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ABSTRACT

Locus of control, a generalized belief about causality in one's personal life, was identified as a potential variable impinging upon the acquisition of science-related attitudes in classes of high school students from 10th grade biology, and 11th and 12th grade chemistry, and of college elementary education majors. Correlations of the Internal-External Scale with the seven subscales of the Test of Science-Related Attitudes revealed that subjects with an external locus of control did not have as positive attitudes towards science as internal students and that the relationship between locus of control and science attitudes strengthened with age. (Author)

GENERALIZED BELIEFS AND ATTITUDES: LOCUS OF CONTROL AND SCIENCE ATTITUDES IN HIGH SCHOOL AND COLLEGE STUDENTS

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Abstract

Locus of control, a generalized belief about causality in one's personal life, was identified as a potential variable impinging upon the acquisition of science-related attitudes in classes of high school students from tenth grade biology (*n* = 60) and eleventh and twelfth grade chemistry (*n* = 89) and of college elementary education majors (*n* = 61). Correlations of the Internal-External Scale (Rotter, 1966) with the seven subscales of the Test of Science-Related Attitudes (Fraser, 1977, 1978) revealed that subjects with an external locus of control did not have as positive attitudes towards science as internal students and that the relationship between locus of control and science attitudes strengthened with age.

Introduction

Affective learning outcomes identified in science education as "science attitudes" are receiving attention from a number of science educators wishing to improve the attitudes of the public towards science and technology. Blosser (1984) listed a number of problems identified in 1982 by the National Science Teachers Association concerning science-technology-society issues for the 1980s. Affective concerns included a decline in public appreciation for science and decreased support for science education.

Although there is continued interest in students developing positive science attitudes, the inclusion of affective objectives in the design and evaluation of science curricula has been very difficult. Science teachers who are accustomed to dealing with objectives in the cognitive domain have difficulty addressing objectives in the affective domain. Designing curriculum to maximize learning by students with individual differences makes the task still more difficult because so little is known about the role of individual differences in the acquisition of affective outcomes.

We identified locus of control as a potential variable in affecting the acquisition of science attitudes for a number of reasons. The psychological construct of locus of control was operationalized by Rotter (1966) as a general orientation of an individual towards causation in his/her own personal life. Levensen (1974) characterized "externals" as individuals believing that their destinies are determined by fate, chance, or powerful others: and "internals" as believing that they themselves are the primary controllers of their lives. Stuessy (1989) found that locus of control was a variable impinging upon the development of scientific reasoning abilities of adolescents, with external individuals demonstrating lower scientific reasoning abilities than internals. We reasoned that a generalized belief about causality (locus of control) would affect the ability of children to develop attitudes about causality and, in particular, towards science, a human endeavor which assumes that the world can be described causally, rationally, predictably.

Methodology

Two paper-and-pencil instruments were used in order to acquire information about the nature of the relationship between locus of control and science attitudes. Rotter's 1966 Internal/External Scale (I-E Scale) was used to measure the construct of locus of control. This test consists of 29 paired, forced-choice statements, one of which indicates an external orientation and the other which indicates an internal orientation. The total score on the test is the number of external statements selected. The Test of Science Related Attitudes (TOSRA) (Fraser 1977, 1978) is a multidimensional test consisting of 70 items in a Likert-type format. The TOSRA consists of seven subscales with ten items for each: Social Implications of Science, Normality of Scientists, Attitude to Inquiry, Adoption of Scientific Attitudes, Enjoyment of Science Lessons, Leisure Interest in Science, and Career Interest in Science.

The TOSRA and I-E Scale were administered by classroom teachers in the spring of 1988 to students from three sources: (1) tenth grade students (n = 60) from rural/suburban high school biology students (28 percent female: 84 percent Hispanic), (2) eleventh and twelfth grade students (n = 89) from metropolitan high school chemistry classes (50 percent female: 40 percent Hispanic), and (3) elementary education majors (n = 61; 79 percent female: 46 percent Hispanic) enrolled in science methods classes at New Mexico State University.

Student responses on answer sheets to the items on the TOSRA and I-E Scale were hand-scored. The statistical package SAS was used to calculate descriptive statistics and Pearson correlation coefficients for the I-E Scale with each of the subscales of the TOSRA.

Results

Table 1 presents correlations of each of the subscales of the TOSRA with the I-E Scale. Significant correlations ($p < .05$) are noted for six of the seven subscales in the

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Insert Table 1 about here

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university group, with higher locus scores (indicating a higher external orientation) negatively correlating with higher scientific attitudes. Of note is that career interest in science was not significantly correlated with locus of control in any of the data sets. In the high school chemistry group, significant correlations were noted for three of the subscales, while only one significant correlation (i.e., between locus of control and enjoyment of science lessons) was noted for the high school biology class.

