of attitude change will be diminished under situations where the person can attribute the behavior solely as a response to reward or coercion. Interestingly, Breer and Locke propose the opposite, that situations of high incentive produce the greatest attitude change. For the purposes of this study, however, these theoretical arguments are less important than discovering whether or not performing energy conservation actions does lead to more positive energy conservation attitudes (and related behaviors) in the real world setting of the high school educational system. In that setting, rewards (e.g., higher grades, praise, etc.), coercion (teacher's orders and/or threats) and some degree of self-determination are all involved. It is to that setting that this study must generalize.

A third theoretical base of support for the task oriented strategy is that of "self perception theory" (Bem, 1965, 1972). Briefly summarized, this theory states that, when internal cues are minimal or uninterpretable (i.e., no strong feelings previously exist), people infer their attitudes and other internal states primarily from their behavior, much the same as external observers who infer a person's attitude or inner state by observing his/her behavior. Hence, having students do energy conservation (something which high school students are not likely to have strong attitudes about--a supposition supported by extensive EES pilot testing in Michigan) should increase their positive attitudes toward energy conservation.

In addition to the theoretical foundation, there is applied research support for a task oriented approach, particularly in the related field of environmental education. Howell and Warmbrod (1974) contrasted the use of an environmental training manual in a "hands-on" group of students with the same manual in a more traditional setting and found the hands-on group to be significantly more effective. Similarly, Aird and Tomera (1977) evaluated the use of an activity centered water conservation class with a no treatment control group and found significantly more positive attitudes in the experimental group. Finally, the previous cited results of Leedom (1979) provide strong support for attempting a task oriented strategy in the effort to encourage positive energy conservation attitudes and behaviors.

Summary

To summarize, this study examines a potential means of responding to the energy problem by working through the educational system to encourage positive energy conservation attitudes and behaviors. Prior research has suggested that one useful approach in this area might be to attempt to promote the teaching of energy conservation subjects by teachers. Therefore, this study focuses on that link of the educational delivery system and experimentally tests different strategies for influencing teachers to teach about energy conservation. Four different approaches were compared (teacher consultation; teacher consultation with a committee focus; teacher workshops; teacher workshops with a "task oriented" element). The following chapter outlines the methodology of this study.

CHAPTER II

METHOD

Subjects

A population of 111 high schools in 12 counties throughout Michigan was identified with the assistance of the Michigan State Department of Education. The 12 counties contain over 10% of the population of Michigan and were selected to contain a good combination of rural, suburban, and urban areas. The high schools themselves include a mix of approximately 80% public and 20% private (religious) schools. The schools range in size from 150 to 2,200 students and include a variety of racial and socioeconomic mixes as well. Hence, this study should provide for good generalizability to high schools in almost any setting.

This experiment included the entire population of high schools in the target regions. In order to provide for the soundest methodological procedures, these schools were randomly assigned to treatment and control conditions.

Design

The experimental design was essentially a one way analysis of variance with five levels of treatment conditions (teacher consultation, energy committee consultation, teacher training workshop, teacher training workshop with "task oriented" training, and no treatment control). Schools were randomly assigned to the conditions in the proportions outlined in Table 1.

To use the terminology of Campbell and Stanley (1966), the experiment was a "post test only" design. There were six dependent variables.

Table 1

Experimental Design

Teacher Consultation	Energy Committee	Teacher Workshop	Teacher Workshop Plus Task	Control
N = 25	N = 12	N = 26	N = 26	N = 22

N = 111 Schools

Procedure

Experimental and Control Conditions

All schools in the experimental conditions first received a general introductory letter from the Michigan Energy Extension Service (EES). (See Appendix A.) The purpose of this letter was to acquaint the principal with EES and to introduce the regional EES coordinator. The regional coordinator then contacted the principal by phone to arrange a meeting with him/her, at which time the coordinator briefly explained the program which had been selected for that school and asked the principal to set up a meeting with teachers he/she felt would be interested in such a program. At the option of the principal, this intermediate meeting between principal and coordinator could be eliminated and the principal could agree by phone to set up a meeting with interested teachers. (Essentially, there was no minimum or maximum number of teachers required for this initial meeting. As few as one teacher or as many as ten or more would be acceptable. Experience of EES efforts in the past suggested that from two to five teachers was the most realistic estimate of likely attendance. Principals were encouraged to request that approximately three to five teachers attend.)

At the meeting of teachers, the following sequence of activities would occur. First, the coordinator would introduce herself and briefly outline her responsibilities. Second, the teachers would be asked to fill out the brief registration sheet, which would serve to record the names and phone numbers of the teachers present. Then the coordinator would present a brief (10-15 minutes) standard presentation about the energy problem in general, what EES had done and was doing, and how important it was that teachers be involved in helping to solve the problem. At this point, the coordinator would begin the treatment-specific presentation.

Teacher Consultation. For this condition, the coordinator's basic approach would be to present herself as a resource person for the teachers and to attempt to persuade and assist the teachers to teach energy conservation units in their classes. As a part of this effort, the coordinator would hand out to the teachers some examples of standardized energy education curriculum packages and also provide them with an extensive list of additional energy related materials (e.g., filmstrips, curricula, visual aids, etc.) available through her office or through the state office. She would discuss with the teachers how these materials might be presented in their classes and would encourage the teachers to use them. The coordinator would emphasize her availability as a consultant at their initiative and would also provide them with her phone number and address and encourage them to contact her if they had questions or requests later. In response to any subsequent requests by teachers, the coordinator could meet with individuals or small groups of teachers to provide information and/or materials.

Energy Committee. For this condition, the role of the coordinator was similar to that in the consulting condition, except that a prime area of effort was toward having the teachers from an energy committee within the school. Membership on that committee would be recommended (but not rigidly required) to include at least two teachers, the principal, chief custodian, president of the student body, one or more students from each grade, and representatives from other major areas such as athletics, cafeteria staff and bus drivers. Recommended guidelines would also be provided for frequency of meetings, location, leadership, etc. The coordinator would present herself as a resource person to assist in the formation of the committee and, particularly, to provide materials that might be requested (e.g., curricula, film-strips, educational materials available from the State, etc.). The coordinator would suggest activities the committee could pursue, including having teachers teach more energy units in their classes; having teachers have their students work on a school project to save energy or on a school energy conservation fair; etc. The coordinator would also provide essentially the same examples of curriculum materials and list of resources available that were provided to the teacher consultation schools. In addition, the coordinator would also provide examples of possible school activities, such as plans for an energy fair, a procedure for monitoring school energy consumption, etc. The coordinator would continue to urge the teachers to teach energy conservation and to utilize their students in any energy committee projects that may evolve.

Teacher Workshop. For this condition, the coordinator's basic approach would be to generate a commitment on the part of the teachers to attend the teacher workshop. A brief description of the workshop as well as the time, date, and location would be announced, along with suggestions for car pooling, etc. to facilitate attendance. Teachers were only given a general list of available materials at this meeting and were told that they would be able to obtain or order these materials at the workshop. All teachers assigned in this condition were provided with the same standard workshop.

The teacher workshop itself consisted of a five hour workshop (including one hour for dinner) held in a conveniently located school in the region. It was conducted by a team of faculty from the Science and Math Teaching Center at Michigan State University, under contract to EES. A secondary education specialist from EES also assisted in the workshop and supervised the proceedings.

The workshop included: an initial presentation of the workshop agenda, participants, speakers, etc.; a large group presentation including both lecture and media (filmstrip and slide) components; small group discussions, including an activity session for the teachers to participate in a small group learning situation; and a reconvening of the total group for discussion and summary. Also included in the workshop schedule was a complimentary dinner and the distribution of materials such as curriculum packages. (See Appendix B for a copy of the workshop agenda.)

Teacher Workshop Plus Task Oriented Training. The role of the coordinator in this condition was essentially identical to that in the standard teacher workshop condition. As for the workshop itself, it was essentially the same workshop described above, except that included in the workshop was an approximately one hour long presentation and discussion of the "task oriented" strategy in energy education (as described previously in the Introduction). Also, examples of "task oriented" education curricula were distributed in addition to the more standard energy education curricula. Once again, teachers were encouraged to teach energy conservation units, particularly task oriented units. As in the other workshop condition, all teachers assigned to this condition were provided the same standard workshop.

Control Condition. The control schools received no contact from EES or the coordinators during the operational phase of the project. At the time of the post test, the control schools received a letter and subsequent contact from the coordinator, just as the experimental schools received previously. Once again, a group of "interested teachers" were identified and the coordinator met with them. These interested teachers and their students were at that time (prior to any treatment manipulation) given the same measures that the "experimental" teachers and students were given, thereby providing the "no treatment" control group comparison (See Table 2 for the overall project outline.) Teachers were then provided with the standard consultation treatment, including the curriculum materials.

Training and Supervision of the Project Personnel

The overall experimental design of this project was established over a series of meetings involving EES personnel (including the principal investigator, regional coordinators, Cooperative Extension Service staff, and Science and Math Teaching Center staff). The basic parameters of the study were agreed upon at the conclusion of these meetings. The regional coordinators were involved in two subsequent training sessions where the protocols to be followed in dealing with schools in each treatment condition were rehearsed.

With the beginning of the 1978-79 school year, the regional coordinators began to initiate contacts with the experimental schools. To avoid any "history" effects or bias due to time of year, weather, etc., the intervention schedules were staggered such that the different treatment conditions were all implemented over the same time span. Also, to avoid differences due to differential length of time for responding to treatment, post-tests were distributed to schools in the same order in which they were initially contacted. For the same reasons, control schools received their pretests in a similarly spaced manner (i.e., pretests began in the control schools at the same time that post-tests began in the experimental schools and continued in the same proportion during the time that the experimental schools were post-tested). During the project itself, the principal investigator met with the regional coordinators by phone or in person on a weekly basis.

The development of the teacher training workshops was a fairly autonomous task performed by the Science and Math Teaching Center as a subcontractor of EES. Minimal control was exerted over this development by EES except to assist in facilitating subjective evaluations by the participating teachers of some pilot workshops. Using this process, a quite "popular" workshop was developed, albeit of untested actual effectiveness. The only structure EES enforced on the actual workshops involved the distribution of curriculum materials, the recording of names and schools of teachers who attended, and, of course, the task versus nontask manipulation. The principal investigator monitored the actual workshops either through direct attendance or written summaries (including "workshop evaluation forms" completed by the attending teachers).

Definition of the Dependent Variables

In dealing with a problem area as new and as complex as the one in this study, there is no single or even multiple set of clear cut dependent variables. "Effectiveness" of the treatments involved here might be defined in a variety of ways. Recognizing this fact, a set of six dependent variables that were utilized are outlined below.

At the most general level of analyses for the evaluation of these treatments is the basic question of whether or not the school even agrees to participate in the treatment. Obviously, a treatment, however well designed, is of no use if schools won't participate. To answer this question, a dichotomous variable of "accepted" versus "not accepted" was utilized.

School Acceptance of Treatment. A school "accepting" a treatment was operationally defined as the successful occurrence of the initial meeting of interested teachers with the EES coordinator. In order for this to occur, the principal must first have agreed to the treatment concept being presented and the teachers must have agreed and been interested enough to attend the initial meeting. This definition of school acceptance is thus seen as a more desirable one than other more limited options, because it includes both principal and teachers. This data was gathered through the regional coordinators' project logs.

Once treatment delivery occurred, the next area of major interest was the response of the teachers to the treatment. For this study, the primary variable of interest concerning the teachers was whether or not they taught energy conservation to their students. To more fully explore this important outcome criterion, three operational definitions were used to assess teacher response in this regard.

Percent of Schools Where Energy Conservation is Taught. Based on the previous year's correlational findings, high priority was placed on teaching energy conservation related units. This measure was an attempt to determine, at the most basic level, which treatment approaches resulted in a school being exposed to energy conservation instruction. This variable was operationally defined as having at least one of the teachers initially contacted within a school teach an energy conservation class unit (i.e., a dichotomous variable of "yes" or "no" for each school). This data was gathered through written post-test questionnaires and telephone interviews with the individual teachers.

Percent of "Interested Teachers" Who Teach an Energy Unit. Another way to examine the teacher response to treatment was to determine, of the "interested teachers" identified initially, which strategy led to a higher proportion of teachers actually teaching an energy conservation unit. By directly considering the response of each teacher contacted, this measure allowed more sensitivity than the previous measure, which only answered the question of whether or not the school received an energy conservation unit at all. This data was also gathered through the post-test questionnaires and telephone interviews with teachers.

Average Number of Hours of Energy Materials Taught. Finally, a slightly different way to examine the question of energy conservation teaching activity is to obtain an indicator of how much energy conservation instruction actually occurred (as opposed to what proportion of schools had a unit taught or what proportion of teachers taught a unit). The question of how much instruction occurred was answered by obtaining an estimate from each teacher of the number of hours of energy conservation related materials he/she taught during the experimental period.

This information was recorded for each teacher, thus allowing comparisons to be made at the teacher level or, by summing across teachers within each school, at the school level. Once again, this data was obtained through post-test questionnaires and telephone interviews with individual teachers.

Although the intervention under study in this experiment is targeted at the teacher, an additional important outcome domain is, of course, the ultimate impact on the students. To assess that impact, two measures were utilized.

Student Energy Conservation Attitudes. Due to the impossibility of actually observing energy consumption behaviors of students in such a large scale study, the measurement of student attitudes toward energy conservation became all the more important. The attitude measure used in this study is a 45 item, five point Likert-type scale measuring attitudes toward taking action in a variety of energy conservation areas. It is part of the Youth Energy Survey (YES) questionnaire (which will be discussed in more detail in a moment). The measure was administered by participating teachers to their students at the appropriate post-test time and collected from the teachers by the regional coordinators.

Self-Report of Energy Conservation Behaviors. As a part of the above mentioned YES questionnaire, a series of self-report items were included as a means of attempting to examine the effects of the treatment on energy conservation related behaviors (in such areas as transportation, home heating and electricity use). Students were asked whether or not they had performed each of a variety of energy conservation behaviors during the past three months (corresponding to the period of time since the intervention). While acknowledging the relative weakness of self-report measures, this technique was chosen as the only practical method of examining energy conservation activity available in such a large scale study.[2]

Measurement Instruments

The Youth Energy Survey (YES) Questionnaire. Considerable time and effort was placed into developing and pilot testing the YES questionnaire which was used to measure student response in this study. Indeed, the effort began with a consideration of the appropriateness of the very concept of utilizing a self-report instrument in such an experiment. It was noted that objections have been raised in the social science literature about the wisdom of using expressed attitudes to predict behavior. Critics (e.g., Wicker, 1969; Abelson, 1972) have successfully pointed out that it is unwise to simply assume that expressed attitudes will be congruent with actual behavior. However, it was also noted, that more recently, attitude-behavior research has enjoyed more support, with increasing evidence of adequate predictability of behaviors by expressed attitudes. For example, both Schumann and Johnson (1976) and Kelman (1974) have argued that relationships of at least moderate strength are the rule rather than the exception when "consequential and socially important attitudes and behaviors are investigated in non-laboratory settings" (Eagly & Himmelfarb, 1978, p. 528). In fact, a variety of studies in the environmental and energy areas have shown a good correspondence between attitudes and behaviors (Weigel & Newman, 1976; Gottlieb & Matre, 1976; Hogan & Paolucci, 1979). Most recently, a review of the literature in the area of energy conservation concluded that, although the relationship is less than perfect, expressed attitudes

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[2]Some reason for optimism was felt, based on the results of other research with which the author has been involved (see Blakely, Kushler, Parisian & Davidson, 1980), where it was found that self-report of behavior by adolescents (legal offenders in this case) could provide meaningful, reliable and valid data.

do indeed appear to be causally related to actual behaviors (Farhar, et al., 1979). Ultimately, after considering the research record, it was decided to proceed with the development of the attitude measure but to take great care to assure the quality and appropriateness of the instrument being created.

In developing the YES questionnaire, a common attitude measure format was chosen, that of the Likert-type scale. Specifically, the format which was used consisted of a series of statements, each followed by a five point response continuum ranging from "strongly agree" to "strongly disagree." It was felt that the use of a five point continuum could provide a range wide enough to adequately gauge change in attitudes and provide good reliability (Lissitz & Green, 1975) and at the same time be concise enough to not prove cumbersome or hard to understand for the high school students.

As for the content of the questionnaire, a variety of sources were considered, including some earlier attempts that others had made to measure energy conservation attitudes (e.g., Rappeport & Labaw, 1975; Olsen & Goodnight, 1977). In addition, the literature on psychological measurement, which stresses the importance of targeting attitudes specifically related to intended behavioral objectives (in order to maximize the relationship of observed attitudes to actual behavior) was particularly useful (see Eagly & Himmelfarb, 1978). After considering these inputs, a pool of approximately 80 items was generated and pilot tested with several hundred high school students.

Following this pilot testing and extensive analysis, utilizing a combination of rational and empirical processes (e.g., Jackson, 1971), a final highly reliable 45 item attitude measure was constructed. The attitude measure was combined with a series of demographic related questions and a set of self-report behavior questions and placed on a single convenient, machine-readable survey form (see Appendix C). Subsequent use of this instrument during the past three years, with over 100,000 high school students in nine states, has demonstrated consistent reliability and very encouraging validity results.

The overall 45 item energy conservation attitude scale has repeatedly demonstrated high reliability (Cronbach's Alpha greater than .90 on three applications with sample sizes of approximately 500; 12,000; and 15,000). Also, its validity has been demonstrated in several small scale studies. Among the various findings have been that the attitude measure is significantly positively correlated with: teacher ratings of energy conservation attitudes; student's self-report of energy conservation behavior; ownership of smaller cars; performance of various optional energy conservation tasks provided by teachers, and, in one small scale study (Leedom, 1979), with actual reductions in household electrical consumption. (Additional information about this instrument can be found in Stevens and Kushler, 1979.)

As for the set of self-report behavior items, they too have undergone much analysis. Although these items are not particularly cohesive as a scale (Cronbach's Alpha tends to be around .60), they have demonstrated good utility as individual items that can be suumed to achieve a crude indicator of energy conservation behavior. In particular, in a separate small scale study (Condon & Davis, 1979), respondents' responses on the YES measure were cross-checked with follow-up telephone interviews with both the student and a parent, and good consistency was obtained.

