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ABSTRACT

Designed to test the effects of knowledge acquisition on attitude formation and change, this study investigated whether knowledge-oriented instruction would have a different effect on students' nuclear attitudes than attitude-oriented instruction. High school students (N=331) from six schools who had not studied nuclear energy in any class or major curriculum unit participated in the study. The six schools were divided into two experimental groups (one receiving the knowledge treatment and one receiving the attitude treatment) and one control group (receiving a placebo treatment). Attitude and knowledge were measured with pretests, posttests, and retention tests. Data from the study indicated that knowledge about nuclear energy can be increased without increasing favorable attitudes toward nuclear energy and that favorable attitudes toward nuclear energy can be increased without changing knowledge of the subject. The teaching implications relating to knowledge and attitudes are also discussed and recommendations for further research are indicated. (ML)

Tne Effect of Persuasion on Nuclear Attitudes of Secondary School Students

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The Effect of Persuasion on Nuclear Attitudes of Secondary School Students

Statement of the Problem

This study addressed the research question: Does knowledge-oriented instruction have a different effect on students' nuclear attitudes than attitude-oriented instruction?

Theoretical Basis of the Study

The Theory of Reasoned Action of Fishbein and Ajzen (1975) says attitudes are the accumulation of an individual's evaluated beliefs with respect to a given attitude object. New information only changes attitudes if evaluated as positive or negative. Based on this concept, neutral information should not affect attitudes. The Theory of Reasoned Action predicts that informational treatments lacking the evaluative component would not change attitudes. Conversely, a treatment addressing the evaluative component would affect a subject's attitudes.

Research into the Learning Theory Approach of Carl Hovland provides for the systematic design of a persuasive communication to change attitudes. The phrase, "Who says what to whom with what effect?" summarizes this model. This study combined Fishbein and Ajzen's evaluated belief concept with Hovland's approach giving attention to source, message, recipient, and persistence of change factors.

Results from the research of Crater (1972) and Nealey and Rankin (1978) show that knowledge of and attitudes toward nuclear power plants have been correlated but do not establish a cause and effect relationship. According to Borg and Gall (1983), an experimental design is necessary to determine causality.

Review of the Literature

Knowledge and Attitude

Crater (1972) reported a relationship between student's knowledge about radioactivity and attitudes toward the use of radioactivity Careful analysis shows his tests actually measure knowledge of and attitudes toward nuclear energy.

Crater suggested a causal relationship between knowledge about radioactivity, and favorable attitudes toward it. While some studies support a knowledge/attitude link for science issues (Hough & Piper, 1982), the majority of studies do not imply cause-effect relationships. Fahar, et al. (1979) found "Studies have not shown knowledgeability to be a significant predictor of attitudes..." (p. 239).

Nealey et al. (1983) summarize the relationship between nuclear knowledge and attitudes in stating attitudes are based on beliefs which are based on information.

The Hovland Approach

Zimbardo, Ebbesen, and Maslach (1977) and Petty and Cacioppo (1981) have summarized the various systems of attitude change.

The attitude change component of this study used the Learning Theory Approach of Carl Hovland (1953) and his colleagues as a theoretical basis. This approach is philosophically consistent with traditional instruction and assumes attitude change to occur through the learning of persuasive messages. Cognitive learning theory proposes that concept acquisition takes place through the assimila-tion of new information.

Petty and Cacioppo (1981) divide the research about communicator credibility into five areas: expertise, trustworthiness, attractiveness, similarity, and power. Expertise is the speaker's evidence of knowledge about a topic. Trustworthiness is the perceived motivation of the speaker to communicate information without bias (Meyers, 1983). Attractiveness affects credibility in that it assists the communicator in gaining and holding attention (McGuire, 1969; Chaiken, 1979). Brock (1965) identified the similarity between the communicator and the audience as being credibility enhancing. Power operates to enhance credibility only when certain factors are present (Kelman, 1958) and does not apply to this study.

Grabowski (1980) found that a persuasive message can be brief and still change attitudes. Lumisdaine and Janis (1953) and Watson and Johnson (1972) studied the number of sides presented in a persuasive message. One-sided arguments intensify the attitudes of those who agree with the position of the speaker. A two-sided argument is more persuasive with subjects initially neutral or opposed to the speaker's position or intelligent, well educated subjects. (Lumisdaine and Janis, 1953).

Katz (1960) described attitude arousal as a condition of initiating attitude change. Janis and Feshbach (1953) have studied fear appeals for arousing attitudes. Rogers (1975) reported that a fear appeal coupled with a proposed avoidance plan can create a drivelike state.