Discussion

Subjects with an external locus of control do not have as positive attitudes towards science as internals. This appeared to be especially true when the attitude was toward the individual's wanting to take part in science activities (subscales Enjoyment of Science Lessons and Leisure Interests in Science). In addition, attitudes towards inquiry were more negative for externals. This finding is quite predictable, as the items on the Attitude Towards Inquiry subscale asked students to respond about their attitudes toward independent learning and finding out information for themselves. Externals, who do not believe that causal relationships exist between their own behavior and outcomes, may view the process of scientific inquiry as undesirable, contradictory, or irrelevant to the way one learns about the world. Externals may prefer being told by others and using authorities as sources of information because they view events in their own worlds as capricious or under the control of powerful others. Also, externals see scientists as different from themselves. Consequently they classify the scientist as "not normal." Such a view appears not yet developed among the tenth grade biology students. Younger students generally may be less likely to develop strong opinions about science and science-related activities.

The observed general trend of an increased relationship with age between locus of control and attitudes towards science leads us to speculate that (1) attitude toward science might become clearer with age and therefore show clearer relationships as individuals become older: and (2) an individual's locus of control might become stronger, more important, more general and clearer as the individual matures. Although we have no evidence to support these speculations. we suggest further research in this area to clarify why the relationship between locus of control and science attitudes strengthens with age.

Our tentative findings which indicate a locus of control-TOSRA relationship suggest that a good science education in a high school learning environment which alters students' beliefs about the cause-and-effect in their personal lives and in the world around them may also alter students' attitudes about science. Mary Budd Rowe (1974) has suggested that locus of control may be a function of the experiences one has with cause-and-effect phenomena; that is. the more one experiences cause-and-effect phenomena, the more likely one is to reject chance as the determiner of one's life. Rowe has contended that providing learners with science activities that demonstrate causality will make their locus of control more internal. Our interest in the development of positive science attitudes leads us to ask whether an intervention which changes locus of control also changes science-related attitudes.

Finally, we mention recent theoretical considerations which appear to be contrary to Rowe's suggestions. Ajzen and Fishbein's (1980) "theory of reasoned action" has been used as a model for understanding science attitudes (Koballa, 1988; Krynowsky, 1988). Briefly, this model recognizes attitude as one of three variables that function as the prime determinants of behavior, namely attitude towards the behavior, subjective norm, and the weights of these predictors. "Attitude" is defined specifically as the "attitude towards a behavior," rather than as a generalized attitude towards persons, institutions, and policies, or science, for that matter. Science attitudes would be characterized as an "external variable" (Ajzen and Fishbein, 1980, pp. 82-91), as would the variable of locus of control. These external variables are posited to have only an indirect influence upon behavior and important in understanding why people have established particular beliefs which underly a given behavior; they are not important, however, in the determination of a particular behavior. Ajzen and Fishbein argue that external variables cannot be changed or are difficult to change and that they do not contribute to the prediction of any particular behavior. Ajzen and Fishbein contend that behavioral change is effected by attacking specific beliefs which lead to changes in attitudes towards specific behaviors.

The Ajzen and Fishbein model stimulates us to pose several related questions. First, we ask whether locus of control is indeed resistant to change, as Ajzen and Fishbein suggest, or whether locus of control can be altered by science learning environments which emphasize the causality of science such as those suggested by Rowe. If locus of control can be changed, a related question relates to ascertaining the effects associated with the change. Our research would suggest that a change towards internality would be associated with more positive science attitudes. In light of the model, however, one must question the role of generalized, positive science attitudes in science education. Koballa (1988b) found the absence of a significant relationship between junior high school students' behavioral intentions to enroll in at least one elective science course and their generalized attitude toward science. He concluded that "the demonstration of a change in attitude toward science as a result of an intervention is suspected to be insufficient to induce behavioral change" (Koballa, 1988b, p. 489). Are science attitudes indeed external in planning strategies to effect behavioral change in science students, as suggested by Kopalla? If so, are there other reasons for including curricular objectives that relate to the generalized attitudes of students towards science? The model definitely offers a new perspective and suggests several possibilities for performing attitude research in science education.

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Table I

Correlation of Locus of Control with Subscales of the Test of Science Related Attitudes (TOSRA). (Pearson Correlation Coefficients with Level of Significance Shown Below in Parentheses.)

	Data Set		
	HSBIO	HSCHEM	UNIVEE
TOSRA Subscale	n = 60	n = 89	n = 61
Social Implications of Science	-.13 (.32)	-.09 (.35)	-.39** (.002)
Normality of Scientists	-.10 (.42)	-.22* (.03)	-.40** (.001)
Attitude to Inquiry	-.02 (.83)	-.27* (.01)	-.25* (.05)
Adoption of Scientific Attitudes	-.06 (.61)	-.11 (.27)	-.31* (.02)
Enjoyment of Science Lessons	-.25* (.05)	-.22* (.03)	-.26* (.03)
Leisure Interest in Science	-.15 (.25)	-.09 (.07)	-.31* (.01)
Career Interest in Science	-.21 (.11)	-.17 (.10)	-.22 (.08)

Note: * $p < .05$

** $p < .01$