Together these pieces of supporting research indicate that, within the limitations of the methodology, accurate and meaningful measures of student attitudinal and behavioral responses were obtained with the YES instrument.

Teacher Response Measures. Three additional measures were developed and utilized in this study, all of which were intended to gather data from the participating teachers. Two of them, the Classroom Questionnaire for Teachers and the Teacher Energy Education Questionnaire (see Appendices D and E, respectively) were written instruments distributed to the teachers at post-test time. In addition to gathering the primary outcome data concerning the teaching of energy conservation, these measures also gathered information about teacher attitudes and self-perceived knowledge about energy, as well as various other pieces of descriptive information to be used in subsequent correlational analyses.

The third measure was a Teacher Telephone Interview, also conducted at post-test time, which included essentially the same information as the written measures (only with an opportunity for a more personalized method of feedback). The primary intent of the telephone interview was to obtain the necessary information from those teachers (approximately 15%) who did not correctly complete or did not return their written questionnaire. In addition, however, the opportunity was taken to utilize the interview as a method of validating the written questionnaires. To accomplish this, a sample of approximately one-fifth (n = 53) of the teachers who had completed the written measures was also interviewed by telephone. Excellent correlations were obtained between the written and interview data, including the primary outcome measures of whether or not the teacher taught energy conservation and how much energy conservation was taught. (This data is presented at the end of the Results chapter.) These findings increase the confidence in the accuracy of the written questionnaire data as well as the acceptability of using the telephone interview data when the written questionnaires were not available. (These interviews were conducted by upper level undergraduate students, trained by the principal investigator. See Appendix F for a copy of the interview format.)

Concluding Operations

Following the experimental and post-test phases of the project, the regional coordinators were allowed to contact and provide services to all schools in the region. Particular emphasis was placed on the control schools (which had been placed on a "waiting list" if they called earlier in the year). When preliminary data analyses were completed, copies of their individual school's results were sent to each participating school, along with a note of appreciation and an invitation to inquire further about the EES project and its findings.

Table 2

Project Outline

Initial Population	Randomized	Begin Treatment	Monitor Responses	Post-test	Data Analysis	Conclude Operations
Initial list of schools obtained.	Random assignment of schools to treatment. (N = 111)	School contacts begin. (Last approximently six weeks.)	Coordinator monitors teacher responses.	Post-test of teachers and students.	Begin preliminary data analysis of major dependent variables.	Provide feedback to schools. Coordinators free to contact all schools.
	Teacher consultation. N = 25 schools.	C_1..........	....	..........C_2		
	Teacher workshop. N = 26 schools.	C_1..........	....	..........C_2		
	Teacher workshops plus task training. N = 26 schools.	C_1..........	....	..........C_2		
	Energy committee. N = 12 schools.	C_1..........	....	..........C_2		
	Control. N = 22 schools.	....	....	..........C_1		

CHAPTER III

RESULTS

The Sample

Subject Mortality

As one might expect in such a large scale field experiment, the final sample size deviated somewhat from that described in the projected plan. (See Table 1.) All randomization procedures for the selection and assignment of schools were kept intact, however, so that the integrity of the experimental design was not violated. The final number of schools assigned to each condition, as well as the subject mortality within each condition, are presented in the table below.

Table 3

Final Sample Composition: Subject Mortality by Condition[a]

	Type of Intervention					
	Teacher Consultation	Energy Committee	Teacher Workshop	Teacher Workshop Plus Task	Control	Row Total
Final Sample	20	10	21	20	19	90
Non-Participants	5	2	5	6	3	21
Total Initial Assignment	25	12	26	26	22	N=111

[a] $\chi^2 = .75$ df=4 ($p > .90$)

The top row of the table represents the final number of schools actually participating in the study (i.e. actually held a teacher meeting where the regional EES coordinator presented the program). The difference between those totals and the number of schools initially assigned is comprised of schools which, for one reason or another, did not wish to participate in the project.

These results were deemed quite satisfactory as the overall non-participation rate was relatively low (19%). More importantly, there was no relationship between willingness to participate and experimental condition ($p > .90$). The sample size was still quite adequate and well-distributed across conditions. Although these findings were very encouraging, one more characteristic of the sample was still considered prior to examining the experimental results.

Effectiveness of Randomization

Although a randomization procedure was utilized in order to avoid problematic discrepancies between the five conditions on any salient extraneous variables, it is always desirable to perform some analyses to confirm the accuracy of this assumption. In order to check for equivalency between the groups, a total of eight descriptive variables were examined: size of schools (in terms of number of students); percentage of public and private schools; regional locations of schools; number of teachers participating per school; sexual composition of teachers participating; type of subjects taught by the teachers; sexual composition of participating students; and grade level of participating students. In addition, teacher responses were measured on certain other variables pertaining to their situation in the school. Teacher ratings were obtained on the general freedom of teachers in their school to design their own lesson plans and, more specifically, how free that teacher felt to improvise or include new topics in his/her own lesson plans. Finally, teachers were also asked how many other teachers they knew at their school were interested in teaching about energy conservation topics.

Analyses revealed that there was only one significant difference between the schools in the five conditions on any of the above eleven variables. That was on the variable of subject taught by the participating teachers ($p <.05$). In particular, it appeared that the control group had somewhat fewer teachers in the hard sciences (i.e. biology, chemistry, math, general science, etc.) and somewhat more in the social sciences (i.e. history, English, civics, etc.) than the experimental groups. Further analyses were pursued to see if this difference could be an important biasing factor. Fortunately, it was found that the subject taught by the teacher was unrelated to whether or not the teacher taught energy conservation topics in his/her classes. Furthermore, the direction of the non-significant relationship was such that social science teachers were slightly more likely to have included energy conservation topics in their classes than hard science teachers (67% of classes to 59% respectively). Therefore, it was concluded that the differences between conditions on this variable would not be a problem for subsequent analyses and would, if anything, make those analyses somewhat more conservative by slightly favoring the control group.

These findings, together with the non-significant results on the other ten variables, suggest that the randomization procedure did produce functionally equivalent groups for the purposes of this experiment. With this in mind, the experimental results can now be examined.

Treatment Effects

As outlined in the Methods section, there were six dependent variables in this experiment. Four of these were primary outcome measures at the level of direct school or teacher response. They are:

1) school acceptance of treatment; 2) percentage of schools in which energy conservation is taught; 3) percentage of "interested teachers" who teach an energy unit; and 4) average number of hours of energy instruction provided. Two of the dependent variables can be regarded as secondary outcome measures, being at the level of eventual student response. They are: 5) student energy conservation attitudes; and 6) student self-report of energy conservation behaviors. The results for each of these variables are presented below.

Primary Outcome Measures

School Acceptance of Treatment. The results for this variable are actually presented earlier in Table 3. As one can see from that table, there was very little difference between the five approaches in terms of school participation rate. In addition, it is interesting to note that over 80% of the schools contacted agreed to participate in the project.

Percent of Schools in Which Energy Conservation Was Taught. The results for this variable, which is the most basic indicator of the impact of the program, are presented in Table 4.

Table 4

Percent of Schools
In Which Energy Conservation Was Taught
by Condition[a]

	Type of Intervention					
	Teacher Consultation	Energy Committee	Teacher Workshop	Teacher Workshop Plus Task	Control	
Energy Conservation Taught	(80%) 16	(100%) 10	(95%) 20	(100%) 20	(58%) 11	
Energy Conservation Not Taught	(20%) 4	(0%) 0	(5%) 1	(0%) 0	(42%) 8	
Total	20	10	21	20	19	N=90

[a] $\chi^2=18.9$ df=4 ($p<.001$)
Cramer's V=.46

As one can see from the table, there is a clearly significant difference between the control and experimental groups as to whether or not a school received energy conservation instruction from its interested teachers. (The difference between the four experimental groups is not significant.) However, because of the very small expected frequencies in the second row of the table, the obtained chi-square value must be regarded with some caution. To help overcome this problem, the data were combined by logical categories into a 2 x 2 table comparing "experimentals" with "controls," and a corrected chi-square was calculated. These results are presented in Table 5.

Table 5

Percent of Schools
In Which Energy Conservation Was Taught
Experimental vs. Control

	Experimental	Control	
Energy Conservation Taught	(93%) 66	(58%) 11	
Energy Conservation Not Taught	(7%) 5	(42%) 8	
Total	71	19	N=90

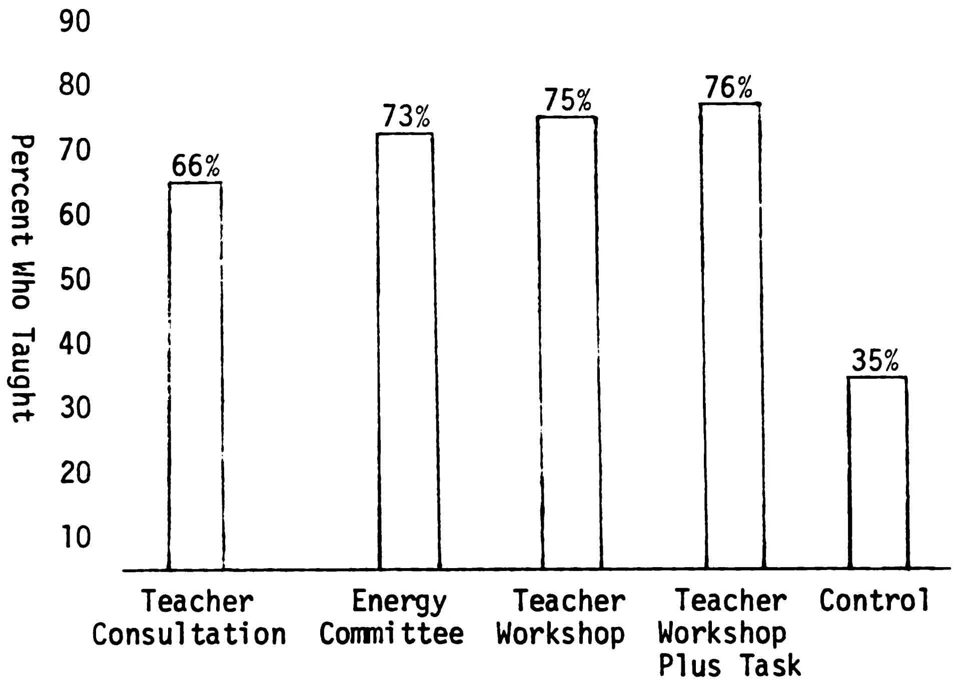
Corrected chi-square = 12.21 df=1 ($p<.001$)
Phi = .41

Here again, the results demonstrate that a significantly higher percentage of experimental schools received energy conservation instruction.

Percent of Interested Teachers Who Teach an Energy Unit. This variable provides somewhat more detail as to the relative effectiveness of the different conditions than the previous measure. Rather than a simple dichotomous indicator of whether or not a school was impacted, this variable assesses the proportion of interested teachers who actually followed through and delivered energy conservation instruction. Although there was no significant difference between conditions in the average number of interested teachers per school (there were a total of 260 teachers participating, for an average of approximately three per school), a percentage figure rather than a total number of teachers was used to provide maximum comparability.

Figure 1

Percent of Interested Teachers
Who Taught Energy by Condition



Analysis of Variance

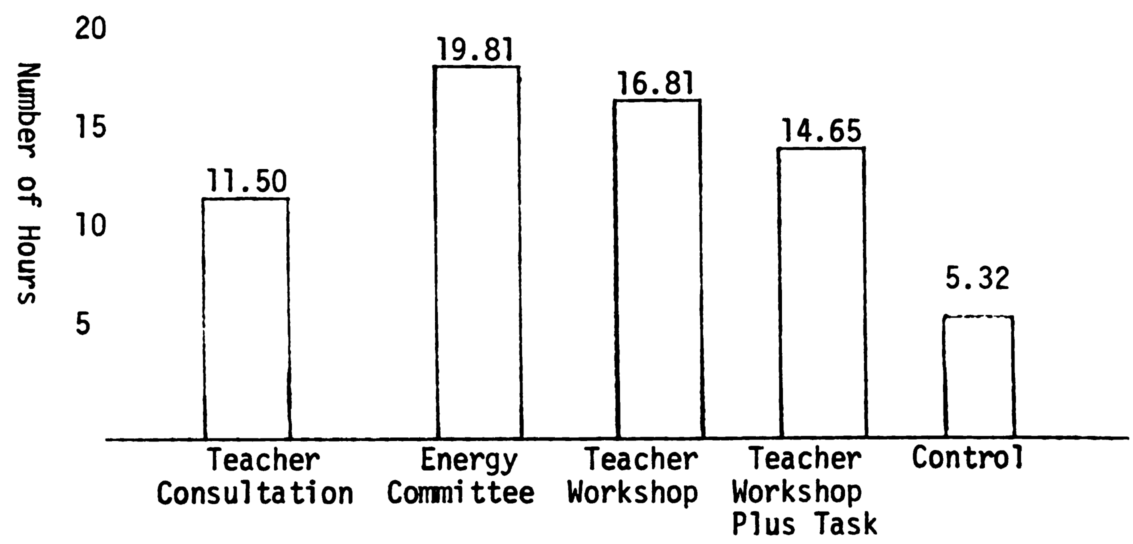
Source	DF	Mean Square	F	Significance of F	Eta^2
Between Groups	4	5972.5	5.967	.0003	.22
Within Groups	85	1000.9			
Total	89				

As one can see by this graph, there was a considerable difference between the control condition and the four treatment conditions in terms of the percentage of interested teachers who did actually teach energy conservation topics in their classes. (Planned comparisons showed all four groups superior to the control group at the $p < .005$ level or below.)

Number of Hours of Energy Instruction Provided. A final way of looking at the impact of interventions on the schools is to consider the actual number of hours of energy instruction provided. As compared to the earlier measures of whether or not a school received any instruction, and what percentage of targeted teachers taught energy conservation, this variable provides a better indicator of the amount or quantity of impact on the participating school. These results are illustrated in two ways: first, the total number of hours of energy conservation taught in a school by the targeted teachers (see Figure 2); and second, the average number of hours of energy instruction per teacher (see Figure 3).

Figure 2

Hours of Energy Instruction Per School[a]
by Condition



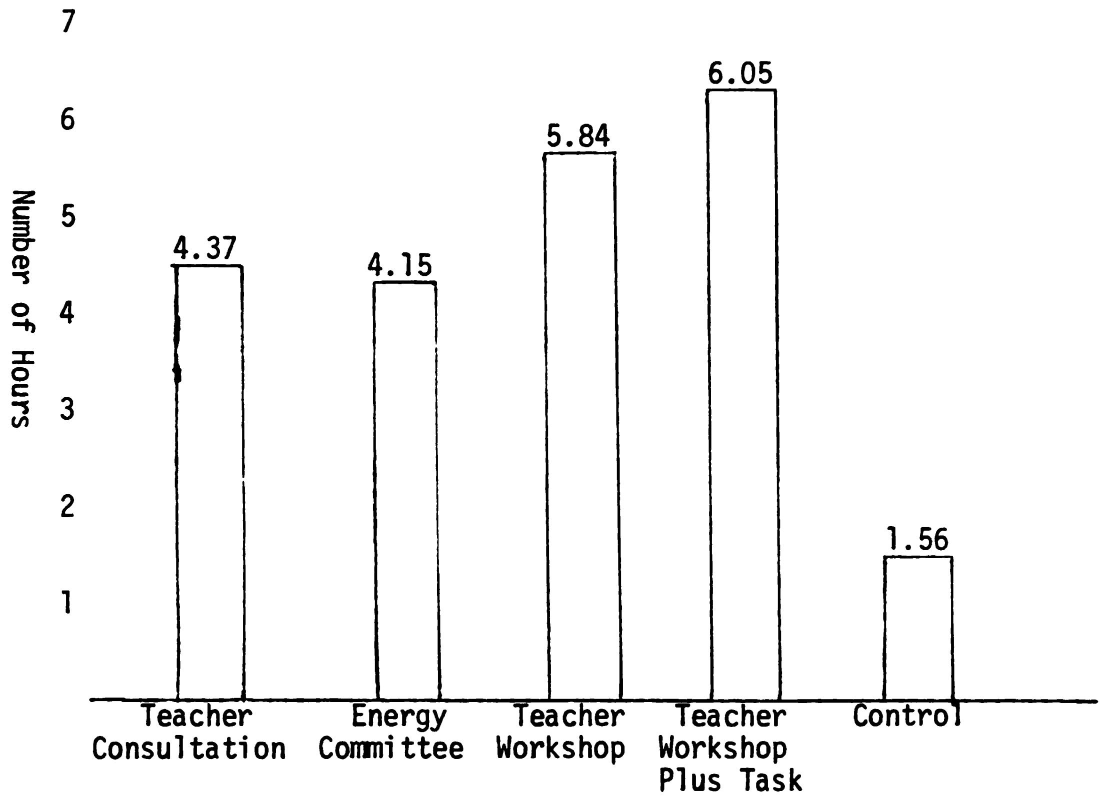
[a]These results persist in a very stable manner when the number of interested teachers is covaried out.

Analysis of Variance

Source	DF	Mean Square	F	Significance of F	Eta^2
Between Groups	4	497.2	3.095	.019	.13
Within Groups	85	160.6			
Total	89				

Figure 3

Hours of Energy Instruction
Per Teacher by Condition



Analysis of Variance

Source	DF	Mean Square	F	Significance of F	Eta^2
Between Groups	4	62.8	4.563	.002	.18
Within Groups	85	13.7			
Total	89				

Once again, the schools in the experimental conditions score significantly higher than those in the control condition. (Planned comparisons show all the experimental groups to be superior to the control group at the $p<.05$ level or below with the exception of the teacher consultation condition in Figure 2, which only reaches the $p=.13$ level.)

