CLASSROOM VARIABLES AND STUDENT-ATTITUDE TOWARDS SCIENCE

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A review of empirical studies reveals a positive relationship between several science classroom variables and student-attitude towards science. The classroom variables include exemplar science curricula, laboratory- centred instruction, laboratory resources and classroom environment. However, there is no conclusive research evidence to establish a relationship between these classroom variables and student-attitude due to discrepancies in the attitude testing instruments utilised.

Introduction

This paper will review the effect of science classroom variables on student-attitude towards science. There is evidence to the fact that students indeed develop a better attitude towards science through learning by experience (Kyle, Bonnstetter, McCloskey and Fults, 1985). The classroom variables that provide opportunities for experience-based science learning are exemplar curricula, laboratory, hands-on discovery methods, laboratory resources, the teacher and the teacher's attitude, etc. Since the relationship between these variables and attitude is covert, only by utilising attitude testing instruments student-attitude towards science is measured.

Student-attitude towards science. According to Gauld (1982), and Haladyna and Shaughnessy (1982) there are two ways the term "attitude" is defined with respect to science. These are: scientific attitude, and attitude towards science. Scientific attitude refers to approaches utilised for problem solving, decision making and scientific thinking by acting primarily on evidence. Attitude towards science, on the other hand, may address a person's affective domain-specific feelings, such as views, judgements, thoughts and opinions towards science. For example, discovery learning could affect a student's attitude towards science (Kyle, et al., 1985).

Attitude testing instruments. Generally attitude testing instruments are questionnaires designed to determine opinions. For example, in the "Science Attitude Questionnaire" developed by Okibukola and Adeneyi (1987), students would select the most appropriate answers reflecting their attitudes towards science learning. In the "Projective Test of Attitudes" (Lowery, 1966), an interviewer will make an assessment of student-attitude based upon his or her personal interview with the students. In the "Preference and Understanding" (Vargas-Gomez and Yager, 1987) developed from the National Assessment of Educational Progress Survey (1978), there are

separate statements representing student-attitude. The students will choose appropriate Likert type numerical ranks which follow each statement to express the degree to which they agree or disagree with the statement. For additional information on attitude testing instruments refer to Kyle, Penick and Shymansky (1980), National Assessment of Educational Progress (1978), Lowery (1966), Simpson and Troost (1982), Osgood, Suci and Tannenbaum (1967) and Remmers (1960).

Review of Empirical Studies

Twelve attitude studies were randomly chosen from those studies published between 1975 and 1990 in the *Journal of Research in Science Teaching, Science Education, and School Science and Mathematics.* One study did not provide any quantitative data hence was removed from the sample resulting in eleven studies ($N = 11$). They are either correlational or experimental studies (Table 1).

Exemplar science curricula positively influence student-attitude towards science. In an experimental study involving the Science Curriculum Improvement Study (SCIS), a significant increase of positive student-attitude towards science was recorded by Kyle, Bonnstetter and Gadsden (1988). The "Preference and Understanding" attitude testing instrument was used in this study. When compared with the attitudes of the students in the control group, the experimental group said science is their favourite subject, it is fun, exciting, interesting and curious. Also, the experimental group students requested more time for learning science.

In another research where the SCIS curriculum was followed for six years, the student-attitude towards science and scientists showed a significant increase (Lowery, Bowyer and Padilla, 1980). Students have enjoyed the experimenting activities of the SCIS curriculum more than anything else. This research has used the Projective Test of Attitude for testing student-attitude.

Vargas-Gomez and Yager (1987) studied the attitudes of students using exemplary curricula across the United States of America. The sample for this survey was randomly selected from a target population of third, seventh and eleventh graders across the U.S.A. The attitude testing instrument used in this study was the "National Assessment of Educational Progress" attitude survey. Vargas-Gomez and Yager (1987) reported that students in the exemplar programme developed a positive attitude towards science as well as their science teachers. Both the students and their teachers exchanged questions and engaged in sharing ideas.

Hofman (1977) compared the effect of the National Science Foundation (NSF) curriculum with traditional curricula on the attitude of eight-year-old students. His experimental group used the NSF science curriculum, and the control group used textbook-based curriculum. The students who followed the NSF curriculum showed a significant positive attitude towards science whereas those who followed textbook-based curriculum did not show any significant change of attitude.

High school students using the "Interdisciplinary Approach to Chemistry" (IAC) curriculum reported that chemistry was fun and they liked it (Sherwood and Herron, 1976). IAC is a process

oriented laboratory-based chemistry curriculum. The students who followed the IAC curriculum reported on the "Scale to Measure Attitude Towards any School Subject" that the learning processes involved in IAC held their interest longer. They also reported that they understood chemistry better through the IAC curriculum than the textbook curriculum.

Learning science through laboratory has developed a positive attitude towards science among students with reading difficulties (Milson, 1979). Milson reported in a study involving fifty-four ninth-graders who had reading difficulties that the concrete experience of the laboratory influenced positive student-attitude towards science. In a similar study, Johnston, Ryan and Schroeder (1974) recorded a significant positive attitude among 108 elementary students who used laboratory-based science learning. Okebukola (1987) in a large scale study of student - attitude, found out the hands-on experience associated with laboratory-based learning as the influential factor for better student-attitude.

