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Exploring the effects of demonstrations on elementary science attitudes

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EXPLORING THE EFFECTS OF DEMONSTRATIONS ON ELEMENTARY SCIENCE ATTITUDES

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PART I

INTRODUCTION TO THE PROBLEM

Since the government's report of A Nation At Risk, it has been a goal of many teachers to increase student achievement and participation in science. This trend might be attained if the students' attitudes toward science changed.

Review of the Literature

Attitudes toward science. Feelings toward science are considered one's attitude. Koballa, Jr. and Crawley (1985) found that a science attitude should refer to a general and enduring positive or negative feeling about science. They thought that attitudes toward science fulfilled basic psychological needs, such as the need to know and succeed, as well as future behavior. They also felt that the direction and emotional intensity of attitudes determined the outcome of one's behavior.

Attitudes affect elementary interests and reactive curiosity. According to a study conducted by Harty, Anderson, and Enochs in 1984, attitudes had an important influence on the science teaching/learning situation as a goal for the teaching of elementary school science by both teachers and science educators.

Effects of attitudes on science. Rust (1977) inferred that interests demonstrated patterns of choice, which remained stable over time and were not the result of external pressure within the contextual setting of an elementary school science learning environment. Secord and Backman (1964) defined attitudes as "regularities of feelings, thoughts and dispositions to act towards their environment". Penny and McCann (1964) found that reactive curiosity has a tendency to approach, explore and vary new, complex and frequent stimulus situations. Thus, reactive curiosity was found to be a very important part of the learning situation.

According to Koballa, Jr. and Crawley (1985), teaching only science facts and related concepts did not develop a positive attitude toward science. Students need a positive attitude to make judicious decisions about science. They found that attitudes toward science may affect future behavior. Thus, positive or negative feelings about science could serve as a convenient summary of scientific beliefs.

A considerable amount of evidence supported the idea that attitude has an effect on achievement in science. Even an increase in curiosity would help students to achieve more in science (Koran and Longino, 1982). Simpson (1978) suggested that interest in science generally accounted for 20 to 25% of the academic achievement in science. Because of the relationship of beliefs, behavior, and attitude; an attitude change in science could cause a corresponding change in science beliefs and science related behavior (Ajzen and Fishbein, 1980).

Science attitude assessment. The Likert-type scale was the most often used tool of assessment for elementary science attitudes. Thomas Fisher (1973) stated that "the Likert-type rating scale was uniquely suited for assessing science attitudes". Story and Brown (1979) found the Likert-type scale to be a good indicator of science attitudes. Harty and Beall (1984) demonstrated the reliability and validity of this scale for measuring science attitudes.

Science attitudes change. Jaus (1977) suggested that the conventional textbook method enforced negative attitudes toward science while the activity-oriented methods tended toward a more positive attitude. Harty, Anderson, and Enochs (1984) also correlated positive attitudes with activity-oriented lessons. Davis, Raymond, Rawls, and Jordan (1976) related positive attitudes toward science with the activity level of the lessons. In a study of over 1800 students, Lazarowitz, Baird, and Allman (1985) found that students felt they achieved best when the lessons matched their needs and interests. Flexor and Borun (1984) found that of the science lessons which most students liked, they preferred pictorial exhibits over regular classroom instruction. Process-oriented (Reese, 1978) and activity-based (Bredderman, 1985) programs were favored by students over their regular classroom instruction.

Although the literature has encouraged activity-based science lessons to obtain a more positive attitude in students, it is seldom accomplished. Bonnstetter and Yager

(1985) found that many elementary teachers would welcome help with activity experiences and equipment in their science lessons. Koballa, Jr. and Crawley, (1985) found elementary student peers and others such as high school students had an important effect on the science attitudes of elementary students. Perhaps high school students could fill the need of these teachers.

Justification of the Problem

Science attitudes, interests and curiosity in science influenced the science/learning lesson. Harty, Anderson and Enochs (1984) suggested that the nurturing of interest, curiosity and a positive attitude toward science had to be an important goal for elementary science educators.

Literature supported the use of activity-based lessons (Bredderman, 1985) and pictoral demonstrations (Flexor and Boron, 1984) to increase positive attitudes toward science. Yet only the exemplary elementary teachers found the time or equipment to set up science experiements and demonstrations for their science lessons (Bonnstetter and Yager, 1985).

Statement of the Problem

The purpose of this study was to determine if demonstrations and experiments performed by high school science students for elementary students would have an effect on their attitudes toward science.

Hypothesis

It was expected that there would be no significant difference between the pretest and posttest means of the elementary students' attitudes toward science when subjected to activity-based lessons presented by high school science students.

PART II

PROCEDURE

Subjects

The subjects of this study included thirty-four sixth grade students who participated in this treatment at the author's school.

Setting

The study was conducted in a colleague's sixth grade science class. The school, located in a small, Midwestern rural community, consisted of grades Kindergarten through twelve, all in one building. The students were all Caucasian of predominantly middle class Christian descent. The writer's high school science students presented the activity-based lessons to the sixth grade science class. The elementary teacher used more involved activities and employed a variety of equipment and lessons, usually available only at the high school level. The high school teacher, researcher, selected high school science students based on ability and interest in presenting the lessons. Time availability was a consideration. These students attended an inservice on the use of the required equipment and the procedures of the lesson, including a written plan to be followed.