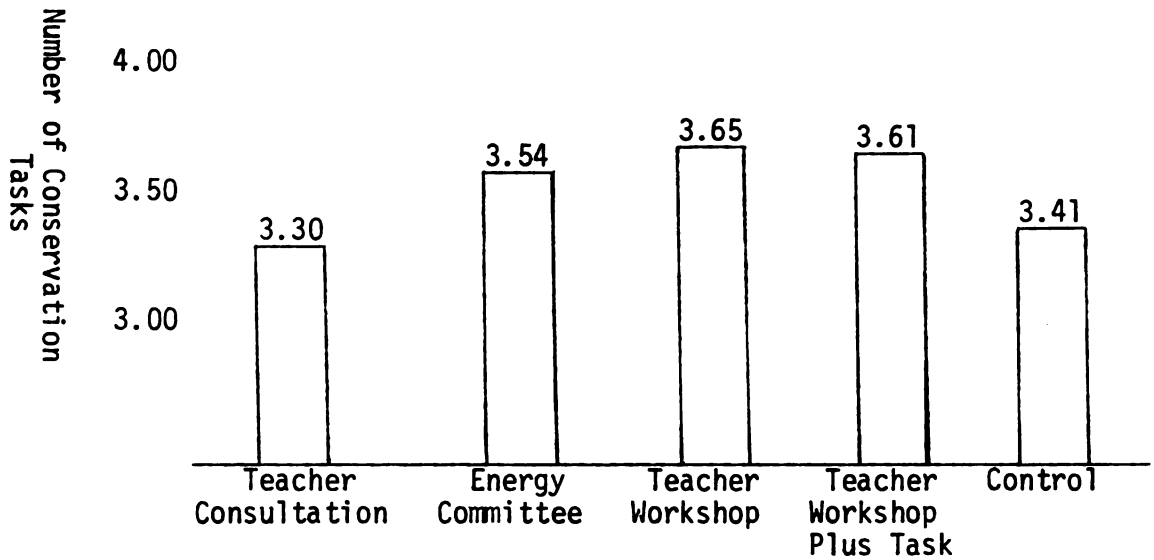
Secondary Outcome Measures

Student Energy Conservation Attitudes. While it is true that the actual interventions utilized in this study were targeted at the teachers, it is very important to consider the impact of these efforts on the ultimate consumer: the student. Unfortunately, the results of such an analysis are somewhat disappointing. Using a one-way analysis of variance, with schools as the unit of analysis, there turned out to be virtually no difference between the five conditions in overall energy conservation attitude score ($F=.60$, $p=.66$). While the two workshop conditions tended to produce slightly higher scores, the difference was not enough to be meaningful. These results are further discussed in the next chapter.

Student Energy Conservation Behaviors. The other important secondary outcome measure was student self-reported energy conservation behaviors. The following graph presents the average number of conservation tasks (out of ten possible) that the students in each condition reported completing during the time period of the study.

Figure 4

Student Energy Conservation Behavior
by Condition



Analysis of Variance

Source	DF	Mean Square	F	Significance of F	Eta^2
Between Groups	4	.38	2.10	.089	.10
Within Groups	75	.18			
Total	79				

The results for this variable were not quite statistically significant (p=.089). Three of the four experimental groups scored higher than the control group. However, planned comparisons revealed that there were no statistically significant differences (p=.108 for the teacher workshop vs. control comparison). Further, a posteriori contrast tests revealed no significant differences between any of the conditions.

Other Variables of Interest

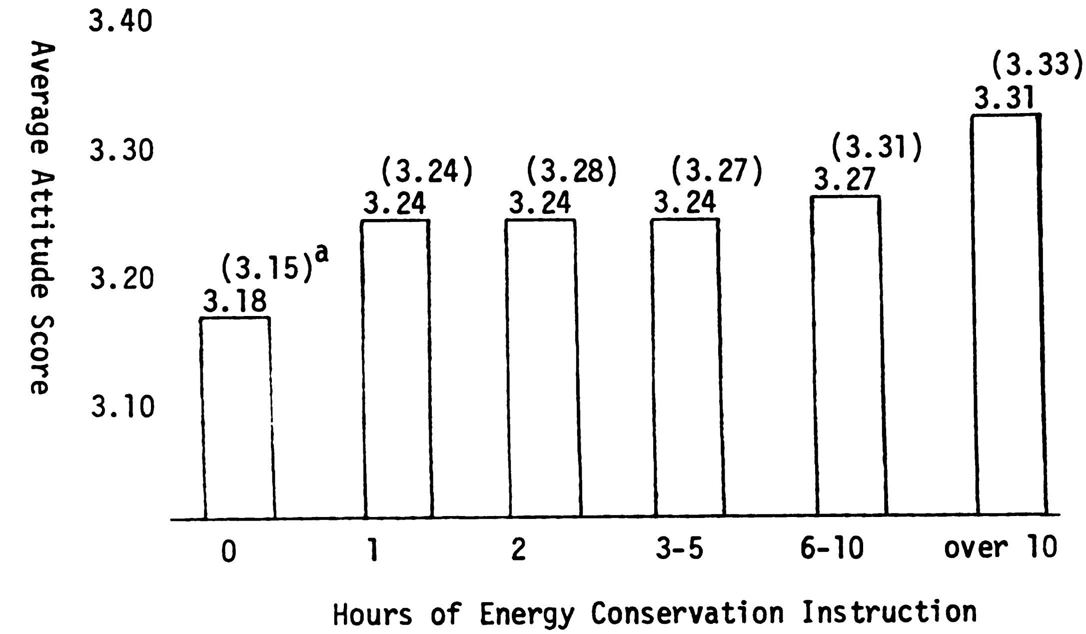
Student Outcomes at the Classroom Level

While comparisons between the different conditions in the experiment failed to produce meaningful differences in student energy conservation attitudes and behaviors, it was decided to further pursue this issue by examining the classroom level data. At this level of analysis, the impact of teaching or not teaching energy topics on student outcome measures could be more closely considered. Data was available on a total of 617 classrooms from the participating schools. The effect of teaching energy topics on student energy conservation attitudes and behaviors was examined using this data.

Student Attitudes. As it turned out, almost exactly one-half of the classrooms examined received energy conservation instruction. Collapsing across all five experimental conditions, classes receiving and those not receiving such instruction were compared. The results show that energy conservation instruction was positively related to student attitude scores ($T=4.04$, $p<.001$). Furthermore, it was found that more hours of energy conservation instruction were positively related to higher attitude scores. Figure 5 below illustrates this data.

Figure 5

Student Attitude Score by
Number of Hours of Energy Conservation Instruction



[a]As an indicator of the relative validity of the teacher questionnaire data used in this graph, the numbers in parentheses indicate the average attitude score obtained by categorizing students according to their own estimate of the number of hours of energy conservation taught in that class. The figures not in parentheses are based on the per classroom average attitude score using the teacher's estimate of number of hours of instruction. The statistics reported are based on the teacher level data. (A direct comparison of teacher vs. student estimates of the number of hours of energy conservation instruction provided in the class revealed a correlation of $r=+.60$, $p <.001$.)

Analysis of Variance

Source	DF	Mean Square	F	Significance of F	Eta^2
Between Groups	5	.159	3.89	.0018	.03
Within Groups	611	.041			
Total	616				

As one can see from the graph, when examined at the classroom level, there does appear to be an impact of energy conservation instruction on student attitudes. Although the strength of the linear relationship is slight ($r=+.16$, $p<.001$), the fact that it is consistent over such a large sample and verified by both teacher and student reported data, indicates that some confidence can be placed in the relationship. This issue will be further discussed in the final chapter.

Student Behaviors. The student self-reported conservation behaviors were also examined using the classroom level data. Once again, classrooms receiving energy conservation instruction were compared with those not receiving such instruction. Although the magnitude of the relationship was not quite as strong as for the attitudinal results, those receiving instruction did score significantly higher ($T=2.38$, $p=.018$). However, when the impact of varying amounts of energy conservation instruction on student behaviors was examined, as in the above graph, the results were in the desired direction but were not quite significant. The linear relationship between instruction and student behavior was statistically significant but weak in absolute terms ($r=+.12$, $p=.002$). This issue will also be further discussed in the final chapter.

Teacher Outcomes at the Teacher and Classroom Level

Aside from the main dependent variables of whether or not and how much a teacher taught about energy conservation, there were two other variables measured in the teacher post-test questionnaire (see Appendix E), which might be considered outcome measures in some respects. These were the variables of teacher self-rating of knowledge about energy and energy conservation (item #5) and teacher rating of the importance of the need for energy conservation (item #8).

Teacher Knowledge. The results for the variable of teacher self-rating of knowledge about energy and energy conservation are similar in pattern to the actual teaching results but are not as pronounced. The control group scored the lowest of the five conditions, while the task workshop group scored the highest. Unfortunately, the results were not statistically significant.

Rated Importance. The variable of teacher rating of the importance of the need for energy conservation also showed a very similar pattern of results. The two workshop groups were highest, the control group was second to the lowest, and the consultation group scored lowest of the five groups. (Interestingly, this was the same pattern exhibited in the student conservation attitude and conservation behavior scores.) Once again, however, the results did not reach statistical significance.

The "Task-Oriented" Strategy

One additional important area of interest in this study was, of course, the "task-oriented" strategy of encouraging teachers to assign actual energy conservation activities to students. The results of this effort can be examined in terms of both teacher response and ultimate student impact.

Teacher Response. The data concerning the classroom activities of teachers was examined for the teachers in each of the five conditions. Table 6 presents the results obtained in terms of the use of energy conservation tasks as student assignments.

Table 6

Use of an Energy Conservation Task Assignment in Class by Condition[a]

	Teacher Consultation	Energy Committee	Teacher Workshop	Teacher Workshop Plus Task	Control
Task Assigned	8%	3%	9%	15%	4%
No Task Assigned	92%	97%	91%	85%	96%

N=642 classrooms

[a] $\chi^2=15.7$ df=4 p=.003

As one can see from the table, the results were statistically significant and the task-oriented workshop produced the highest level of energy conservation task assignment by teachers. To further examine the magnitude of difference, the "teacher workshop with task" condition was directly compared with its nearest competitor, the standard teacher workshop condition. Here again the results show that the workshop plus task condition produced a significantly higher percentage of teachers assigning conservation tasks in the classroom (Tau C =-.09, $p < .05$).

Student Response. As discussed previously, there were no significant differences between conditions on student attitudes and behaviors (although students in the task workshop condition scored highest and next to the highest in conservation attitudes and behaviors respectively). Once again, however, it is useful to consider the classroom level data when examining the task variable.

Here the results are somewhat mixed. Across all five conditions, it turns out that just under 10% of participating classes received an energy conservation task assignment. Students in classes receiving such an assignment scored higher on the attitude scale, but not quite significantly higher, than those in classes not receiving such an assignment. However, students in task assignment classes did score significantly higher on the variable measuring conservation behaviors ($F=4.89$, $p=.027$).

Correlational Analyses

In addition to the direct analysis of the primary and secondary outcome variables, a final area of interest is in terms of the relationship of the numerous survey variables to the major dependent variables used in this experiment. To examine this issue, a series of regression analyses were performed using both the teacher and student response outcome measures.

Teacher Response. Two major indicators of teacher response were utilized in these regression analyses: whether or not a teacher taught about energy conservation to his/her students, and the number of class hours devoted to energy conservation topics. Seven variables from the teacher survey were used as predictors in a stepwise regression analysis with each of those two dependent measures.

- sex of the teacher
- subject taught by the teacher
- number of other teachers at the school whom the teacher knows that are interested in energy conservation
- teacher's self-rating of knowledge about energy conservation
- teacher's rating of the importance of conserving energy
- teacher's rating of how free he/she feels to improvise in choosing his/her own topics for classroom subject matter
- dichotomous variable of whether or not the teacher received an education intervention in this project (i.e. experimentals vs. controls).

The results of these analyses are presented in Tables 7 and 8.

Table 7

Multiple Regression: Whether or Not Teacher Taught Energy Conservation with Seven Teacher Survey Variables

Variables in the Equation	Multiple R	R Square	Simple R	Overall F
Whether experimental or control	.359	.129	.359	25.74
Number of other teachers	.420	.176	.226	18.51
Self-rated knowledge of energy conservation	.439	.193	.207	13.72
Rated importance of energy conservation	.445	.198[a]	.154	10.59[b]

(The remaining three variables add less than .01 to the R-Square value.)

[a]The final R-Square value, corrected for shrinkage, was .180.

[b]Significant at $p<.001$.

Table 8

Multiple Regression: Number of Classes About Energy Conservation Taught by Teacher With Seven Teacher Survey Variables

Variables in the Equation	Multiple R	R Square	Simple R	Overall F
Whether experimental or control	.376	.141	.376	28.69
Number of other teachers	.458	.210	.269	22.94
Self-rated knowledge of energy conservation	.495	.245	.272	18.64
Rated importance of energy conservation	.507	.257[a]	.208	14.76[b]

(The remaining three variables add less than .01 to the R-Square value.)

[a]The final R-Square value, corrected for shrinkage, was .239.

[b]Significant at $p<.001$.

As the tables reveal, it was possible to explain a fair amount of the variance in the major teacher outcome measures (whether or not a teacher taught about energy conservation and the number of classes the teacher devoted to energy conservation topics). In particular, the experimental educational intervention accounted for the largest proportion of variance in each of those variables, closely followed by the number of other teachers interested in energy conservation topics (perhaps a "peer group" effect) and the teachers' self-rated knowledge of energy conservation. Together these three variables accounted for almost all of the explained variance in each of those outcome measures.

Student Response. Regression analyses were also performed on the two major indicators of student response: energy conservation attitude score and self-report of conservation behavior. A total of 15 variables obtained from the student Youth Energy Survey questionnaire were entered into the stepwise regression equation for each of the two dependent variables. Those 15 variables are listed below in order of their appearance on the questionnaire (see Appendix C for questionnaire). A sixteenth variable was also included to represent experimental or control group status.

- Grade level of student
- Sex of student
- Age of student
- Number of persons living in student's household
- Number of bedrooms in student's home
- Whether or not student lives within one mile of school
- Whether or not student owns his/her own car
- Number of cars owned by the family
- Size of largest car owned by family
- Type of dwelling student lives in
- Number of different academic courses in which the student has received energy conservation instruction
- Whether or not the student has had an energy conservation task assigned by a teacher
- Whether or not the student has received energy conservation instruction from the participating teacher
- Number of hours of energy conservation instruction received
- Number of pages read about energy in the previous week
- Whether or not the teacher received an education intervention in this project (i.e. experimentals vs. controls)

The results of these regression analyses are presented in Tables 9 and 10.

Table 9

Multiple Regression: Student Energy Conservation Attitude Score with 16 Variables

Variables in the Equation	Multiple R	R Square	Simple R	Overall F
Whether or not energy conservation instruction was received	.118	.014	.118	15.14
Sex of student	.157	.025	-.097[a]	13.67
Grade level of student	.178	.032	.092	11.71
Size of family car	.198	.038	-.086[b]	10.94
Number of persons in household	.212	.045	.072	10.19
Number of different energy conservation courses received	.224	.050	.105	9.49
Whether experimental or control	.232	.054[c]	.065	8.70[d]

(The remaining 9 variables add less than .01 to the R-Square value.)

[a]Females have more positive attitude scores.

[b]The smaller the size of the family's largest car, the more positive the energy conservation attitude of the student.

[c]The final R-Square value, corrected for shrinkage, was .050.

[d]Significant at $p<.001$.

Two factors are worthy of note in considering these results. First, as is apparent, only a small percentage of the variance in student attitudes was accounted for. (This is perhaps not surprising given the extremely large sample size and the complexity of the variable.) Second, the two variables most highly correlated with student attitudes (although they cancelled each other out to some extent in the regression analysis) were both educational intervention factors (i.e. whether or not the student received energy conservation instruction and the number of different academic courses in which the student received energy conservation instruction.)

The results for the student behavioral variable are similar, although slightly more positive.

Table 10

Multiple Regression: Student Energy Conservation Behavior Score with 16 Variables From the Y.E.S. Questionnaire

Variables in the Equation	Multiple R	R Square	Simple R	Overall F
Number of different energy conservation courses taught	.205	.042	.205	47.43
Energy task taught	.244	.059	.169	34.02
Number of energy pages read	.257	.066	.150	25.43
Size of family car	.265	.070	-.080[a]	20.56
Number of energy hours taught	.272	.074	.100	17.18
Whether energy conservation was taught	.281	.079	.139	15.32
Number of persons in household	.286	.082[b]	.057	13.62[c]

(The remaining 9 variables add less than .01 to the R-Square value.)

[a]The smaller the family's largest car, the higher the student's energy conservation behavior score.

[b]The final R-Square value, corrected for shrinkage, was .076.

[c]Significant at p<.001.

The same two factors are also worthy of note in considering this table. Although the R-Square value is somewhat higher, it is still quite low in absolute terms. Once again, this is not necessarily surprising. As to the second factor, however, the relative impact of the educational intervention variables is even considerably more apparent in this analysis.

Together these last four tables suggest that, although the variables measured in this study are only able to explain a modest amount of variance in the teacher outcome measures, and even less in the student outcome measures, a large proportion of the variance that is explainable appears to be attributable to variables associated with the experimental intervention. These findings, as well as the experimental results presented earlier, will be discussed further in the next chapter.

Reliability and Validity Issues

After having reviewed the experimental and correlational results of this study, it is appropriate to reinforce those findings at this point with a discussion of reliability and validity of the data obtained. This is particularly true of the teacher questionnaire data, for two reasons. First, unlike the Youth Energy Survey utilized to gather the student level data, which had undergone considerable reliability and validity testing during its development, the teacher questionnaire was a new and relatively unproven instrument. Second, the teacher response data contained the primary outcome measures of the study and, thus, deserves careful justification.

As referred to briefly in the previous chapter, a special series of teacher telephone interviews were conducted to enable an assessment of the reliability and validity of the written teacher questionnaires. A random sample of approximately 20% of the participating teachers (n=53) who had completed a teacher questionnaire were interviewed by telephone at their home by trained undergraduate interviewers. The presentation of this interview was not directly tied to the evaluation of this project, but rather it was introduced as a "survey of energy-related education activities in Michigan." In the process of the interview, however, the key questions from the written teacher questionnaire were included. (See Appendix F for a copy of the interview format.)