Table 1

Reference	Purpose	Research Hypothesis	Subject	Measures	Procedure	Analysis	Results
Kyle, Bonnstetter and Gadson, 1988	SCIS vs. traditional curri. on attitude	SCIS-significant positive effect	Elementary students N = 456 (R)	Preference and understanding	One year instrn. Then post-test	Chi square test	SCIS group-positive attitude
Lowery, Bowyer and Padilla, 1980	Attitude after 6 yrs using SCIS	SCIS-sig. positive	Jr. high N = 110 (R)	Projective Test of Attitudes Lowery, 1966	Interview/ 12 minutes/ student post-test only	AVOVA	Accepted the hypothesis
Gomez-Vargas and Yager, 1987	Attitudes of learners in exemplary programmes vs.traditional programmes	Exemplary-sig. positive	Exempl. N = 150 (R) grades-3/7/11th. Trad. N=2500 from NAEP studies	Preference and understanding	Random post-test	Z-test	Exemplary programmes developed positive student attitude
Hofman, 1977	NSF curriculum vs. traditional on attitude	NSF-positive attitude	Students, 8 yrs of age. N=79 (R)	Projective Test of Attitudes	Pre-test, 8mo. Instrn., Post-test	Two way AVOVA	Accepted the hypothesis
Sherwood and Herron, 1976	Interdisc. Approach to Chemistry (IAC) curri. on attitude	IAC develops positive attitude	High schoolers	Scale to measure attitude towards any school subject Remmers, 1960	Pre-test, Post-test	F-test	Significant influence

Milson, 1979	Laboratory curri. and the attitude of learners with reading difficulties	Concrete exper. develops positive attitude	Grade 9 N = 54 (R)	Semantic Diff. Forms Osgood, 1967	Pre-test, Post-test	AVOVA and multiple linear regression	Accepted the hypothesis
Okebukola, 1987	Influencing factors toward lab. performance	Hands-on and teacher attitude influence student attitude	Grade 11 Students = 819, Teachers = 39	Teach./ Students' Lab. Info. and Attitude Towards Chemistry	Random-3 times	Multiple Regression Analysis	Accepted the hypothesis
Johnston, Ryan and Schroeder, 1974	Lab. centred vs. text-centred learning and attitude	Lab/text-centred differ towards attitude	Elementary students N = 108(R)	Projective Test of Attitudes	Post-test Two- week Instrn.	AVOVA	Lab. has more influence on attitude
Mulpo & Fowler, 1987	Effect of discovery vs. traditional methods on the attitudes of formal vs. concrete S's.	Instructional method has no influence on attitude	Concrete = 60 (R), Formal = 60 (R) Grade 11	Achievement Test on Science Attitude	Pre-test, Ten week instrn., Post-test	Two way AVOVA	Rejected the hypothesis
Talton & Simpson, 1987	Classroom Environment and Attitude	Classroom Env. affects attitude	Grade 10 N = 1560 (R) Teachers = 23	Simpson and Troost Instrn. 1982	Three times per school year	Pearson Corr. and F-test	Accepted the hypothesis
Okebukola & Adeneyi, 1987	Lab. resource utilisation and attitude	Relationship	Students =252 Teachers = 21 Lab. Assts = 18	Scientific Attitude Questionnaire	Random testing	AVOVA and Pearson Corr.	Frequency, quality, teacher's affect attitude

Note: (R) means random sampling

Talton and Simpson (1987) found that classroom environment influences students' attitude towards science. The classroom environment includes factors, such as emotional climate, physical environment, friends and teachers. They found that the teachers' positive attitude towards science as well as peer interaction as motivators of positive student-attitude towards science.

Mulpo and Fowler (1987) studied the effect of discovery and traditional methods of learning chemistry on the attitudes of concrete and formal operational learners. The results indicated no significant difference in attitude among concrete and formal operational learners. However, discovery method of learning showed a higher correlation with student-attitude than traditional method.

Okebukola and Adeneyi (1987) argue that positive student-attitude depends on the extent to which the laboratory resources are utilised effectively.

Their definition of laboratory resources included the teacher, the laboratory assistants as well as laboratory materials. In addition to using the "Scientific Attitude Questionnaire" they also performed direct classroom observations. The outcome of their study revealed a significant positive correlation between frequency as well as quality use of the laboratory resources and student-attitude towards science. They also found that the resource person's (the laboratory assistant's) attitude towards science had an influence on student-attitude.

Discussion and Conclusion

According to this review, several classroom variables influence student-attitude towards science. They include exemplar science curricula, laboratory-based learning, utilisation of laboratory resources, hands-on discovery methods, teacher's attitude, classroom environment, etc. The empirical studies reviewed have been performed in classrooms at various geographical locations representing students from a variety of educational, socio-economic and cultural backgrounds. The studies have employed various attitude testing instruments. Three of the eleven studies reviewed have used the "Projective Test of Attitudes" and two have used the "Preference and Understanding Questionnaire". The remaining six studies have used six different attitude test instruments.

Munby (1980) after reviewing 50 attitude testing instruments in science education opined that "there seems little to be said of the instrument to enlist our confidence" (p. 237). Two major problems of attitude testing instruments are: lack of a theoretical framework to support the instrument (Shrigley, 1983; Munby, 1983; and Zeidler, 1984); and lack of sufficient validity and reliability (Munby, 1980; Gardner, 1987; Bratt, 1984; Schibeci, 1983; and Butts, 1983). Unless these problems are resolved, it would continue to be difficult to establish a conclusive relationship between student-attitude and classroom variables.

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