Instrument Employed

The study design included a pretest, treatment and posttest. The pretest and posttest (see Appendix A) were taken from an attitude survey which was shown to be acceptably valid and reliable in measuring student attitudes toward junior high science (Fisher, 1973).

The treatment consisted of weekly activity-based lessons presented by the selected high school science students. It was given during the regular sixth grade science class. The sixth grade teacher's presence lent support and coordination to the learning experience. The activity-based lessons were intended to compliment the book-based lessons as well as improve science attitude.

Methodology

The subjects were given a pretest and a posttest by the sixth grade teacher. These tests measured their attitudes toward science through a Likert-type scale as suggested by Fisher (1973) (Appendix A). The answer choices were weighted five, four, three, two, and one, respectively, with the five assigned to the answer which, if checked, would be a sign of the most positive attitude toward science. Each statement was scored and tallied to derive a total score for the survey. These totals were used to determine the group means and significance of the treatment.

For a six week period, the subjects were involved in a weekly activity-oriented lesson presented by high school science students. These lessons supplemented or replaced the science lesson ordinarily planned for that time period. The activity-oriented lessons and relative setups (Two examples in Appendix B and C) were determined by the cooperative efforts of a sixth grade teacher and a high school science teacher (researcher).

Statement of Terms

Activity-oriented Lessons - were demonstrations, experiments, and/or displays of some science concept or phenomenon.

Likert-type Scale - an instrument used to determine the student's attitude toward science. Items in this particular survey were found to be valid and reliable for this purpose by its author, Fisher (1973).

Assumptions and Limitations

The pretest and posttest were given anonymously by the classroom teacher to the same students both before and after the six treatment lessons. It was assumed that nothing other than the treatment affected the students' science attitudes. The sixth grade teacher was also careful not to change the normal instruction. Of course, with thirty-three students of similar race, culture and background, the students were not necessarily representative of all students. The lessons were limited to earth science lessons at the sixth grade level as presented by high school students.

PART III

PRESENTATION AND INTERPRETATION

The thirty-four sixth grade students completed the pretest the first week of spring quarter. They participated in six treatment lessons and took the posttest the last week of the spring quarter.

Results of the Data

The pretest and posttest scores, as compared in Table 1, showed a t value of -.22. This finding was not significant at the .05 level of significance. The null hypothesis was accepted.

TABLE 1

GROUP MEANS, AND t VALUES
FOR SIXTH GRADE SCIENCE STUDENTS SCIENCE ATTITUDES
BEFORE AND AFTER ACTIVITY-BASED TREATMENTS

	N	MEAN (5=+,1=-)	STANDARD DEVIATION
Pretest	20	3.39	.54
Posttest	20	3.26	.22

t = -.22
df = 19
t found not significant at the .05 level.

Discussion

There was no significant difference between the pretest and posttest means of the elementary students' attitudes toward science when subjected to activity-based lessons presented by high school science students at the .05 level.

It appeared that this treatment made no difference in the attitudes toward science of these sixth grade students. There was no control group to compare, but the external validity was maintained as the results were not generalized to other settings. The instrument remained the same. Selection was not random and internal validity of history and maturation were not controlled. The attitude, found to be positive toward science both in the pretest and the posttest, may have indicated the treatment was ineffective. The lessons taught before the treatment may have produced the positive attitude. Six treatments of twenty minutes each, given during the last quarter of school, may not have been enough to improve on an already positive program. In agreement with this, Rust (1977) found attitudes were stable over time in the elementary science setting.

The means of the individual survey questions were determined with five being the most positive and one being the least positive in Table 2.

TABLE 2

GROUP MEANS COMPARISON
OF PRETEST AND POSTTEST QUESTIONS

Question	Mean (5=+, 1=-) Pretest	Posttest
1	3.62	3.45
2	4.47	4.33
3	3.68	3.30
4	2.26	2.40
5	3.09	3.06
6	3.21	3.03
7	3.18	3.36
8	4.21	4.06
9	3.26	3.09
10	3.03	2.90
11	3.59	3.50
12	2.76	2.67
13	2.94	3.03
14	3.09	2.76
15	3.94	3.64
16	2.88	2.88
17	4.15	3.88
18	3.62	3.64
19	3.82	3.27
20	3.00	2.94

These results, when coordinated with the questions found in Appendix A, demonstrated some of the areas which may have been affected by minimal control of the internal validity and questionable effectiveness of the treatment. The positive exceptions were questions four, seven, thirteen, and eighteen. These questions dealt with the importance of science, experiments, and the future need for science.

PART IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This study determined that demonstrations and experiments performed by high school science students for elementary students did not have an effect on their attitudes toward science. There was no significant difference between the pretest and posttest means of the elementary students' attitudes toward science when subjected to activity-based lessons presented by high school science students.