The results of this mini-study were very encouraging. For the major dichotomous outcome variable of whether or not a teacher taught about energy conservation, a "percent exact agreement" level of 94% was obtained. For the several interval level outcome variables, similarly positive results were observed. This is presented below in Table 11 using Campbell and Fiske's (1959) methodology of a multitrait-multimethod (MTMM) matrix of correlations to examine convergent and discriminant validity. Four important teacher level variables are presented: hours of energy conservation taught (hours); self-rating of freedom to design their own lesson plan (free); self-rating of knowledge of energy and energy conservation (know); and rating of the importance of conserving energy (import). Each of these variables was measured through two methodologies: a questionnaire (Q) and a telephone interview (T).

Table 11

Multitrait Multimethod Matrix
of Teacher Response Data

	Hours Q	Free Q	Know Q	Import Q	Hours T	Free T	Know T	Import T
Hours Q	---							
Free Q	.17	---						
Know Q	.41	.35	---					
Import Q	.30	.37	.55	---				
Hours T	.75	.13	.55	.43	---			
Free T	.10	.61	.42	.28	.12	---		
Know T	.48	.36	.85	.49	.64	.26	---	
Import T	.13	.07	.21	.51	.27	.22	.14	---

Using the four criteria suggested by Campbell and Fiske for evaluating the MTMM matrix, the data show quite good convergent and discriminant validity. First, the correlations between the same variable measured by different methods (i.e. the convergent validity diagonal) are very high and easily statistically significant. Second, the convergent validity values are higher than their corresponding heterotrait-heteromethod correlations (e.g. Know T with Know Q is higher than Free T with Know Q or Hours T with Know Q, etc.). Third, the convergent validity values are higher than their corresponding heterotrait-monomethod correlations (e.g. Hours T with Hours Q is higher than Import Q with Hours Q or Know Q with Hours Q, etc.). Fourth, a similar pattern of variable interrelationships is visible in the heterotrait-monomethod and heterotrait-heteromethod submatrices (e.g. Hours with Know tends to be the highest correlation, Know with Free and Hours with Import tend to be in the middle, and Hours with Free and Import with Free tend to be the lowest).

In summary, it appears that the data used in this study demonstrates good reliability and validity characteristics. This should help increase the confidence one can place in the preceding experimental and correlational findings.

CHAPTER IV

DISCUSSION

The purpose of this study was to experimentally examine the relative effectiveness of four alternative strategies for attempting to influence high school teachers to include energy conservation instruction in their classes. The primary outcome variables were the acceptance and participation rate by the targeted schools and the presence and quantity of energy conservation instruction provided by participating teachers in those schools. Secondary outcome variables were the energy conservation attitudes and reported behaviors of the students of participating teachers. The relative effectiveness of the four modes of educational intervention was tested by means of a longitudinal field experiment in a twelve county area in the Lower Peninsula of Michigan (as described in Chapter II).

Experimental Outcomes

As can be seen from the data presented in the preceding chapter, the four educational interventions examined do demonstrate significant impact as compared to a no-treatment control group on many of the outcome variables. These results are discussed below.

School Acceptance of Treatment

In designing any educational intervention, including one addressing the energy problem, an obvious area of initial concern is whether or not targeted schools will even participate in the program being offered. In these times of numerous mandated federal and state educational programs, together with shrinking financial resources, many schools feel overburdened and underfunded and, understandably, are often reluctant to become involved in additional programs and activities.

It is to the credit of the programs offered in this study, as well as to the perceived importance of the energy problem by educators, that a very high level of participation by schools was achieved. Over 80% of the targeted schools participated in the program. Furthermore, there was no significant difference between the alternative interventions being offered in terms of the participation rate by targeted schools. These results suggest that (a) energy conservation programming appears to be positively valued by schools, and (b) the four particular intervention strategies offered in the study appear to be somewhat equivalent in terms of initial positive appeal to school personnel (i.e., principals and teachers).

Teacher Response

The next and most important level of concern in this study is the actual response of teachers to the intervention. In other words, the question is "do the treatment strategies being tested lead to increased levels of energy conservation instruction."

The results of the study in this area are very positive. In terms of whether or not a participating school receives energy conservation instruction, in terms of whether or not participating teachers provide energy conservation instruction, and in terms of the quantity of such instruction teachers provide, the four educational interventions tested are all clearly superior to the no-treatment control group. Depending on the particular variable (see Table 4 and Figures 1-3), the levels of energy conservation instruction in the experimental intervention groups are from two to four times higher than the control group. As for differences between the four experimental conditions, the two workshop conditions tend to achieve somewhat higher (but not statistically significant) levels of conservation instruction than the two consultation strategies.

One alternative explanation for these findings that should be considered is that it was not the experimental intervention itself accounting for these differences, but rather it was an effect of the attention received and/or a "social desirability" response. A factor encouraging this interpretation is the fact that all four treatment conditions were relatively similar in their superiority to the control condition. In response, it should be noted that, although this alternative hypothesis is not directly refutable in the experimental design of this study, several important factors act to mitigate its likelihood.

First, the relative similarity of the four experimental groups is not necessarily surprising. As described earlier, these four groups were deliberately standardized in terms of teacher recruitment, background information provided on the "energy problem" and curriculum materials provided. Hence a good deal of the attributes of the intervention were common to the four treatment groups. Furthermore, there were some trends toward distinctions between the four groups (although not statistically significant) with the workshop groups tending to produce somewhat greater levels of response.

Second, the influence of "social desirability" in terms of wanting to appear positive on the socially important topic of energy conservation, should affect the control group teachers as well as the experimental teachers. Control group teachers were recruited identically.

In addition, as the verification of randomization comparisons presented earlier indicated, they were essentially equivalent to the teachers in the experimental conditions in descriptive attributes.

Third, the influence of social desirability, in terms of a positive response to a program evaluation, was hopefully minimized through several methodological steps that were taken. For example, the post-test survey questionnaires were not given to teachers until over two months after their receipt of the intervention. This should hopefully minimize the post-treatment "halo effect" which often occurs. Furthermore, the reliability and validity of the teacher data received careful attention. In particular, the previously discussed follow-up telephone survey was utilized to validate the teacher responses. This survey was conducted by persons unknown to the teachers and was presented as a state-wide "survey of energy-related education activities in Michigan" in a deliberate attempt to remove any indication of a specific program evaluation. The results of this survey, for both experimental and control teachers, showed excellent reliability and validity.

Fourth, a "known-groups" method of validation was also applied to the teacher data concerning amount of energy conservation instruction provided. Sixteen classrooms (n = 440 students) were randomly selected such that eight were from teachers who had indicated ten or more hours of energy conservation instruction had been provided and eight were from teachers who had indicated no energy conservation instruction had been provided. The student responses on the YES questionnaire item for hours of energy conservation instruction provided were then compared between the two groups. For the first group (i.e., teachers indicated teaching) the mean student response was for the category "5 to 10 hours" of instruction received. For the second group (i.e., teachers indicated not teaching) the mean student response was just over one hour of instruction received. Thus, these results also serve to cross validate the teacher data.

Finally, in addition to the closely corresponding data reported earlier in Figure 5, the data obtained from teachers concerning the number of hours of energy conservation taught was directly compared with student estimates of the number of hours of energy conservation instruction provided by that teacher. The results indicate that the student responses do indeed validate the teacher responses, and furthermore, the degree of this correspondence ($r = +.60$) was virtually identical for both experimental and control teachers. This latter fact, combined with the above findings, helps to reject the alternative hypothesis of a social desirability response or a treatment by measurement interaction accounting for the observed experimental results on the teacher outcome variables.

In summary, the experimental results suggest that the previous research findings and logical rationale for each of the four intervention strategies, as outlined in Chapter I, are supportable insofar as this study is concerned. It appears that teacher workshop and teacher consultation strategies can be successfully utilized to promote energy conservation instruction by teachers.

Student Response

In contrast to the teacher response, the eventual student level results showed that the experimental conditions did not produce statistically significant superiority to the control condition in student energy conservation behaviors. This is an interesting, albeit somewhat disappointing, finding and deserves further examination.

There are numerous possible explanations for this lack of positive results. Five of the most representative explanations might be as follows:

1) the educational system and/or the educational strategies employed are inappropriate for the goal of influencing student attitudes and behavior in this area;
2) the instrument used to measure student outcomes was not appropriate or not sensitive enough;
3) the control group was advantaged in some unknown way;
4) the actual materials and techniques provided to the teachers were not powerful enough to significantly impact students;
5) although quite significant in comparison to controls, experimental group teaching levels were still not high enough to reach the threshold of meaningful impact on student attitudes.

Each of these possible explanations will be considered in turn.

The first explanation above represents the broadest interpretation and generalization. Like most broad generalizations, it is probably inaccurate. In addition to the fundamental logic underlying the whole educational system in terms of its ability to impart knowledge, influence character and values, and ultimately influence behavior, there are also specific prior research results supporting the effectiveness of the types of interventions used in this study (e.g., Moon, 1969; Wasik & Nicodemus, 1969; Howell & Warmbrod, 1974; Leedom, 1979; etc.). Hence, it would probably be unwise to reject the concept of using educational interventions to positively impact student energy conservation.

The second explanation is a bit more realistic but still seems unlikely in this situation. The YES questionnaire has undergone extensive reliability and validity testing and has shown fine results. In particular, its construct validity has been demonstrated using a wide variety of concrete conservation behaviors as well as independent teacher ratings of conservation attitudes. Although it seems to have somewhat narrow variability (S.D. = .55, $\overline{x}$ = 3.20 on a five point scale), its very high reliability (Cronbach Alpha = .93) should preserve its usefulness in this setting. Thus, the particular measure used would not seem to account for the lack of positive results. (Furthermore, there are virtually no published alternative measures available at this time even if desired.)

The third explanation, that the control group was somehow advantaged, also does not seem likely. As described previously, a randomization procedure was utilized in this experiment and the effectiveness of that randomization was confirmed with a variety of analyses. It is, therefore, improbable that the control group was somehow advantaged on some variable that would negate any true positive impact of the experimental interventions.

The fourth explanation, that the actual materials and techniques provided to teachers were not powerful enough to significantly impact students, may have some merit. For the most part, the curriculum materials provided in this study were selected by the Michigan EES on the basis of availability (i.e., they were available in some quantity from the U.S. Department of Energy). With the exception of the one task oriented material developed by a Michigan researcher (Leedom, 1979), no data at all was available demonstrating the impact or usefulness of the materials used. In retrospect, as a purely subjective assessment, one might consider the materials as adequate but far from outstanding. (See Appendix G for a list of the curriculum materials used.)

The results of this study tend to confirm the "adequate but not outstanding" description of the materials. The impact of the curriculum materials provided was examined in three basic ways. First, those classrooms in which energy conservation had been taught (n=330) were selected from the data set. Then, t-tests were performed for each of the seven curriculum materials, comparing classrooms in which the material had been used with classrooms in which it had not. Of the fourteen possible comparisons (student attitudes and student behavior scores by each of the seven materials), all were in the desired direction while six reached statistical significance (see Appendix H).

However, an analysis of variance, covarying out the effects of the number of hours of energy conservation taught and the number of project materials used, revealed that none of the above fourteen comparisons reached statistical significance. Hence, it appears that the quantity of energy conservation instruction is really more important than the use of any particular curriculum materials, at least for the materials examined in this project.

In line with this reasoning, a second method of analysis looked at this issue more directly by examining the cumulative impact of using more than one of the provided materials. An analysis of variance was performed using the categories of none, one, and two or more of the provided materials, covarying out the effect of the number of hours of instruction provided. The direction of the relationship was linear and positive for both student outcome measures and was statistically significant (F=5.12, p=.006) for student attitudes but not statistically significant for student behavior score.

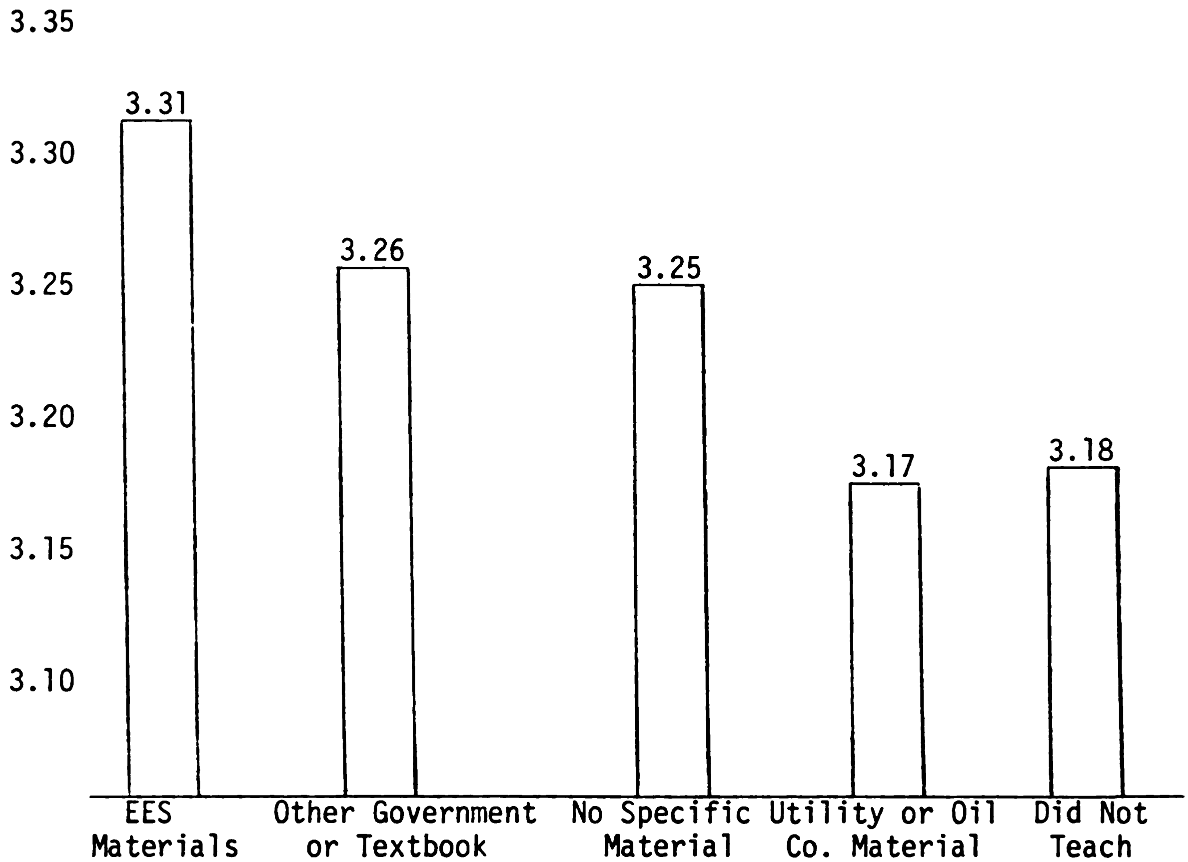
A third method of analysis examined the effect of different categories of curriculum materials. Each classroom was classified into one of five groups according to the type of instruction received. Those five groups were as follows:

1) energy instruction using EES provided materials;
2) energy instruction using other government or textbook materials;
3) energy instruction using unspecified materials or no particular materials;
4) energy instruction using utility or oil company provided materials;
5) no energy instruction at all.

An analysis of variance was then performed between these five groups on student attitude and behavior scores. The ordering of the results was virtually the same for attitude score and behavior score, but only the attitude score analysis reached statistical significance. These results are presented in Figure 6.

Figure 6

Student Conservation Attitude Scores[a]
by Type of Curriculum Material Used



[a]These results persist in an almost identical pattern when the number of hours of energy conservation instruction provided per class is covaried out.

Analysis of Variance

Source	DF	Mean Square	F	Significance of F	Eta^2
Between Groups	4	.317	8.00	.0001	.05
Within Groups	622	.039			
Total	626				

(A Duncan Multiple Range Test at the .01 level revealed that Group 1 was significantly higher than the other four groups and that Groups 1, 2 and 3 were all significantly higher than Groups 4 and 5. No other comparisons were significant.)

As one can see from the graph, there was a moderately positive impact associated with the use of the materials provided in the program. However, it appears that the impact was not of especially great magnitude, relative to other available government and textbook materials, suggesting that there could be room for improvement in this area. Hence, it appears that the adequacy of the materials provided could be one possible explanation of the lack of significant positive results at the student level.

One additional item worthy of discussion is also provided by Figure 6. It is interesting to note that the category of energy materials provided by utility companies or oil companies produced the lowest student energy conservation attitude scores. This is of special interest in view of the controversy which has grown around the practice of private economic interests providing educational materials for use in the schools. Many critics have called this a questionable practice due to potential conflict of interest and other concerns. One area of particular attention has been energy education (Harty, 1980; Business Week, 1980). While keeping in mind the non-experimental nature of the data in Figure 6, those results can still have meaningful implications for that debate in view of the fact that virtually no sound empirical evaluation has occurred in that area. These results suggest that there may be some substance to the criticisms. Thus, it is hoped that further research will be pursued on this issue.

Finally, the fifth explanation (that although quite significant in comparison to controls, the experimental group teaching levels, on the whole, were still not high enough to reach the threshold of meaningful impact on student attitudes and behaviors) also may have some merit. In fact, this is perhaps the most likely explanation available. Although the experimental groups' teachers taught an average of four to six hours of energy conservation versus only 1.5 hours for control group teachers (see Figure 3 presented in the previous chapter), this magnitude of difference may not be enough to significantly discriminate between the groups in student impact.

Indeed, in looking back at Figure 5, one sees some support for this supposition. While significantly higher than classrooms receiving no energy conservation instruction, classrooms in the 3 to 5 hour range are really at about the same plateau in terms of student results as classrooms receiving 1 or 2 hours of such instruction. It is only when the hours of energy conservation instruction approach and exceed 10 hours per class that further significant improvement in student results are seen. Although further study would be needed, these results suggest that there may be "thresholds" in the amount of instruction provided that increasingly impact students. If this were the case, then the lack of significant positive results for the student outcome variables could be due to a failure to reach that next threshold with enough of the teachers in the experimental groups. In other words, although the interventions produced significantly more energy conservation instruction, and energy conservation instruction is desirable because it is positively related to student activities and behaviors (as the correlational and classroom level findings indicate), the intervention did not produce enough additional instruction to provide, as a group, significantly additional impact on students.