Attitudes About Nuclear Energy

Nuclear energy for makes a good topic for an attitude study on a science-related issue. While Nealey (1981) indicates there were few studies about nuclear attitudes before 1970, a number of studies existed by 1981. Many attitude studies look at attitude objects toward which subjects do not have sufficient emotional intensity (Koballa and Shrigley, 1984). Webber (1982) finds construct validity in nuclear energy as clearly different from general environmental attitude.

Crater's (1972) study correlated a test of nuclear science with nuclear attitudes. Data from 1205 students, showed a correlation between attitude and knowledge of .26 which is significant at the .001 level. He concluded that "...increased knowledge possessed by college students about a particular area of science such as radioactivity *will tend to produce more favorable attitudes* toward that field" (p. 62, italics inserted). Most attitude research does not support this finding.

Crater's conclusion supports what Otway, Maurer, and Thomas (1978) call "oversimplified theories about attitude formation." They propose Fishbein and Ajzen's Theory of Reasoned Action to explain the formation of nuclear attitudes.

Nealey and Rankin's (1978) research did show a correlational relationship between knowledge and strength of pronuclear attitude. Willson's (1983) meta-analysis of science attitude/science achievement studies science showed an average correlation of 0.16. Nuclear knowledge seems more strongly related to nuclear attitudes than other science-related issues. Nonetheless, causality cannot be inferred from correlational data. These studies commit the mistake described by Borg and Gall (1979) of assuming causal-comparative data prove a cause-and-effect relationship.

Procedure

Subproblems

To design a study to address the problem presented at the beginning of this paper, two subproblems were addressed. These subproblems were: 1) Will changing the nuclear knowledge of a group of high school students change their attitudes toward nuclear energy? and 2) Can the nuclear attitudes of high school students be changed without increasing their knowledge of nuclear energy?

Manipulating knowledge about nuclear energy and attitudes toward nuclear energy independently in an experimental setting would disprove causality between the two constructs.

Instruments

Two measurement instruments were necessary for this investigation. The attitude subscale of the Nuclear Energy Assessment Battery is a six-item, five choice, Likert-type attitude measure developed by Calhoun (1985). The subscale has a possible score from 5 to 30 with higher scores indicating more pronuclear attitudes.

This researcher created the knowledge subscale of the NEAB concurrently with Calhoun's development of the attitude scale. The subscale is a 20-item, four-answer multiple choice test. The possible score range is zero to twenty points. Treatment Design

Following Grabowski (1979) and Koballa (1981), the instructional medium for the treatments was videotape. The videotapes were supported by a student guide and homework assignments. The homework assignment required the student to produce written messages that supported the information presented in the videotapes.

The Study

This study tested the effects of knowledge acquisition on attitude formation and change. The study attempted to discern the relationship between the variables by manipulating each independent of the other.

Field Test of the Treatments

A field test was conducted in early 1985 to determine the insturment reliabilities ard treatment effectiveness.

The field test showed that the instruments were reliable for the experimental population and the treatments performed as they were designed.

Variables Tested

The independent variable used in this study was treatment at three levels, knowledge, attitude, and control. Two dependent variables, attitude and knowledge, were analyzed.

Attitude and knowledge were measured with a pretest to determine initial group equivalence. The constructs were measured by a posttest immediately following instruction to determine gains from the treatments. A retention test was given three weeks following the instruction to determine whether changes in knowledge and attitude were retained.

Subjects

The subjects were 331 high school students in grades 10-12 from six schools in Pennsylvania and Ohio. The teachers in the participating schools indicated the students had not studied nuclear energy in any class or major curriculum unit. Subjects were assigned to the treatments as intact groups by random assignment to treatment and control groups.

Experimental Design

The testing was not done at one time. Therefore, random assignment would have allowed students to interact and contaminate subjects across treatments. Use of a quasi-experimental design (Campbell and Stanley, 1963) maintained adequate internal and external validity.

Figure 2 schematically represents the design of the study. The six schools were divided into two experimental groups and one control group. The experimental groups received different instructional programs dealing with nuclear energy. Group I (T_k) received the knowledge treatment and group II (T_a) received the attitude treatment. The control group (T_c) received a placebo treatment.