This study used a Likert-type scale (shown valid and reliable by Fisher (1977)) to measure the student's science attitudes before and after six weekly treatments of activity-based lessons. The treatments were twenty minutes in length and integrated into a normal sixth grade science class within a rural Midwestern school. The length of treatment and internal validity of this research may have influenced the results.

Conclusions and Recommendations

The results of this study suggested that it was not advantageous to supplement a sixth grade science class with more activity-based lessons. The class already possessed a positive attitude toward science. In this small rural school, the extra activity-based lessons did not make a significant difference in attitudes toward science.

This study would merit repetition with a class which demonstrated a negative attitude toward science. Longer treatment times might also be warranted in future studies. In some schools which have mentor teachers, this treatment might improve equipment distribution and the use of teacher aids.

APPENDIX A

SCIENCE SURVEY

Check appropriate line: Male______ Female______

Please circle the answer that most agrees with how you feel about science. Answer how you feel and not how you think you should feel.

Do not sign your name.

1. Reading science is difficult.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

2. We spend too much time doing experiments.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

3. I am learning a lot about science this year.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

4. What we do in class is what a real scientist would do.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

5. In science class we study "Today's Problems."

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

6. I dislike coming to science class.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

7. I read more science materials than I did in fifth grade.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

8. I enjoy doing the science experiments.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

9. I can solve problems better than before.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

10. My friends enjoy doing science experiements.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

11. What I am learning in science will be useful to me outside school.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

12. I think about things we learn in science class when I'm not in school.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

13. I do not want to take any more science classes than I have to take.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

14. Reading science is more fun than it used to be.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

15. Experiments are hard to understand.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

16. Science is dull for most people.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

17. The things we do in this class are useless.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

18. The kinds of experiments I do in class are important.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

19. I learn a lot from doing my science experiments.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

20. Most people like science classes.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

APPENDIX B

Example of One of the Six Lessons of the Treatment

This lesson was correlated with a sixth grade science course using the book: Science by Modern Curriculum Press, 1987.

Time - 20 minutes

Materials: rock samples: granite, basalt, pumice, shale, limestone, sandstone, conglomerate, slate, mica schist, marble, gneiss, quartzite, and obsidian.

Objectives:

1. The students should be able to distinguish between igneous, metamorphic and sedimentary rocks by general characteristics.
2. The students will touch 13 different rocks of the varying groups and give their obvious characteristics.
3. The students will be given an example of one use man has made of each of the rock samples.

Introduction - (read by the high school students)

A rock is classified by its origin, the size and arrangement of mineral grains, and its composition. Igneous rocks are formed by the cooling and solidification of magma (liquid rock). The minerals and conditions of cooling determine the rock's characteristics. Sedimentary rocks are formed by the cementing or compressing of rock particles. The minerals and conditions of deposition determine the rock's characteristics. Metamorphic rocks are formed from rocks experiencing great amounts of heat, pressure and/or chemical action caused by crustal motion. Please write a characteristic of each rock and guess whether it is igneous, sedimentary or metamorphic rock. At the end we will check to see who gets the most right.

Action -

The high school students then introduce the thirteen rocks. As they distribute them, they give the rock's name and a common use. The thirteen rocks are granite, basalt, pumice, shale, limestone, sandstone, conglomerate, slate, mica schist, marble, gneiss, quartzite and obsidian.

After the rocks are collected, their group is announced and the students are congratulated on the success they've had. The student with the greatest number correct is applauded.

APPENDIX C

Example of One of the Six Lessons of the Treatment

This lesson was correlated with a sixth grade science course using the book: Science by Modern Curriculum Press, 1987.

Time - 20 minutes

Objectives:

1. The students will be able to distinguish between temperature, barometric pressure and humidity.
2. The students will touch and be able to recognize Fahrenheit and Celsius thermometers, a common barometer and humidity gauge.
3. The students will watch the formation of a tornado in a glass container while listening to its causes.

Part 1

Introduction: (read by the high school students)

There are three measurements done with gauges by weathermen. They are temperature, pressure, and humidity. The temperature can be measured by Fahrenheit thermometers (based on the freezing point of seawater) or Celsius thermometers (based on the freezing point of distilled water). Thermometers tell how hot the air is. The pressure, measured by a barometer, tells how heavy the air is. The humidity, measured by a humidity gauge, tells how much moisture is in the air.

Action -

The high school students pass around the room each of the gauges as they discuss them.

Part 2

Introduction - (read by the high school students)

This is a tornado machine. In the atmosphere a tornado forms as a warm front or warm air mass is trapped beneath a much colder air mass. The cold air mass is heavier than the warm air beneath it. The warm air finds an opening or thin spot in the cold air and rises quickly forming a whirlwind or funnel cloud. Winds in a tornado may travel at 200 mph and can do a lot damage. As you can see, this machine forms warm air which rises quickly through cold air making a small funnel cloud as it rises.

Action -

Turn on the machine. While it is running, give the introduction. At the end of the introduction, toss in small bits of paper which will travel up the funnel cloud. Allow the students to give it a try.

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