This interpretation, if correct, has some major implications for the educational community in its efforts to provide energy education. Up to this time, writers in this field have been almost uniformly in agreement that energy education should not be presented as an additional curriculum but, rather, should be "infused" when appropriate into existing curricula (e.g., Carey, 1976; Duggan, 1978; National Center for Education Statistics, 1978; Fowler, 1981). This indeed was the explicit philosophy of the Michigan EES in assembling and presenting the program discussed in this study. Under such a scheme, encouraging the use of one, two, or a few hours of energy conservation instruction is deemed as a desirable project goal. The current results suggest that a much more intensive coverage of the subject may be called for if the student outcomes are desired to be meaningfully improved over the level already occurring in the baseline case. These findings and their implications for public policy will be returned to later in this chapter.

Other Variables of Interest

Implementation of the Task Oriented and Energy Committee Strategies

Aside from the primary goals of encouraging teachers to teach about energy conservation in their classes, two of the intervention strategies used in this experiment contained additional features of interest: the "task" strategy of the task workshop group and the "committee" strategy of the energy committee group. It is useful to consider the degree to which each of these features were implemented in the overall effort to increase energy conservation education.

The results for the task strategy implementation were presented in Table 5 of the preceding chapter. It is encouraging to note that the task group had a significantly higher rate of assignment of energy conservation tasks in class than the other groups. However, the positive findings are tempered somewhat by the fact that the overall rate of assignment for the task group was still fairly low (i.e., 15% of classes received an energy conservation task assignment), and that some level of task activity was even present in the control group (4%). Hence it appears that, although somewhat successful, the degree of emphasis provided to task oriented training, and/or the quality of the rationale and material provided in support of the task strategy, may have been inadequate to achieve widespread adoption of task oriented energy conservation instruction.

A similar situation resulted in terms of the energy committee strategy. Follow-up surveys revealed that, although schools in the energy committee condition had the highest rate of implementation, that rate was not extremely high (33% of the schools in that condition had at least begun the formation of some type of energy committee), and at least some schools in each of the other four conditions had also begun the formation of energy committees on their own (ranging from 11% of the consultation group to 17% of the schools in the workshop condition). Indeed, chi-square analysis revealed that this difference between the conditions was not statistically significant. Thus, in this case as well, it appears that the intervention was somewhat successful in promoting implementation of a recommended strategy (i.e., the formation of school energy committees) but that there remains much room for improvement in facilitating a higher rate of adoption.

As for the efficacy of these two strategies in terms of ultimate student level outcomes, the impact of both task assignments and committee formation was examined. The results for the effect of task assignment were presented in the previous chapter. Students in classes that received an energy conservation task assignment scored significantly higher on the energy conservation behavior variable and higher, but not quite significantly, on energy conservation attitudes.

In regard to the committee impact, it has already been shown that the schools in the committee condition did not have significantly higher student attitude or behavior scores. Nevertheless, in order to more closely examine the impact of this factor, all schools that did report the formation of a committee, regardless of condition, were combined and compared with schools which had not. This method of analysis also showed no significant impact on student attitudes or behaviors. However, it is interesting to note that those schools reporting the formation of a committee had a higher percentage of interested teachers who taught energy conservation topics ($p < .05$) and a higher average number of hours taught per teacher ($p = .001$).

These latter results thus are reminiscent of the problem discussed in the previous section (i.e., positive results are visible at the level of teacher activity but are not significant at the level of student outcome). Once again, the same possible explanations concerning the adequacy of the materials and the thresholds of instruction intensity are applicable.

In summary, it appears that some degree of success was achieved in facilitating the implementation of the two particular intervention strategies of student task assignments and school energy committees. However, their level of implementation was still not as high as might be desired, and certainly not as visible as the impact on energy conservation instruction by teachers. This suggests that further improvements could be made in the design of interventions to promote these strategies. In particular, more attention might be paid to discovering motivating variables for the adoption of these innovations, at both the individual and organizational level.

As for the desirability of further promotion of these strategies, the results are somewhat mixed. The assignment of energy conservation tasks to students was associated with significantly higher student behavior scores and somewhat, although not significant, higher attitude scores. Given these reasonably positive results, together with the theoretical (e.g., Breer & Locke, 1965; Bem, 1965, 1972) and previous research (e.g., Leedom, 1979) support for this approach, it seems appropriate to recommend the task oriented strategy for further use in energy conservation education programs. This recommendation is made easier by the fact that the strategy also has good face validity and, depending on the manner in which implemented by teachers, could actually produce tangible energy savings during the educational process (e.g., having students "weatherize" a house) in addition to longer term attitudinal and behavioral impacts.

The situation for the energy committee strategy is a little less clear. The implementation rate was not very impressive, suggesting some difficulty (confirmed by the informal reports of the EES regional coordinators) in getting schools to form an energy committee. This is perhaps not surprising given the complexity of this task and the need to coordinate the actions of several different actors within the school, as opposed to simply persuading individual teachers to teach about energy conservation. The recommendation is further weakened by the fact that, even in those schools that did implement an energy committee, no positive impacts on students were apparent as compared to schools without energy committees. On the positive side, schools with energy committees did have a higher rate of teaching energy conservation classes. In addition, there is a good deal of theoretical and research support suggesting the usefulness of such a strategy in attempting to change the school as an organization (Fullan, 1972; Fairweather, Sanders & Tornatzky, 1974; Fullan & Pomfret, 1977). In view of these factors, the recommendation would probably be to maintain the energy committee concept for further research. However, additional or alternative intervention strategies are probably needed in order to achieve wider and more successful implementation.

Correlational Analyses

Two primary areas of interest were explored through correlational analyses: teacher level responses and student level responses. In general, the correlational results are supportive of the conceptual model used in designing this study.

Teacher Level Responses

The experimental outcomes of this study, as previously discussed, demonstrate the soundness of the original hypothesized strategy (i.e., that it is possible to get teachers to teach about energy conservation). The correlational results at this level further reinforce the assumptions underlying this study.

This is evident in examining the results of the regression analyses performed with the teacher outcome variables of whether or not a teacher taught about energy conservation and how many hours of energy instruction were provided (see Tables 7 and 8). The single greatest predictor of each of these variables, accounting for well over half of the explained variance in each case, was the dichotomous variable of whether or not a teacher received one of the educational interventions (i.e., experimentals vs. controls). However, it is also interesting to note that the next three most powerful predictors are all variables that fit well with the conceptual model of social change attempted in this study. In order of their entry into the regression equation, these variables were: the number of other teachers at the school that the teacher knows who are interested in energy conservation; the teacher's self-rated knowledge of energy conservation; and the teacher's rating of the importance of energy conservation.

In addition to the logic of including these variables in any process of attempted persuasion and behavior change (i.e., knowledge, attitudes and peer impact), they each have ample research support in the educational and organizational change literature (e.g., Havelock, 1971, 1973; Fairweather, et al., 1974; Cox, et al., 1974; etc.).

For these reasons, each of these variables was assumed to be a step through which teacher behavior could be influenced. In that respect, for example, all four experimental conditions included instructional and persuasive components intended to impact teacher attitudes and knowledge concerning energy conservation. As for the peer effect, all four conditions touched on that issue through the initial teacher meeting, with the committee strategy particularly suited to maximize that impact.

However, it should be noted that the correspondence between conceptual model and observed outcomes was not a perfect fit. Although the correlational results suggest the soundness of the original assumptions about the relationship of attitude, knowledge, and peer influence to teaching behavior (all significantly positively related), these variables are also apparently not sufficient to explain the teacher outcome behavior. As presented in the previous chapter, although the control group tended to score the lowest on these intermediate variables, the results were not statistically significant. The magnitude of difference between the groups on these variables clearly cannot account for the obtained differences in the primary outcome variables.

There are several possible explanations for this finding. First, it is quite possible that the measurement of attitude, self-rated knowledge, and peer association was inadequate. Due to limitations of time and space in this large scale study, each of these variables was measured with a single item on the teacher questionnaire. This explanation is made less likely, however, by the excellent correspondence obtained between teacher responses on the written questionnaire and the telephone interview. Also, despite methodological limitations, these variables were significant predictors in the regression equations. Still, although perhaps quite reliable, this study obviously cannot claim to have measured the full dimensions of the attitude, knowledge and peer factors.

A second and more likely explanation is that, although these three variables are contributors, other unmeasured factors played a more important role in the observed results. This possibility is supported by the fact that a good deal of the variance in the teacher outcome variables remained unexplained. Also, as the regression results demonstrate (i.e., the impact of the dichotomous "experimental vs. control" variable), something about the intervention (in addition to its impact on the measured variables of attitude, self-rating of knowledge and peer exposure) was strongly impacting the teacher outcome measures. Unfortunately, the limitations on this study are such that it is not possible to provide data on what those additional factors might be.

Finally, it may be that the method of recruitment of teachers used in this study had the effect of limiting the possible variance on these variables and, thus, lessened the potential for positive impact by the experimental intervention. That is, by asking for "interested teachers" to attend the initial organizational meeting (for both experimental and control groups), it is quite possible that participants were thus already at a fairly high plateau in terms of their attitude about the importance of energy conservation or their familiarity with other interested teachers, for example. Hence, large gains in these variables were not possible.

This could explain the failure to observe large differences in these variables in the experimental comparisons. It would, therefore, be useful to conduct a similar study with an unrestricted group of teachers (e.g., all the teachers in a school) to more fully examine the impact of the interventions on these variables.

In summary, regression analyses performed on the teacher outcome variables are supportive of the conceptual model used in designing this study. The single most significant predictor of teacher outcome was the presence or absence of an educational intervention. In addition, the expected variables of teacher attitude concerning the importance of energy conservation, teacher self-rating of knowledge concerning energy conservation, and the number of other teachers interested in energy conservation known to the teacher, were all also significantly related to whether or not a teacher taught and how much energy conservation was taught. However, it was suggested that further research is needed to more fully examine the process by which teacher behavior is influenced.

Student Level Response

Just as for the experimental results, the correlational results for the student outcome variables of energy conservation attitude and self-reported energy conservation behavior are fairly unimpressive. The multiple regression results showed that a total of 15 variables from the Youth Energy Survey could only account for 6% and 9% of the variance in attitudes and behaviors, respectively (see Tables 9 and 10). It is interesting to note, however, that of that small amount of variance accounted for, most is attributable to variables concerning energy conservation instruction received. This is particularly true of the outcome variable of self-reported energy conservation behaviors, where the variables of the number of different courses in which energy conservation instruction was received, whether or not a "task" assignment was received, and the number of pages about energy read in the last week, were the three top predictors, accounting for nearly 7% (out of a total 9%) of the variance.

Furthermore, it should also be noted that it is not unusual for studies to reveal low percentages of variance accounted for when attempting to predict household energy conservation behavior (e.g., Claxton, McDougall & Ritchie, 1980; Verhallen & Raaij, 1980; Webber, 1980; etc.), although one of the most recent and most comprehensive studies of residential energy use and user characteristics (including detailed housing characteristics unavailable in the current study) was able to account for approximately one-half the variance in actual household energy consumption (Hirst, Goeltz & Carney, 1981).

In terms of the demographic variables, a couple of observed relationships are worthy of note. Females tended to be significantly more positive in their energy conservation attitudes than males. This finding corresponds well with previous research concerning energy and environmental attitudes (e.g., Kuhn, 1979; Farhar, et al., 1979). Indeed, sex of the student was the second variable to enter the regression equation for the student attitude outcome measure. As for behaviors, however, sex was not a significant predictor. This distinction could possibly be due to the composition of the behavior list, which included numerous physical/mechanical tasks (e.g., helping to caulk or insulate a home), that may not have been as likely to have been performed by females as males.

One other interesting result was the relationship observed between the size of the family car and student attitudes and behaviors. In each case, the relationship was significant and the variable entered the regression equation as one of the first four predictors. The smaller the family car (on a four point scale composed of subcompact, compact, mid-sized, and full-sized), the more positive the student's energy conservation attitude and behavior. This result has interesting implications in terms of the role of parents in the formation of student attitudes and behaviors. This is an important issue, particularly in comparison to the influence that the school might exert through an educational intervention. Unfortunately, a true examination of that issue is beyond the scope of this study.

Public Policy Issues and Implications

In considering the research conducted in this study and the results that have been obtained, there are several important issues and implications for public policy. This is true both in the area of energy conservation programming in general and the use of the educational system in particular.

Energy Conservation as a Goal

It should first be stressed that there remains a clear and pressing need for energy conservation. In spite of the current short-term oil market glut, brought on primarily by the combination of a world-wide recession and a temporary decision by Saudi Arabia to boost production and restrain prices, the serious long-term energy problem remains. Recent studies reinforce the fact that domestic supplies of conventional fuels just simply cannot be expected to be increased to meet current demand, much less future higher levels of demand (Yergin, 1980; Rand Corporation, 1981). Furthermore, the economic costs, both to the nation as a whole in terms of energy imports, and to the general public in terms of very high energy prices, are extremely damaging (Smith, 1977; D.O.E., 1978a; D.O.E., 1979c; Lovins, 1980; Yergin, 1980).

Fortunately, as has been repeatedly demonstrated, the potential for conservation in the United States is tremendous (Fowler, 1978; Stobaugh & Yergin, 1979; National Academy of Sciences, 1979; Ross & Williams, 1979; Honeywell Inc., 1980; Bonneville Power Administration, 1980), with estimates of clearly achievable energy savings of 25% or more. Furthermore, investments in conservation are clearly cost-effective as compared to investments in producing additional conventional fuels (Stobaugh & Yergin, 1979).

This is especially true when the true marginal cost of new units of energy are compared with conservation. For example, one major West Coast utility has estimated that they are able to "produce" extra energy for their supply grid through home conservation and retrofit programs at one-fourth the cost of building additional generating plants (Davenport, 1980). Indeed, despite decades of emphasis on energy growth and promotional rate structures (i.e., declining costs per unit as consumption increases), some of the nation's utilities and regulatory bodies are seriously turning to conservation as a cost-effective alternative to increasing production (California Public Utilities Commission, 1980). (See Lovins, 1976; 1979; 1980 and Roe, 1980 for further discussion of this issue.) At the home-owner level, the economics are just as attractive. In the typical house, a variety of low-cost/no-cost actions with a total price of well under $100 can save 25% on the household fuel bill (D.O.E., 1979a). Finally, even certain financial institutions are becoming aware of the desirability and economic soundness of conservation and have emphasized the fact that long-term lenders would find it more desirable to invest in communities which have strong energy conservation programs (Hawes, 1980).

The Need for Energy Conservation Programming

If conservation of energy makes such economic sense, however, one might ask why it is necessary to have public sector programs to promote conservation. Why not let the forces of the free market operate to produce conservation behavior? While there is some merit to using market forces, there are several reasons why such a strategy is not sufficient. First, as has been amply documented elsewhere, there are already deeply imbedded subsidies and market distortions which present an artificial cost structure to consumers, including the failure to adequately consider the "social costs" (e.g., pollution, resource depletion, social disruption) of increased energy production (Stobaugh & Yergin, 1979; Hayes, 1979; Lovins, 1980; Hawes, 1980).

Second, it appears that the relative price-inelasticity of demand for energy means that waiting for energy price increases to produce desired levels of conservation will take far too long and extract far too great a price from the average consumer. For example, recent research suggests that a doubling of the price of energy produces only about a 10% reduction in consumer demand, at least in the short run (Stern & Gardner, 1981). This rather gloomy conclusion is reinforced by the results of some recent research conducted by consultants to the new presidential administration, originally intended to be used as a rationale for pursuing a "free market" approach to the energy problem (D.O.E., 1981). This research found that the rapid price increases for energy had not resulted in increased conservation investment and efficiency as desired but, rather, had generally resulted in curtailment of economic activity and declines in productivity (Marlay, 1981).

Third, in spite of existing economic incentives, a major lack of information about energy conservation options tends to prevent meaningful public response. Indeed the awareness, concern and knowledge levels of the public concerning energy conservation are quite low (Milstein, 1977; Farhar, et al., 1979; McDougall, Ritchie & Claxton, 1979; Timmer, 1981). Furthermore, as previous research on "information seekers" has shown, only a small percentage of the population is typically committed enough to actively seek out information on their own (Thorelli, Becker, & Engledow, 1975). The public response to date seems to bear this out. After two years, only 5% of the nation's taxpayers had claimed the available energy conservation tax credits on their U.S. income tax forms (Savitz, 1980).

The combination of the above factors has led most in the field to conclude that market forces and the efforts of the private sector are not enough and that, if the goals of conservation are to be accomplished, then the governmental sector must take an active role (Stobaugh & Yergin, 1979; Sawhill, 1979; Savitz, 1980; etc.). It is also interesting to note, however, that there is substantial public support for that position. Indeed, many detailed surveys have shown strong public support, not only for the ideas of conservation and renewable energy sources but also for the active role of government in the provision of information and incentives to promote these concepts (S.E.R.I., 1980; Council on Environmental Quality, 1980; Timmer, 1981).

In view of these facts, it is encouraging to note that previous studies have shown that energy conservation interventions can be effective. This has been demonstrated both in large scale evaluations of government energy programs (D.O.E., 1978b; D.O.E., 1979b) as well as in smaller scale psychological research (Winett & Neale, 1979; Shippee, 1980; Stern & Gardner, 1981). In particular, psychological research on consumption information feedback (Seligman & Darley, 1977; Becker, 1978;

Winett, et al., 1978; etc.), persuasive and informative messages (Abbott, 1978; Craig & McCann, 1978), public commitment (Pallak, Cook & Sullivan, 1980), the "foot in the door" technique (Arbuthnot, et al., 1976-77; Scott, 1977), and utility metering/billing strategies (McClelland & Cook, 1980) have all produced positive findings for energy conservation interventions.