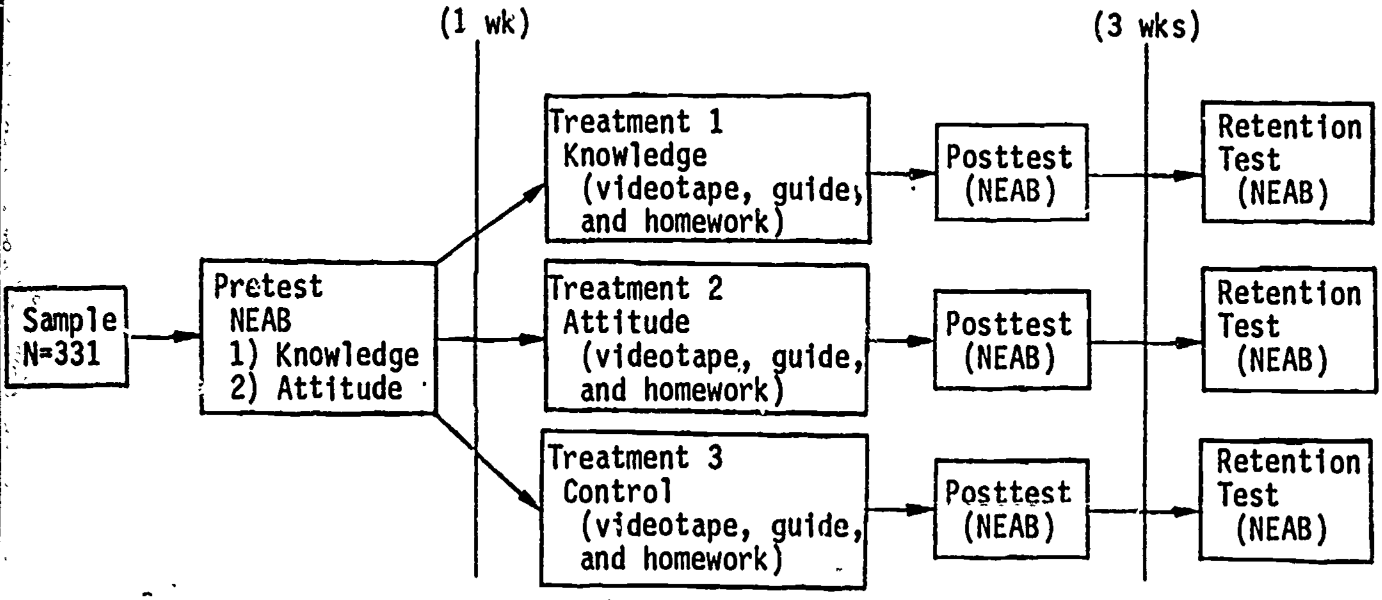

Figure 3.4. Schematic Representation of the Design of the Study

Results

The following analyses were performed: 1) analysis of variance with repeated measures (ANOVR), 2) one-way analyses of variance (ANOVA) and 3) Tukey wholly significant difference (WSD) pair-wise contrasts among the means.

Pretest Equivalence

Analyses of variance were used to test the assumption that all treatment groups had initially equivalent knowledge and attitude toward nuclear energy. The analysis of variance found the probability of knowledge equivalence among treatments to be 0.180 which is not significant at the .01 level. The probability of differences among the groups on attitude means was 0.104 which is not significant at the .01 level. Therefore, all groups were initially equivalent on both knowledge and attitude scores.

Changes in Knowledge and Attitude

The mean knowledge score of the knowledge treatment group went from 12.22 on the pretest to 15.78 on the posttest and was 14.91 on the retention test. The mean knowledge score of the attitude treatment group went from 13.13 to 13.24 to 12.53. The mean knowledge score of the control treatment group went from 12.95 to 12.79 to 13.55.

The analysis of variance with repeated measures (ANOVR) tested whether the knowledge score differences were statistically significant. The probability of equivalence of the treatments on the knowledge posttest was 0.001. This indicates the need to use the analysis of variance to determine what differences exist in the data.

The analysis of variance on posttest knowledge scores found the probability of equivalence among the treatments to be less than .001. These data require the use of the PSI HAT Comparison to determine specific differences between any two groups.

The mean knowledge score of the knowledge treatment group was 2.54 higher than the attitude treatment group. The obtained t statistic for this difference was 4.870, exceeding the critical value of t at 2.38 for 100 degrees of freedom. The knowledge treatment group was also significantly higher than the control group at the .01 level (difference = 2.99, t = 4.137, df = 59, critical value = 2.41). The obtained t statistic for the attitude treatment group score was 0.618. This did not exceed the critical value of t at 2.40 for 64 degrees of freedom.

To determine whether increased knowledge about nuclear energy increased students' positive nuclear attitudes, the data from the analysis of variance for the posttest attitude scores were examined.

The mean attitude score of the knowledge treatment group went from 16.49 on the pretest to 17.43 on the posttest and was 17.62 on the retention test. The mean attitude score of the attitude treatment group went from 17.30 to 20.47 to 20.?? The mean attitude score of the control treatment gr[illegible]nt from 18.68 to 17.26 to 18.31.