Hence, in summary, it appears that energy conservation programs are technically feasible, economically justified, socially desirable and publicly supported. The most important question remaining would thus seem to be what mechanism(s) should be used in energy conservation programming.

<u>Use of the Educational System as a Vehicle</u>

As the previous discussion indicates, the general assumptions which led to the formation of this study: that energy conservation is necessary and that energy conservation programming can be effective--appear to be well founded. The remaining assumptions and implications to be considered concern the use of the educational system as one vehicle for promoting conservation and, in particular, the use of the intervention strategies tested in this experiment.

From the perspective of both theory and prior experience, the use of the educational system for promoting energy conservation seems well supported. As pointed out in Chapter I, there is ample precedent, apparently with some success, for attempting such a strategy for promoting a national objective. In terms of the conceptual models of change underlying the interventions utilized in this study, there is research support in the energy conservation field for the basic approach of targeting information/persuasion at consumer attitudes and behaviors (Abbott, 1978; Black, 1978; Craig & McCann, 1978; Seligman, et al., 1979;

Becker, et al., in press). In addition, there is general and applied research support for the more specific strategies attempted, including that of "task oriented" instruction (Breer & Locke, 1965; Bem, 1965, 1972; Leedom, 1979) and energy committee formation (Mahan, 1971; Fullan, 1972; Fairweather, Sanders & Tornatzky, 1974; Berman, 1980; Tornatzky, et al., 1980). Thus the educational system in general, and the intervention strategies selected for use in this study in particular, would seem conceptually well suited for a program promoting energy conservation.

Implications of the Current Study

In terms of the use of the educational system for promoting energy conservation, the implications of this study are generally positive, with some qualifications. The primary focus of intervention, getting teachers to teach about energy conservation in their classes, was successfully achieved. The results show that various methods of teacher consultation and teacher workshops can be successfully utilized to promote such teaching. This is a very positive finding and indeed has broader implications for the feasibility of educational interventions in general. In this respect, the results support and expand upon the findings of previous educational researchers in the areas of science education and environmental education (e.g., Schwirian, 1969; Hughes, 1971; Grunau, 1972; Schmuck, et al., 1975; Milson, 1975; Hounshell & Liggett, 1976; Trent, 1978; etc.).

However, in the area of ultimate impact on society (i.e., students and their families), the implications are less clear. This study failed to produce significantly positive experimental effects in terms of student energy conservation attitudes or behaviors. Although the correlational results clearly continue to support the positive relationship between energy conservation instruction (and "task oriented" instruction) and those desirable outcome variables, the particular intervention strategies used in this study were apparently not powerful enough to produce substantial student attitude and behavior change.

Several possible explanations for the lack of strong student impact were discussed previously, with two being identified as most probable. These were: the possibility that the materials and techniques provided in these interventions were not of sufficient quality, and that the targeted goal of infusing energy conservation instruction into existing curricula for a few hours during the school year may not be of sufficient duration or intensity to produce marked changes in student attitudes and behaviors. In addition, the problem of adequate motivation for teachers and school personnel was also discussed, particularly in regard to the somewhat more complex goals of implementing the energy task assignment strategy and the school energy committee strategy. More research is needed in each of the above areas before particular educational intervention strategies can be confidently recommended.

It is encouraging to note that the Michigan EES is currently designing a program which will respond in large part to the above concerns. A new strategy of "mini-grants" (i.e., $30 to $200 grants for the purchase of supplies, materials, equipment, etc.) to teachers for energy conservation projects is going to be implemented. This program is designed to respond to several of the probable weaknesses of the previous strategies, by producing educational projects of long duration and greater intensity, by providing a more clear vehicle for "task" activities, and by providing greater teacher incentives in the form of the mini-grants and the associated recognition within the school and school district. In addition, the potential energy conservation impact will be increased by emphasizing projects which also involve the school, students' families, and the larger community. This new strategy will be implemented in the forthcoming school year and will be compared to a more standard workshop intervention and a no-treatment control group. Hopefully, research such as this will help to more adequately determine the true potential for educational system interventions in the energy conservation area.

Conclusion

After examining and discussing the results of this experiment, it appears that some general statements can be made regarding several aspects of this study. First, in terms of the primary focus of this experiment, it appears that it is indeed possible to influence high school teachers to include energy conservation topics in their classes. Moreover, it seems that this goal can be accomplished through any of the four strategies tested (teacher consultation, energy committee consultation, teacher workshop, teacher workshop with a "task" component), although there may be a slightly more positive approach to the workshop modes. In general, the magnitude of differences observed was on the order of two to three times as much energy conservation instruction provided by experimental teachers as by control teachers.

Second, in terms of the ultimate impact on the students themselves, although the observed trends were in the desired direction, the results were not statistically significant. The experimental interventions did not produce significantly higher student energy conservation attitudes or self-reported behavior scores. Several potential explanations for these findings were offered, including most prominently the possibilities that the materials and techniques offered to and utilized by the teachers were not of sufficient quality and that the strategy of "infusing" a few hours of energy conservation instruction into existing school curricula may not provide an intervention of sufficient intensity to produce substantial

changes in student attitudes and behaviors. As discussed, the classroom level analyses provided some support for each of these suppositions.

Third, the correlational results tended to support the conceptual model underlying this study. The single most significant predictor of the teacher outcome variables was whether or not the teacher received an experimental intervention. The next three most significant predictors were: the number of other teachers known who are interested in energy conservation; the teacher's self-rating of knowledge about energy conservation; and the teacher's rating of the importance of energy conservation. These three variables are all logical components of the type of information and persuasion change strategy employed in this study and in that sense reinforce some of the assumptions made in designing the interventions utilized. As for the student level outcomes, although the overall percent of variance accounted for was quite low, the most significant predictors tended to be variables measuring exposure to energy conservation instruction. In that sense, those correlational results also tended to support the intervention rationale.

Fourth, it appears that there are several areas that should be recommended for further research. In particular, it would be desirable to conduct smaller scale, more intensive research concerning the question of how best to influence student attitudes and behaviors. Among the issues suggested in this report are the curriculum materials and techniques used (where there seems to be much room for improvement), and the concept of a more intensive course on energy conservation as opposed to the strategy of infusing a few hours of instruction on the topic. Clearly, it would be desirable to have a more powerful, and empirically tested, energy conservation education product or "package," prior to attempting further large-scale dissemination efforts. Other important areas of research would include examining motivational factors for teachers and for the school as an organization, especially concerning the adoption of such innovations as task oriented teaching and the school energy committee.

A final major set of issues requiring further research, again most likely in smaller scale studies, concerns the nature of the interaction and reciprocal influence between student and family, and how an educational system intervention can best promote energy conservation within that home situation (including the interaction of an educational/informational approach with other energy conservation programs such as financing, technical assistance, etc.). While these issues were not a part of the scope of this study, they are clearly important ones to consider in examining the future of such educational interventions.

In summary, the current study has demonstrated that it is feasible to design an educational intervention to promote energy conservation, approach the educational system and successfully produce increased levels of energy conservation instruction. Just as importantly, perhaps, it has also helped to identify several areas requiring further work in order to produce the most positive ultimate societal impacts. It is hoped that further research is able to refine and improve such interventions, for the social problem itself is a serious and continuing one and demands a meaningful set of responses.

APPENDICES

APPENDIX A

LETTER TO PRINCIPALS

APPENDIX A

LETTER TO PRINCIPALS

Joe Smith, Principal
Famous High School
Famous, Michigan 45678

Dear Principal Smith:

The Michigan State University Cooperative Extension Service (CES), together with the Energy Extension Service (EES) of the Michigan Department of Commerce, is pleased to announce the availability of an energy conservation education outreach program. This CES/EES program will be available in your area beginning this fall and will feature training and materials for teachers concerning energy education. One of our regional coordinators will be contacting you in the next few weeks to further explain this program and to answer any questions you may have. I hope that you will be able to participate in what we feel will be an interesting and valuable program.

Sincerely,

Director
CES Energy Education Project

APPENDIX B

WORKSHOP AGENDA

APPENDIX B

WORKSHOP AGENDA

3:30-4:00	Registration (and informal interaction)
4:00-4:15	Introduction, overview of EES project, overview of workshop
4:15-4:40	Some type of group exercise to get people acquainted and relaxed
4:40-5:15	Film, "Doubling Time" (about growth in energy demand), and discussion of film
5:15-6:00	Discussion of one of the curriculum packages (or "task oriented" presentation and materials in the "task" workshop)
6:00-6:45	Dinner
6:45-7:00	Reconvene and discuss questions and objectives
7:30-7:45	Presentation and discussion of more energy related background materials (League of Women Voters material)
7:45-8:45	Presentation and discussion of additional curriculum units (transportation audits, NSTA materials, etc.)
8:45-9:00	Wrap up

APPENDIX C

YOUTH ENERGY SURVEY

YOUTH ENERGY SURVEY

Energy Extension Service

INSTRUCTIONS

This questionnaire is designed to gather information on attitudes toward energy conservation. It has three parts. Part one, DESCRIPTIVE INFORMATION asks about your individual characteristics, such as age. Part two, YOUTH ENERGY ATTITUDES, asks about your attitudes toward energy issues. Part three, ENERGY CONSERVATION TASKS, asks about action you may have taken to conserve energy. In each part of the questionnaire please mark your answer to the questions by darkening the corresponding answer circle.

- IMPORTANT: Use black lead #2 pencil only. (DO NOT use ink, color, or other pencil.)
- Make heavy black marks that fill the circle completely.
- Erase cleanly and carefully any answer you wish to change.
- Make no stray marks on the answer sheet.

Example: Proper Mark ● Improper Marks

If you have any questions, ask your teacher.

WRITE TEACHER'S NAME ______________________

BIRTH DATE

MONTH	DAY	YEAR
JAN	0 0	0
FEB	1 1	1
MAR	2 2	2
APR	3 3	3
MAY	4	4
JUN	5	5 5
JUL	6	6 6
AUG	7	7
SEP	8	8
OCT	9	9
NOV		
DEC		

INITIALS

FIRST	LAST
A N	A N
B O	B O
C P	C P
D Q	D Q
E R	E R
F S	F S
G T	G T
H U	H U
I V	I V
J W	J W
K X	K X
L Y	L Y
M Z	M Z

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DO NOT WRITE IN THIS SPACE

DESCRIPTIVE INFORMATION

1. Your grade in school? 6 7 8 9 10 11 12
2. Your sex? .... Female Male
3. Your age? 11 12 13 14 15 16 17 18 19
4. How many persons, including yourself, live in your home? .... 1 2 3 4 5 over 5
5. How many bedrooms does your home have? .... 1 2 3 4 5 over 5
6. Do you live within 1 mile of your school? .... Yes No
7. Do you own your own car? .... Yes No
8. If you answered "Yes" to number 7 would you call your own car a .... Subcompact Compact Midsized Full-sized

9a. How many cars does your family own? .... 0 1 2 over 2

9b. Would you call your largest (or only) family car a .... Subcompact Compact Midsized Full-sized

10. Do you live in an .... Apartment Condominium Duplex House Mobile Home
11. In how many of your courses this school year have you studied about energy conservation? .... 0 1 2 3 or more
12. Have you ever been given a school assignment to try and save energy in your home or car? Yes No

13a. Has this teacher (name you wrote above) taught you about energy conservation in his/her class? Yes No

13b. If you answered "Yes" to 13a, about how many class hours on energy conservation have you had in this class? .... 0 1 2 3 4-5 6-10 11-20 over 20

14. Approximately how many total pages of information about energy have you read in the past week? .... 0 1-5 6-10 11-20 over 20

YOUTH ENERGY ATTITUDES

(Note: SA=Strongly Agree, A=Agree, U=Undecided, D=Disagree, SD=Strongly Disagree)

15. New ways to conserve energy for mankind should not be developed if my taxes have to be increased to pay for them .... SA A U D SD
16. I would ride my bike or walk rather than ride in a car if it helped save energy .... SA A U D SD
17. I am willing to change my life-style to conserve energy .... SA A U D SD
18. I am willing to attend football games right after school (instead of at night) to save lighting energy .... SA A U D SD
19. Energy conservation is one of the most important objectives of my generation .... SA A U D SD
20. I am willing to spend 4 hours caulking the windows in our house or apartment .... SA A U D SD
21. I would like my family to keep the thermostat below 70° in our house .... SA A U D SD
22. The best way for an individual like myself to deal with today's energy shortage is to ignore it and let the scientist worry about it .... SA A U D SD
23. Conserving energy will cause people to lose jobs .... SA A U D SD
24. I would like my parents to buy solar collectors for the roof of our house or apartment .... SA A U D SD
25. The Michigan state government should make energy conservation a high priority .... SA A U D SD
26. I would like my parents to insulate or otherwise reduce our home heating .... SA A U D SD
27. We can decrease our need to build more power plants by encouraging energy conservation .... SA A U D SD
28. The effort made by individuals to conserve energy can have a major impact on our energy problem .... SA A U D SD
29. The government should spend a larger portion of their present budget on energy conservation .... SA A U D SD

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Energy Extension Service

YOUTH ENERGY SURVEY - side two

Continue answering questions - Remember: SA=Strongly Agree, A=Agree, U=Undecided, D=Disagree, SD=Strongly Disagree

30. I would not really change the way I do things just to help save energy .... SA A U D SD
31. I would like my family to reduce their use of electrical energy .... SA A U D SD
32. If I can, I will buy a fast car with a big engine rather than a slower, small engine car .... SA A U D SD
33. I am willing to share a car with two or more other people when going home from school to save energy SA A U D SD
34. I am willing to attend regular weekly meetings of a neighborhood energy conservation association .... SA A U D SD
35. I would like my parents to buy an energy efficient car the next time they buy a car .... SA A U D SD
36. I am willing to drive 55 mph or slower to save gasoline .... SA A U D SD
37. Solving our energy problems through energy conservation will cost less than building new power plants SA A U D SD
38. I am willing to help my family build a solar water heater .... SA A U D SD
39. I am willing to spend 4 hours helping my family better insulate our house or apartment .... SA A U D SD
40. If it meant any extra work for me, I would not favor new laws being passed to help save energy for mankind SA A U D SD
41. Government should use taxes to increase energy conservation .... SA A U D SD
42. Individuals like myself should not be expected to help pay the cost of finding new ways to conserve energy SA A U D SD
43. Cars should be taxed by miles per gallon rather than weight .... SA A U D SD
44. I would like to spend 4 hours doing volunteer work on energy conservation .... SA A U D SD
45. I would like to help build a solar collector on the roof of our house or apartment .... SA A U D SD
46. I am willing to ride a bus to in-town recreational events .... SA A U D SD
47. My individual efforts can help solve the energy problem .... SA A U D SD
48. I would like to help build a windmill to help provide energy for our house .... SA A U D SD
49. Property taxes should be higher for the homes of people that use larger quantities of energy .... SA A U D SD
50. Government should provide tax free loans to help people insulate their homes .... SA A U D SD
51. I would appreciate it if my parents would carpool with neighbors .... SA A U D SD
52. I am willing to take cooler showers or baths to save energy .... SA A U D SD
53. Saving our limited supply of energy should be thought of as one of our nation's most important problems SA A U D SD
54. I am willing to spend 4 hours helping other people make their homes energy efficient .... SA A U D SD
55. The federal government should make energy conservation a high priority .... SA A U D SD
56. I would like my family members to drive less and walk or ride a bike more .... SA A U D SD
57. I would favor using as much energy as needed for me to be comfortable and not worry about man's future needs SA A U D SD
58. I don't worry about conserving energy because new technology will solve the energy problem .... SA A U D SD
59. I favor the increased use of nuclear power .... SA A U D SD
60. Energy conservation will produce new jobs .... SA A U D SD

ENERGY CONSERVATION TASKS

NOTE: Please indicate whether or not any of the tasks listed below have been completed in the past three months.

IN LAST THREE MONTHS, HAS YOUR FAMILY

61. Added three inches or more of insulation to your home .... Yes No
62. Caulked of weatherstripped your home's doors or windows .... Yes No
63. Lowered the thermostat by three degrees or more .... Yes No
64. Traded in a large car for a smaller one .... Yes No
65. Installed a solar collector .... Yes No
66. Carpooled ten times or more .... Yes No
67. Put blankets or plastic over windows to save heat .... Yes No
68. Installed a wood burning heater or wood burning stove .... Yes No

IN THE LAST THREE MONTHS, HAVE YOU

69. Asked your parents to do any of the above tasks .... Yes No
70. Helped someone insulate, caulk, or weatherstrip a home (including your own) .... Yes No
71. Talked to your parents about the need to conserve energy .... Yes No
72. Chosen at least 5 times to walk or ride bus to school instead of riding in a car .... Yes No
73. Turned off lights to save electricity more than 10 times .... Yes No
74. Calculated your own or your family's gas mileage .... Yes No
75. Taken a cooler or shorter shower to save hot water .... Yes No
76. Ridden in a public bus (not a school bus) over three times .... Yes No
77. Tried to save gasoline by driving or riding in a car less .... Yes No
78a. Conserved energy in any other way .... Yes No

DO NOT WRITE IN THIS SPACE

78b. If you answered "yes" to question 78a, please describe below what else you did to conserve energy. (WRITE ONLY IN THE SPACE BELOW)

DO NOT WRITE IN THIS SPACE

APPENDIX D

CLASSROOM QUESTIONNAIRE FOR TEACHERS

APPENDIX D

CLASSROOM QUESTIONNAIRE FOR TEACHERS

Teacher's Name____

School____

Number of Students in This Class__________________________

Hour of the school day this class in taught 1st 2nd 3rd 4th 5th 6th 7th 8th

1) What is the subject taught in this class?____________________

2) Approximately how many hours of energy conservation related materials have you taught this school year in this class? (Circle One)

   0   1   2   3-5   6-10   Over 10

3) If you have taught energy conservation related topics in this class, please briefly describe what was included in your energy education sessions.

____

____

____

____

4) Did any of the work in this class involve class assignments where students were asked to <u>actually try to save energy</u> (e.g., at home, in school, in transportation, etc.)?

   Yes   No

5) What influenced you to teach (or not teach) energy conservation topics in this class?

____

____

____

____

6) Do you plan to teach energy conservation to this class between now and the end of the school year?

   Yes   No   Not Sure

7) Have you used any curriculum materials pertaining to energy conservation with this class?

Yes No

(If yes, please list their titles below.)

____

____

____

8) How free are you to improvise or choose your own lesson plans for this course?

1	2	3	4	5
Not At All	A Little	A Fair Amount	Quite a Bit	Totally Free

9) As compared to other classes you have taught, how would you rate this class in overall scholastic ability?

1	2	3	4	5
Much Lower Than Average	Somewhat Lower Than Average	Average	Somewhat Higher Than Average	Much Higher Than Average

Thank you very much for assisting our project by completing this form. (Please place this form together with the survey questionnaires from the students in this class.)

APPENDIX E

TEACHER ENERGY EDUCATION QUESTIONNAIRE

APPENDIX E

TEACHER ENERGY EDUCATION QUESTIONNAIRE

Please complete each of the following questions as thoroughly as possible.

School________________________ Subjects you teach (please list all)

Name________________________ ________________________________

Home Phone #________________________ ________________________________

Date________________________ ________________________________

1) During this school year (1978-79) did you make any energy education presentation(s) to any of your classes? (Including outside speakers and films. DO NOT INCLUDE ASSEMBLY PROGRAMS.) _____ Yes _____ No

2. If yes, approximately how many different class sessions did you spend on energy education this year? (circle one)

Less than one 1 2 3-5 6-10 Over 10

3) In general, how free are teachers at this school to design their own lesson plans?

1	2	3	4	5
Not At All	A Little	A Fair Amount	Quite A Bit	Totally Free

4) How free do <u>you</u> feel to improvise or choose your own lesson plans?

1	2	3	4	5
Not At all	A Little	A Fair Amount	Quite A Bit	Totally Free

5) How do you consider yourself in terms of knowledge about energy and energy conservation?

1	2	3	4	5
Quite Limited	Somewhat Limited	Average	Fairly Well Informed	Very Well Informed

6) How many teachers at your school (not counting yourself) do you know who are interested in teaching energy conservation related topics? (Circle One) None 1 2 3 More Than 3

7) Has any one contacted you at school this year to encourage you to teach energy conservation? _____ Yes _____ No

If so, please list their name(s) or position(s)?

____

8) How important do you feel it is for Americans to conserve energy?

1	2	3	4	5
Not Important	Only Somewhat Important	Fairly Important	Very Important	Extremely Important

9) Have you used any of the following materials in preparing for or teaching any of your classes?

	Yes	No
Tips for Energy Savers (Small White Pamphlet)	____	____
Energy Conservation In The Home (Thick Yellow Paper Covered Book)	____	____
How A Bill Becomes Law To Conserve Energy (Gray Booklet)	____	____
U.S. Energy Policy: Which Direction (Gray Booklet)	____	____
Family Energy Projects: At Home And On The Road (Orange Booklet)	____	____
"Doubling Time" (Filmstrip)	____	____
Home Energy Game (Brown Paperback)	____	____
Other (please list)		
______________________	____	____
______________________	____	____
______________________	____	____

10) Are there additional services or information you would like concerning energy conservation education? ____ Yes ____ No

(If yes, please briefly describe below.)

____

____

____

11) Please list any comments or suggestions you might have for teachers considering teaching about energy conservation.

____

____

____

____

APPENDIX F

TEACHER TELEPHONE INTERVIEW

APPENDIX F

TEACHER TELEPHONE INTERVIEW

Teacher Name______________________________
School Name_______________________________
Date of Interview_________________________

A. Hello, my name is _______________________________ and I'm with the Michigan Energy Administration. We are conducting a telephone survey of teachers throughout the state to gather information about energy-related education in Michigan.

Would you mind if I asked you a few questions? The interview should only take 5 to 10 minutes.

(If don't agree): Is there a better time I could call you to talk about this?

1) Yes (Find out time.) 2) No (Thank them and hang up.)

(If agree):

1. Have you taught any energy conservation topics in any of your classes this school year? (Include assigned readings, films, guest speakers, etc., but do not include assemblies.)

   1) Yes 2) No (If no, don't sound surprised or disappointed, but ask: "What are the main reasons you haven't included energy conservation topics in your classes?" List response. Proceed to #6.)

(If yes to #1):

2. Could you please describe what these energy-related class activities included. (Note: If teacher taught energy-related activities in more than one class, have them describe them for each class.) (Record teacher's responses.)

3. Did your students have any kind of "hands on" energy activities in these classes? By that, I mean assignments where they actually performed an energy saving task. (Give examples, if necessary.)

   1) Yes 2) No

   (If yes, have teacher describe and then record what the activity(ies) was/were.)

4. How many class hours of energy conservation related materials do you think you have taught this school year?

5. What recommendations would you have for us for effective teaching about energy conservation? For example, has anything you have tried in your classes been particularly successful? (List responses.)

6. Has your school formed any kind of an energy committee to deal with issues concerning energy conservation? (Explain energy committee, if necessary.)

   1) Yes   2) No   3) Don't know

7. How free do you feel to improvise or choose your own lesson plans?

   1) Not at all   2) A little   3) A fair amount

   4) Quite a bit   5) Totally free

8. How do you consider yourself in terms of knowledge about energy and energy conservation?

   1) Quite limited   2) Somewhat limited

   3) Average   4) Fairly well informed

   5) Very well informed

9. How many teachers at your school (not counting yourself) do you know who are interested in teaching energy conservation related topics? (Circle one)

   None   1   2   3   More than 3

10. How important do you feel it is for Americans to conserve energy?

    1) Not important   2) Only somewhat important

    3) Fairly important   4) Very important

    5) Extremely important

APPENDIX G

CURRICULUM MATERIALS

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CURRICULUM MATERIALS

1. Tips for Energy Savers - 1977, Federal Energy Administration, 43 pages.

   Booklet presenting a brief background of the energy problem and the need for conservation. It presents and describes numerous simple and inexpensive ways to save energy in the home and in personal transportation.

2. Energy Conservation in the Home - 1977, University of Tennessee, 319 pages.

   An Energy/Education Conservation curriculum guide for Home Economics teachers covering such subject areas as residential energy, energy and the environment and energy in food, entertainment, and personal care. It outlines America's energy consumption, defines energy and its various forms and provides energy activities.

3. How a Bill Becomes a Law to Conserve Energy - 1977, U.S. Department of Energy, 118 pages.

   Study units include "Case Study of a Bill," which describes how the 55 mph national speed limit became a law and takes the student through the law-making process; and "A Congressional Hearing," in which students play typical roles at a hearing on a national speed limit bill in a simulation game.

4. U.S. Energy Policy - Which Direction? - 1978, U.S. Department of Energy, 90 pages.

   This unit, which is a companion to "How a Bill Becomes a Law to Conserve Energy," concentrates on the executive branch of the government and the various forces that go into making energy policy.

5. Family Energy Projects - 1978, Energy Extension Service, 34 pages.

   Developed for home and transportation energy consumption, this two-part curriculum guide provides task-oriented activities for the student as well as their families that actually allow the students to conserve energy while learning. It is designed for students who have minimal background in energy and can be easily incorporated into any high school subject area curriculum.

6. Energy and Doubling Time - 1978, Science and Mathematics Teaching Center, Michigan State University.

   Booklet and filmstrip describing the energy situation through the portrayal of a mythical creature, the snarf, which reproduces every minute and which eats only a rare resource called ortep. This material explicitly illustrates that our energy use has been and still is following the rules of doubling time.

7. The Household Energy Game - 1974, University of Wisconsin Sea Grant College Program, 20 pages.

   Concentraing on transportation, home heating and cooling, and electrical appliances, this self-help booklet in a game design gives you an idea of how much energy you actually use and how you can manage it more effectively. The game is divided into two parts. Part I helps you construct your current energy budget. Part II offers suggestions on how you can alter your budget to conserve energy and also save money.

APPENDIX H

COMPARISON OF CLASSROOMS IN WHICH TEACHERS DID OR DID NOT USE THE PROJECT PROVIDED MATERIALS

APPENDIX H

COMPARISON OF CLASSROOMS IN WHICH TEACHERS DID OR DID NOT USE THE PROJECT PROVIDED MATERIALS[a]

Material	Student Attitudes	Student Tasks
M 1	.01	.05
M 2	N.S.	N.S.
M 3	N.S.	N.S.
M 4	.001	N.S.
M 5	.05	N.S.
M 6	N.S.	.05
M 7	.05	N.S.

[a]Only classrooms receiving energy conservation instruction were included in the analyses (N=330). Two-tailed T-tests were performed testing classes which used the material vs. classes which did not. All significant differences found favored the group using the project material.

REFERENCES

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Abbott, E. Effects of a year-long newspaper energy series on reader knowledge and action. Paper presented at the 61st Annual Meeting of the Association for Education in Journalism, Seattle, Washington, August, 1978.

Abelson, R. Are attitudes necessary? In B. King and E. McGinnies (Eds.), Attitudes, Conflict and Social Change. New York: Academic Press, 1972.

Aiken, L.R. & Aiken, D.R. Recent research on attitudes concerning science. Science Education, 1969, 53, 295-305.

Aird, A. & Tomera, A. The effects of a water conservation instructional unit on the values held by sixth grade students. The Journal of Environmental Education, 1977, 9, 31-42.

Allen, R.F. & Lahart, D.E. (Eds.). Energy and the environment. Final Report, Volume II. Tallahassee, Florida: Florida State University, College of Education, 1977.

American Association for the Advancement of Science. Guidelines for science and mathematics in the preparation program of elementary school teachers. Washington, D.C., 1963.

American Institute of Architects. A Nation of Energy Efficient Buildings by 1990. New York, 1972.

Anderson, C.D. & McDougall, G.H. Consumer Energy Research: An Annotated Bibliography. Department of Consumer and Corporate Affairs, Canada, 1980.

Arbuthnot, J., Tedeschi, R., Wayner, M., Turner, J., Kressel, S. & Rush, R. The introduction of sustained recycling behavior through the foot-in-the-door technique. Journal of Environmental Systems, 1976-77, 6, 355-368.

Ayers, J. Rural elementary children's attitudes toward the energy crisis. School Science and Mathematics, 1977, 76, 238-240.

Baldridge, J.V. & Deal, T.E. (Eds.). Managing Change in Educational Organizations. Berkeley, California: McCutchan Publishing Company, 1975.

Bartlett, A.A. The Arithmetic of Energy Growth. Washington, D.C.: Worldwatch Institute, 1977.

Becker, L. Joint effect of feedback and goal setting on performance: A field study of residential energy conservation. Journal of Applied Psychology, 1978, 63, 428-433.

Becker, L.J. & Seligman, C. Welcome to the energy crisis. Journal of Social Issues, 1981, 37, No. 2, 1-7.

Becker, L., Seligman, C., Fazio, R., & Darley, J. Relationship between attitudes and residential energy use. Environment and Behavior, in press.

Behavioral and Social Sciences Survey Committee. The Behavioral and Social Sciences: Outlook and Needs. Englewood Cliffs, New Jersey: Prentice-Hall, 1969.

Bem, D.J. An experimental analysis of self-persuasion. Journal of Experimental Social Psychology, 1965, 1, 199-218.

Bem, D.J. Self-perception theory. In L. Berkowitz (Ed.). Advances in Experimental Social Psychology, 6. New York: Academic Press, 1972.

Berkheimer, G.D. NSTA position statement on school science education for the 70s. The Science Teacher, 1971, 38, 46-51.

Berman, Paul. Thinking about programmed and adaptive implementation: Matching strategies to situations. In D. Mann & H. Ingram (Eds.). Why Policies Succeed and Fail. Beverly Hills: Sage, 1980.

Black, J.S. Attitudinal, normative and economic factors in early response to an energy use field experiment. Unpublished doctoral dissertation, University of Wisconsin, 1978.

Blakely, C., Kushler, M., Parisian, J. & Davidson, W. Self-reported delinquency as an evaluation measure. Criminal Justice and Behavior, 1980, 7, No. 4, 369-386.

Bonneville Power Administration. Electric energy conservation study. Portland, Oregon, 1976.

Bonneville Power Administration. The Pacific Northwest residential energy survey. Portland, Oregon, 1980.

Breer, P.E. & Locke, E.A. Task Experience as a Source of Attitudes. Homewood, Illinois: The Dorsey Press, 1965.

Business Week. Industry's schoolhouse clout. October 13, 1980, 156, 157.

California Public Utilities Commission. Energy efficiency and the utilities: New directions. Sacramento, California: Steven Westly (Ed.)., 1980.

Campbell, D.T. & Fiske, D.J. Convergent and discriminant validation by the multitrait-multimethod matrix. Psychological Bulletin, 1959, 56, 81-105.

Campbell, D.T. & Stanley, J.C. Experimental and Quasi-Experimental Designs for Research. Chicago: Rand McNally, 1966.

Carey, H.H. Energy is elementary. Science and Children, 1977, 14, 23-24.

Carlson, R.O. Barriers to change in public schools. In R.O. Carlson (Ed.). Change Processes in Public Schools. Eugene, Oregon: The Center for the Advanced Study of Educational Administration, University of Oregon, 1965.

Cartwright, D. Achieving change in people: Some applications of group dynamics theory. Human Relations, 1951, 4, 386-388.

Chapman, D. Personal communication. August 20, 1978.

Childress, R.B. & Wishart, A.P. Public school environmental education programs, report of a national study. Knoxville, Tennessee: Bureau of Educational Research and Service, University of Tennessee, 1976.

Claxton, J.D., McDougall, G.H., & Ritchie, J.R. Complexities of household energy consumption and conservation. Paper presented at the International Conference on Consumer Behavior and Energy Use. Bouff, Alberta, Canada, 1980.

Collins, T., Herbkersman, C., Phelps, L., & Barrett, G. Establishing positive attitudes toward energy conservation in intermediate level children. The Journal of Environmental Education, 1979, 11, 18-23.

Common Cause. Common Cause action program on energy. In Common, 9, No. 1, 1978, 10-13.

Condon, J.W. & Davis, D.D. Energy attitudes and behavior reports: Michigan middle schools. Lansing Michigan: Michigan Department of Commerce, Energy Administration, 1979.

Cook, E. The flow of energy in an industrial society. Scientific American, 1971, 224, 3, 135-144.

Cooper, R.E. A study of the science curriculum improvement study resource personnel workshop participants to determine the relationship between selected factors and subsequent participant activity. Unpublished doctoral dissertation, Michigan State University, 1972.

Council on Environmental Quality. Public opinion on environmental issues: Results of a national public opinion survey. Washington, D.C.: U.S. Government printing office, 1980.

Costle, D.M. Environment, education and technology. EPA Journal, 7, No. 1, 1981, 2, 3, 41.

Cox, F.M., Erlich, J.L., Rothman, J., & Tropman, J.E. (Eds.). Strategies of Community Organization. Ithasca, Illinois: F.E. Peacock Publishers, 1974.

Craig, E.S. & McCann, J.M. Assessing communication effects on energy conservation. Journal of Consumer Research, 5, 1978, 82-88.

Crosby, M. The new supervisor: Caring, coping, becoming. In R.R. Leeper (Ed.). Changing Supervision for Changing Times. Washington, D.C.: Association for Supervision and Curriculum Development, 1969.

Dacy, D., Kuenne, R., & McCoy, P. Employment impacts of achieving federal energy conservation goals. Prepared for DOE by the Energy Institute for Defense Analysis, Arlington, Virginia, 1978.

Daly, H. Electric power, employment and economic growth. In Toward a Steady State Economy. San Francisco: W.H. Freeman & Company, 1972.

Darley, J.M. Energy conservation techniques as innovations and their diffusion. Energy and Buildings, 1978, 1, 339-343.

Darmstadter, J., Dunkerly, J., & Alterman, J. How Industrial Societies Use Energy: A Comparative Analysis. Baltimore: Johns Hopkins University Press, 1977.

Davenport, C.P. Vice President of Pacific Power and Light, in prepared remarks at a California Public Utilities Commission symposium entitled: "Energy efficiency and the utilities: New directions." Palo Alto, California, 1980.

Ducat, J.C. A study of the relationship of environmental education to environmental attitudes among community college students. Unpublished doctoral dissertation, Michigan State University, 1979.

Duggan, D.D. Energy education and the three Cs. Science and Children, 1978, 15, No. 6, 7-12.

Eagley, A. & Himmelfarb, S. Attitudes and opinions. Annual Review of Psychology, 1978, 29, 517-554.

Fairweather, G.W., Sanders, D.H., & Tornatzky, L.G. Creating Change in Mental Health Organizations. Elmsford, New York: Pergamon, 1974.

Farhar, B., Weis, P., Unseld, C., & Burns, B. Public Opinion About Energy: A Literature Review. Golden, Colorado: Solar Energy Research Institute, 1979.

Fazio, F. & Dunlop, D. The development and use of an energy assessment instrument. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Cincinnati, 1977 (ERIC No. ED 135664).

Federal Energy Administration. Conservation Investment as a Gas Utility Supply Option. Washington, D.C., 1976.

Ferber, S. More on energy: A look at research. American Psychological Association Monitor, April, 1977.

Fergus, E. The role of telephonic consultations in creating innovation adoption in health organizations. Unpublished doctoral dissertation, Michigan State University, 1973.

Festinger, L. A Theory of Cognitive Dissonance. New York: Row, Peterson, 1957.

Fowler, H.S. Evaluation of an institute for the training of elementary school science resource teachers. Journal of Educational Research, 1960, 53, 359.

Fowler, J.M. Energy conservation: Homes and buildings. Washington, D.C. National Science Teachers Association, 1978.

Fowler, J.M. A lot of energy at the NSTA (National Science Teachers Association). Contemporary Education, 1981, 52, No. 2, 73-77.

Fullan, M. Overview of the innovative process and the user. Interchange, 1972, 3, 1-46.

Fullan, M. & Pomfret, A. Research on curriculum and instruction implementation. Review of Educational Research, 1977, 47, 355-397.

Gatewood, C. & Osborn, E. Improving science education in the United States. Journal of Research in Science Teaching, 1963, 1, 355-399.