[illegible]nalysis of variance with repeated measures (ANOVR) tested whether the attitude score differences were statistically significant. The probability of equivalence of the treatments on the posttest was 0.000. This indicates the need to use the analysis of variance to determine what differences exist in the data.

The analysis of variance on posttest attitude scores found the probability of equivalence among the treatments to be less than .001. These data require the use of the PSI HAT Comparison to determine specific differences between any two groups.

The mean attitude score of the attitude treatment group was 3.03 higher than the knowledge treatment group. The obtained t statistic for this difference was 3.430, exceeding the critical value of t at 2.37 for 151 degrees of freedom. The attitude treatment group was also significantly higher than the control group at the .01 level (difference = 3.20, t = 3.655, df = 151, critical value = 2.37). The obtained t statistic for the attitude treatment group score was 0.160. This did not exceed the critical value of t at 2.37 for 151 degrees of freedom.

Discussion and Conclusions

Causality Between Nuclear Knowledge and Nuclear Attitudes

The preceding data show that knowledge about nuclear energy can be increased without increasing favorable attitudes toward nuclear energy. Further, the data demonstrate that favorable attitudes toward nuclear energy can be increased without changing knowledge of the subject. Therefore, these two variables can be manipulated independently and are not causally linked.

Implications of the Study

This study has shown the effectiveness of different instructional models on the knowledge about and the attitudes toward nuclear energy. The experimental design of this study has not supported a causal link between knowledge and attitude. The likely explanation is that the teachers who increased the student's knowledge through instruction also passed on favorable attitudes toward nuclear energy.

Knowledge toward a controversial subject such as nuclear energy can be increased without affecting attitudes. This may hearten some values-neutral education advocates. Conversely, the complex process used in this study to produce instruction that would change knowledge without changing attitude probably limits widespread practice.

Teaching implications of this research deal with instruction relating to both knowledge and attitudes. The difficulty of teaching content without affecting attitudes implies that teachers should be both open and deliberate in the teaching of attitudes. To teach neutral content requires limiting the number of perspectives presented in the classroom. Students should see the teacher/role model bring the decision-making process to a conclusion.

Further, in teaching nuclear science and nuclear issues, the teacher must decide what information deserves to be a part of the curriculum. Students will form attitudes about nuclear energy in nuclear science classrooms. Those attitudes, as with the attitudes of any citizen, should be based on information and not misinformation.

Science classes are for teaching students observational methods for learning about the world around them. This implies that equal time is not deserved for teaching views of the world that are not derived from observational methods. This may give students the impression that certain topics such as "scientific creationism" are not science. That then, is one ramification of teaching true science in the public schools. The judicious selection of information in any classroom has attitudinal implications, and teachers should be open about accepting this societal responsibility.

Recommendations for Further Research

This study has ramifications for further research by replication with other samples, treatments, or attitude objects; additional demographic studies; and the use of nuclear attitudes to standardize attitude object effects in replicating prior research.

Replication with other samples will allow determination of whether the effect observed in this study was specific to this sample or population. Additional experimentation with other attitude objects will provide further confirmation of the role of knowledge in attitude formation.

A brief instrument available for measuring nuclear attitudes provides a mechanism that could standardize prior studies while controlling for attitude object differences.

Several classical studies could be replicated using nuclear energy as an attitude object. Janis and Feshbach (1953) studied attitude change from fear appeals using tooth decay as an attitude object. Hovland and Weis (1951) studied the factor of credibility by using the feasibility of nuclear submarines as an attitude object. Walster and Festinger's (1962) examined how the appearance of the intent to persuade affects persuasion.

Katz (1960) discussed differentiation in beliefs and attitudes. Studies should examine the effect of this factor on attitudes toward nuclear energy. Other aspects of the functional approach as described by Katz should be researched.

A factor analysis study could reveal components important to the formation of and change of attitudes toward nuclear energy. Additional attributes should be included in such a study including anxiety, beliefs, behaviors, and opinions.

Collins et al. (1983) associate chronic stress about the accident at Three Mile Island with psychological coping strategies. Aptitude by Treatment Interaction methods could be used to assess the effectiveness of persuasive communications across the aptitude of coping strategy. Collins et al. use the Ways of Coping Inventory which could be used in conjunction with the Nuclear Energy Assessment Battery. Anger-coping styles (Gentry et al. 1983) could also serve as the basis for a study.

Anxiety and Nuclear Attitude

Spielberger (1966) cites anxiety as a central concept in explaining personality and as a major causative agent for diverse behavioral consequences.

The role of anxiety and nuclear attitudes should be added to the model developed by this research. The relationship between knowledge and anxiety should be examined as well as the effects of anxiety on attitude.

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