Gottlieb, D. & Matre, M. Conceptions of energy shortages and energy conserving behavior. Social Science Quarterly, 1976, 57, 421-429.

Grossman, R. & Daneker, G. Jobs and Energy. Washington, D.C.: Environmentalists for Full Employment, 1977.

Grunau, H.H. An experimental study of the effects of a preservice elementary science curriculum innovation on selected measures of teacher and pupil performance. Unpublished doctoral dissertation, Michigan State University, 1972.

Hannon, B. Energy, labor and the consumer society. Technology Review, March/April, 1977.

Harty, S. Hucksters in the Classroom: A Review of Industry Propaganda in Schools. Washington, D.C.: Center for the Study of Responsive Law, 1979.

Havelock, R.G. Planning for Innovation: Through Dissemination and Utilization of Knowledge. Ann Arbor, Michigan: Institute for Social Research, 1971.

Havelock, R.G. The Change Agent's Guide to Innovation in Education. Englewood Cliffs, New Jersey: Educational Technology Publications, 1973.

Hawes, D.K. Energy Consultant for the Equitable Life Assurance Society in prepared remarks at a California Public Utilities Commission symposium entitled: "Energy efficiency and the utilities: New directions." Palo Alto, California, 1980.

Hayes, D. The Case for Conservation. Washington, D.C.: Worldwatch Institute, 1976.

Hayes, D. Pollution: The Neglected Dimensions. Washington, D.C: Worldwatch Institute, 1979.

Hayes, S.C. & Cone, J.D. Reducing residential electricity energy use: Payments, information and feedback. Journal of Applied Behavior Analysis, 1977, 10, 425-435.

Hilgert, R.L. Teacher reaction to summer workshops. School and Community, 1968, 54, 14-15.

Hirst, E., Goeltz, R., & Carney, J. Residential energy use and conservation actions: Analysis of disaggregate household data. Oak Ridge, Tennessee: Oak Ridge National Laboratory, 1981.

Hogan, M. & Palucci, B. Energy conservation: Family values, household practices and contextual variables. Home Economics Research Journal, 1979, 7, 210-218.

Honeywell, Inc. Reducing U.S. Heating Costs with Thermostat Setback. Minneapolis, Minnesota: Honeywell Energy Management Information Center, 1980.

Hounshell, P. & Liggett, L. Environmental education one year later. Journal of Environmental Education, 1976, 8, 32-35.

Howell, D.L. & Warmbrod, J.R. Developing student attitudes toward environmental protection. The Journal of Environmental Education, 1974, 5, No. 4, 29-30.

Hughes, E.F. Role playing as a technique for developing a scientific attitude in elementary teacher trainees. Journal of Research in Science Teaching, 1971, 8, No. 2, 113-122.

Hungerford, H.R. & Knapp, C.E. Conservation education: Problems and strategies. The Science Teacher, 1969, 36, 29.

Jackson, D.N. A sequential strategy for personality scale development. In C. Spielberger (Ed.). Issues in Clinical and Community Psychology. New York: Academic, 1971.

Kelman, H. Attitudes are alive and well and gainfully employed in the sphere of action. American Psychologist, 1974, 29, 310-324.

Kleinman, G.S. Needed: Elementary school science consultants. School Science and Mathematics, 1965, 65, 738-746.

Knapp, C.E. Attitudes and values in environmental education. The Journal of Environmental Education, 1972, 3, No. 4, 26.

Kuhn, D.J. Study of the attitudes of secondary school students towards energy related issues. Science Education, 1979, 63, 609-620.

Kushler, M.G. & Jeppesen, J.C. Teenage consumers and energy conservation. In J.D. Claxton, C.D. Anderson, J.R.B. Ritchie, and G.H.G. McDougall (Eds.). Consumers and Energy Conservation: International Perspectives on Research and Policy Options. New York: Praeger, 1981.

Leedom, N. A task-oriented approach to energy education. Unpublished masters thesis, Michigan State University, 1979.

Liddle, E.M. A quasi-experimental study of the effects of two modes of instruction on the attitudes of preservice elementary teachers in the area of science teaching. Unpublished doctoral dissertation, Michigan State University, 1971.

Lippitt, R. Training in Community Relations. New York: Harper and Brothers Publishers, 1949.

Lissitz, R.W. & Green, S.B. Effect of number of scale points on reliability: A Monte Carlo approach. Journal of Applied Psychology, 1975, 60, 10-14.

Lovins, A.B. Soft Energy Paths: Toward a Durable Peace. Washington, D.C.: Worldwatch Institute, 1977.

Lovins, A.B. The Energy Controversy: Soft Path Questions and Answers. Washington, D.C.: Worldwatch Institute, 1979.

Lovins, A.B. In prepared remarks at a California Public Utilities Commission symposium entitled: "Energy efficiency and the utilities: New directions." Palo Alto, California, 1980.

Mahan, J.H. Notes from a consultant's diary: Concerns for elementary school innovations. The Elementary School Journal, 1971, 71, 368-375.

Mannino, F.V. & Shore, M.F. Consultation Research in Mental Health and Related Fields: A Critical Review of the Literature. Washington, D.C.: U.S. Public Health Service, 1971.

Marlay, R. Effects on investment in energy conservation of DOE's programs and of market forces. Washington, D.C.: U.S. Department of Energy, 1981.

McClelland, L. & Canter, R.J. Psychological research on energy conservation: Context, approaches, methods. In A. Baum & J. Singer (Eds.). Advances in Environmental Psychology: Vol. 3 Energy Conservation: Psychological Perspectives. Hillsdale, New Jersey: Erlbaum, in press.

McClelland, L. & Cook, S.W. Promoting energy conservation in master-metered apartments through group financial incentives. Journal of Applied Social Psychology, 1980, 10, 19-31.

McCloskey, M. The environmental impacts of synthetic fuels. The Energy Consumer. Washington, D.C.: U.S. Department of Energy, January, 1981.

McDougall, G.H., Ritchie, J.R., & Claxton, J.D. Energy consumption and conservation patterns in Canadian households. Ottawa, Canada: Consumer Research and Evaluation Branch, Consumer and Corporate Affairs, Canada, 1979.

Merkle, D.G. A leadership workshop on elementary school science: An indepth evaluation, Journal of Research in Science Teaching, Vol. 7, 1970, 122-123.

Michigan School Business Officials, School Energy Manual, Lansing, Michigan: Michigan Department of Commerce, 1978.

Miller, J.L. Review and evaluation of D.O.E. energy education curriculum materials. Columbus, Ohio: Battelle Memorial Institute, 1979.

Milson, J.L. Evaluating an environmental education symposium for secondary teachers. Journal of Environmental Education, Vol. 7, 1975, 11-13.

Milstein, J.S. Attitudes, knowledge and behavior of American consumers regarding energy conservation with some implications for governmental actions, in W.D. Perreault (Ed.) Advances in Consumer Research, Vol. IV, ACR Proceedings, 1977.

Moon, T.C. A study of verbal behavior patterns in primary grade classrooms during science activities. Unpublished doctoral dissertation, Michigan State University, 1969.

Morell, D. Energy conservation and public policy: If its such a good idea, why don't we do more of it? Journal of Social Issues, Vol. 37, No. 2, 1981, 8-30.

Myers, J.G. Energy conservation and economic growth - are they incompatible? The Conference Board Record, February, 1975, 27-32.

National Academy of Sciences, Alternative Energy Demand Futures to 2010, Washington, D.C.: National Academy of Sciences, 1979.

National Center for Education Statistics, Energy Knowledge and Attitudes: A National Assessment of Energy Awareness Among Young Adults. Denver, Colorado: Education Commission of the States, 1978.

Newport, J.F. Are science objectives changing? School Science and Mathematics, Vol. 65, 1965, 359-362.

North Carolina Department of Education, Energy Conservation Plan, Raleigh, North Carolina, 1976.

Office of Technology Assessment, Conservation and Solar Energy Programs of the Department of Energy: A Critique. Washington, D.C.: U.S. Government Printing Office, 1980.

Olsen, M. & Goodnight, J., Social Aspects of Energy Conservation, Seattle, Washington: Battelle Human Affairs Research Center, 1977.

Pallak, M.S., Cook, D.A. & Sullivan, J.J. Commitment and energy conservation. In L. Bickman (Ed.). Applied Social Psychology Annual, Vol. 1, 1980, 235-253.

Pettus, A. Environmental education and environmental attitudes. Journal of Environmental Education, Vol. 8, 1976, 48-51.

Pickering, R.S. An experimental study of the effects of inquiry experiences on the attitudes and competencies of prospective elementary teachers in the area of science. Unpublished doctoral dissertation, Michigan State University, 1970.

Rand Corporation, Discovery of Significant Oil and Gas Fields in the United States. Santa Monica, California: Rand Corp., 1981.

Rappaport, M. & Labau, P. General Public Attitudes and Behaviors Regarding Energy Saving. Highlight Report, Volume IX, Princeton, New Jersey: Opinion Research Corporation, 1975, (NTIS No. PB-224-989).

Roe, D.B. In prepared remarked at the California Public Utilities Commission symposium entitled: "Energy Efficiency and the Utilities: New Directions." Palo Alto, California, 1980.

Rogers, E. & Shoemaker, F. Communication of Innovations. New York: Free Press, 1971.

Ross, M.H. & Williams, R.H. Energy efficiency: Our most underrated energy resource. The Bulletin of Atomic Scientists, November, 1976, 30-38.

Ross, M.H. & Williams, R.H. Drilling for oil and gas in our buildings. Report No. 87, Princeton, N.J.: Princeton University, Center for Energy and Environmental Studies, July, 1979.

Ross, M.H. & Williams, R.H. Our Energy: Regaining Control. New York: McGraw-Hill, 1981.

Roth, C. Massachusetts Audubon Society Program. In R.S. Cook & G.T. O'Hearn (Eds.). Processes for a Quality Education. Green Bay: University of Wisconsin, 1971.

Roth, R.E. A model for environmental education. The Journal of Environmental Education, Vol. 5, 1973, 28-29.

Savitz, M. Deputy Director, Office of Conservation and Solar Applications, D.O.E. In prepared remarks at the California Public Utilities Commission symposium entitled: Energy Efficiency and the Utilities: New Directions. Palo Alto, California, 1980.

Sawhill, J.C. (Ed.) Energy Conservation and Public Policy. Englewood Cliffs, N.J.: Prentice-Hall, 1979.

Schachter, M. The job creation potential of solar and conservation: A critical evaluation. Washington, D.C.: U.S. Department of Energy, 1979.

Scheirer, M.A. Program Implementation: The Organizational Context. Beverly Hills: Sage Publications, 1981.

Schmuck, R. & Runkel, P. Integrating organizational specialists into school districts. In W.W. Burke (Ed.) Contemporary Organization Development: Conceptual Orientations and Interventions. Washington, D.C.: National Institute for Applied Behavioral Science, 1972.

Schmuck, R., Murray, D., Smith, M., Schwartz, M., & Runkel, P. Consultation for Innovative Schools. Eugene, Oregon: Center for Educational Policy and Management, University of Oregon, 1975.

Schuman, H. & Johnson, M. Attitudes and Behaviors, Annual Review of Sociology, Vol. 2, 1976, 161-207.

Schurr, S.H. & Darmstadter, J. Some observations on energy and economic growth. Washington, D.C.: Resources for the Future, 1977.

Schwirian, P. Characteristics of elementary teachers related to attitudes toward science. Journal of Research in Science Teaching, 1969, 6, No. 3, 203-213.

Scott, C. Modifying socially conscious behavior: The foot-in-the-door technique. Journal of Consumer Research, 1977, 4, 156-164.

Seligman, C. & Becker, L.J. (Eds.). Energy conservation. Journal of Social Issues, 1981, 37, No. 2, 1-194.

Seligman, C. & Darley, J.M. Feedback as a means of decreasing residential energy conservation. Journal of Applied Psychology, 1977, 62, 363-368.

Seligman, C., Kriss, M., Darley, J.M., Fazio, R.H., Becker, L.J., & Pryor, J.B. Predicting summer energy consumption from homeowners' attitudes. Journal of Applied Social Psychology, 1979, 9, No. 1, 70-90.

Sheaffer, J.R. Improving quality of life through better use of energy and resources. Environmental Education, 1975, 7, No. 1, 1-10.

Shinpoch, J.R. Improving instruction of elementary school science. School and Community, 1969, 55, 35.

Shippee, G. Energy consumption and conservation psychology: A review and conceptual analysis. Environmental Management, 1980, 4, 297-314.

Smith, R.S. The United States and World Energy. Washington, D.C.: U.S. Department of State, 1977.

Solar Energy Research Institute (SERI). A national study of the residential solar consumer. Golden, Colorado: SERI, 1980.

Stapp, W.B. The concept of environmental education. The American Biology Teacher, 1970, 32, 14-15.

Stern, P.C. & Gardner, G.T. Psychological research and energy policy. American Psychologist, 1981, 36, No. 4, 329-342.

Stevens, W.S. Teacher training program: Summary report of subjective assessment data. Lansing, Michigan: Michigan Energy Extension Service, 1978.

Stevens, W.S. & Kushler, M.G. An energy conservation attitude questionnaire: Reliability, validity and uses. Paper presented at the 51st Annual Convention of the Midwestern Psychological Association, Chicago, 1979.

Stevens, W., Kushler, M., Jeppesen, J. & Leedom, N. Youth energy education strategies: A statistical evaluation. Lansing, Michigan: Michigan Energy Extension Service, 1979.

Stobaugh, R. & Yergin, D. (Eds.). Energy Future: Report of the Energy Project at the Harvard Business School. New York: Ballantine Books, 1979.

Stout, B.A. & Myers, C. The fossil-fuel era: A blip on the scale of time. East Lansing, Michigan: Michigan State University Cooperative Extension Service, 1978.

Swan, J. The challenge of environmental education. Phi Delta Kappan, September, 1969, 26-28.

Tanner, L.N. Curriculum change in science: Power and process. Educational Leadership, 1969, 26, 571-575.

Thorelli, H.B., Becker, H., & Engledow, J. The Information Seekers. Cambridge, Massachusetts: Ballinger, 1975.

Timmer, A. Energy information services: Implications for U.S. energy policy. Lansing, Michigan: Michigan Energy Extension Service, 1981.

Tornatzky, L.G., Fergus, E.O., Avellar, J.W., Fairweather, G.W., & Fleischer, M. Innovation and Social Process: A National Experiment in Implementing Social Technology. Elmsford, New York: Pergamon, 1980.

Towler, J. & Swan, J.E. What do people really know about pollution? The Journal of Environmental Education, 1972, 4, 54-57.

Trent, J.H. Changes and trends in environmental education: 1970-75. Journal of Environmental Education, 1976, 7, 1-3.

Trent, J.H. Energy education workshops for secondary teachers. Journal of Environmental Education, 1978, 9, No. 4, 30-35.

Troost, C.J. & Altman, H. (Eds.). Environmental Education: A Sourcebook. New York: John Wiley & Sons, 1972.

U.S. Department of Energy. Energy Conservation in the Home. Knoxville, Tennessee: University of Tennessee, 1977.

U.S. Department of Energy. Energy and You. Washington, D.C.: Office of Public Affairs, DOE, 1978(a).

U.S. Department of Energy. Some Perspectives on Energy Conservation Outreach Programs. Washington, D.C.: Energy Extension Service, DOE, 1978(b).

U.S. Department of Energy. Low Cost--No Cost Energy Savers. Washington, D.C.: Office of Public Affairs, DOE, 1979(a).

U.S. Department of Energy. Observations and Recommendations on the Future of the Energy Extension Service Program. Washington, D.C.: Office of State and Local Programs, DOE, 1979(b).

U.S. Department of Energy. National Energy Plan II. Washington, D.C.: U.S. Department of Energy, 1979(c).

U.S. Department of Energy. Annual Report to the President and the Congress on the State Energy Conservation Program for Calendar Year 1979. Washington, D.C.: Office of State Energy Conservation Programs, DOE, 1980.

U.S. Department of Energy. Staff counters belief that drop in energy use due to more efficient use. Inside DOE, June 12, 1981, 11-12.

U.S. General Accounting Office. Energy conservation: An expanding program needing more direction. Washington, D.C.: GAO, July, 1980.

Vannon, D.A. How to obtain an elementary science consultant for your school. Science Education, 1970, 54, 141-145.

Verhallen, T.M. & Raaij, W.F. Household behavior and energy use. Paper presented at the International Conference on Consumer Behavior and Energy Use, Banff, Alberta, Canada, 1980.

Wasik, J.L. & Nicodemus, R.B. A study of the effects of a workshop and the use of specially developed science materials on fifth grade science classroom practices. Science Education, 1969, 53, 347-355.

Webber, R.E. Psychological attributes of energy conservation activities. Unpublished doctoral dissertation, University of Tennessee, Knoxville, 1980.

Weigel, R. & Newman, L. Increasing attitude-behavior correspondence by broadening the scope of the behavioral measure. Journal of Personality and Social Psychology, 1976, 33, 793-802.

Wick, J.W. & Yager, R.E. Some aspects of the student's attitude in science courses. School Science and Mathematics, 1966, 66, 269-273.

Wicker, A. Attitudes vs. actions: The relationship of verbal and overt behavioral responses to attitude objects. Journal of Social Issues, 1969, 25, 41-78.

Winett, R.A. Efforts to disseminate a behavioral approach to energy conservation. Professional Psychology, 1976, 7, 222-228.

Winett, R.A. & Neale, M.S. Psychological framework for energy conservation in buildings: Strategies, outcomes, directions. Energy and Buildings, 1979, 2, 101-116.

Winett, R.A., Neale, M.S., & Grier, H.C. The effects of self-monitoring and feedback on residential electricity consumption. Journal of Applied Behavior Analysis, 1979, 12, 173-184.

Winett, R.A., Neale, M.S., Williams, K., Yokley, J., & Kauder, H. The effects of feedback on residential electricity consumption: Three replications. Journal of Environmental Systems, 1978-79, 8, No. 3, 217-233.

Yergin, D. In prepared remarks at a California Public Utilities Commission symposium entitled: "Energy efficiency and the utilities: New directions." Palo Alto, California, 1980.