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AUTHOR Moore, Richard W.
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ABSTRACT

The project described in this report is an attempt to develop scales to assess teachers' attitudes toward teaching elementary school science. The instrument produced, Science Teaching Attitude Scales, consists of six scales, each of which has a statement of the attitude to be assessed and five statements to determine the extent to which the respondent accepts or rejects the particular attitude. With each statement there are four response choices: agree strongly, agree mildly, disagree mildly, and disagree strongly. Construct validity of the instrument was established by a field test with 31 elementary school teachers using a type of time series design. The scales were administered to the participants in the spring of 1971 as a pre-pretest, at the start of a four-week summer session on Science Curriculum Improvement Study (SCIS) materials, and at the end of the summer session as a posttest. Results showed no significant difference between the pre-pretest and pretest total scores. There was a significant increase from pretest to posttest on the total scores, which is interpreted as evidence for construct validity of the scales. (PR)

THE DEVELOPMENT, FIELD TEST AND VALIDATION OF SCALES TO ASSESS TEACHERS' ATTITUDES TOWARD TEACHING ELEMENTARY SCHOOL SCIENCE

Richard W. Moore

Miami University

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INTRODUCTION

With increasing attention being given to teaching science in the elementary school, it seems appropriate that science educators should become concerned with elementary school teachers' attitudes toward science and science teaching. The American Association for the Advancement of Science Commission on Science Education recommends that the pre-service education of elementary school teachers ". . . should develop in teachers an appreciation for the historical, philosophical, and current significance of science to society, and positive attitudes about science . . ."[1]

There is no widely-used instrument available to assess science and science teaching attitudes of elementary school teachers. Studies involving the science attitudes of elementary school teachers have been done.[2,3] There are instruments available which could be used to assess teachers' attitudes toward science, however, no instrument is available to assess teachers' attitudes toward teaching science in the elementary school. Hence, the purpose of this study is to produce Scales to assess teachers' attitudes toward teaching elementary school science.

The Scales developed in this study were developed by the same procedure used to develop an Inventory of science attitudes, the Scientific Attitude Inventory, and are compatible with it.[4] That is, each scale consists of a statement of the attitude to be assessed and five statements to determine the extent to which the respondent accepts or rejects that particular attitude. Further, the respondent is given four response choices: (1) agree strongly, (2) agree mildly, (3) disagree mildly, and (4) disagree strongly. This compatability would allow the researcher to use the Scales developed in this study with selected scales from the Scientific Attitude Inventory to assess the attitudes of elementary school teachers toward science and science

teaching. This compatability also makes it possible for the selected scales to be scored with a Fortran IV computer program prepared by the author.

DEVELOPMENT OF THE SCIENCE TEACHING ATTITUDE SCALES

The first step in the development of Scales to assess attitudes of elementary school teachers toward science teaching is to determine what attitudes should be assessed and to write statements of those attitudes. These statements are called position statements. After the position statements are prepared, statements to be used in assessing the extent to which the respondent accepts or rejects each position must be written. These are called attitude statements. Finally, attitude statements which are most useful in this assessment must be selected from those that were written.

Attitudes to be Assessed

The position statements of the attitudes to be assessed are listed below.

ATTITUDES ASSESSED BY THE

SCIENCE TEACHING ATTITUDE SCALES

Scale

1-P The idea of teaching science is attractive to me; I understand science and I can teach it.

1-N I do not like the thought of teaching science.

2-P There are certain processes in science which children should know, i.e., children should know how to do certain things.

2-N There are certain facts in science that children should know.

3-P Science teaching should be guiding or facilitating of learning. The teacher becomes a resource person.

3-N Science teaching should be a matter of telling children what they are to learn.

The first pair of position statements have to do with whether the elementary school teacher wants to teach science. The 1-P statement is taken to represent a positive position, and the 1-N statement is taken to represent a negative position. This pair of statements could be classified as representing emotional attitudes since they are more likely an emotional reaction than a reaction based upon some knowledge--even though a positive attitude here

may be related to the extent of a teacher's knowledge of science.

The second pair of position statements, 2-P and 2-N, deal with the content of elementary school science. The 2-P statement is taken to represent a positive position since it represents current thinking in science education that certain processes of science should be emphasized. For example, referring to the AAAS program, Gega points out that ". . . . it uses process skills as the base for scope and sequence, and selects subject matter mainly to aid in developing these skills."[5] The 2-N statement is taken to represent a negative position since it indicates that there are <u>certain</u> facts that children must know and this seems to be in opposition to current thinking in science education. Since these statements are related to the thinking of science educators, they could be classified as representing intellectual attitudes.

The third pair of position statements, 3-P and 3-N, deal with the teacher's perception of her role in teaching science. The 3-P statement is taken to represent a positive position, and the 3-N statement is taken to represent a negative position. This classification seems to be consistent with the position of the American Association for

the Advancement of Science Commission on Science Education when it states that, "He [the teacher] acts as a guide to learning rather than simply as a dispenser of information."[6] Since these position statements are related to the thinking of science educators, they could be classified as representing intellectual attitudes.

Item Preparation and Selection

Attitude statements designed to assess the extent to which the respondent accepts or rejects the positions described above were prepared. Eight or nine attitude statements were written for each position statement. The intent of this writing was that if a respondent agrees with the attitude statement, that agreement could be taken as evidence that he assumes the position or attitude stated by the position statement. As the attitude statements were prepared, an effort was made to keep them short and simple.

To select the five best attitude statements to represent each position statement, an initial pool of fifty items was presented to a panel of sixteen judges in a questionnaire and to a group of 105 elementary school teachers.

The judges were shown both the positive and the negative position statements for each set or pair of

position statements and the corresponding subset of attitude statements. The judges were asked to indicate whether a respondent's agreement with an attitude statement could be taken as evidence that he (1) assumed the "P" position, (2) assumed the "N" position, (3) assumed both the "P" and the "N" positions, or (4) cannot be taken as evidence that he assumed either of these positions.

The elementary school teachers were asked to respond to each attitude statement by (1) agreeing strongly, (2) agreeing mildly, (3) disagreeing mildly, or (4) disagreeing strongly.

On the basis of the data obtained from the judges and the teachers, five attitude statements were selected to represent each position statement. The items selected were those which (1) received the greatest support from the judges and (2) were not unanimously endorsed or rejected by the teachers.

FIELD TEST OF THE SCIENCE TEACHING ATTITUDE SCALES

The Scales were field tested to demonstrate their validity and their use. Kerlinger indicates that construct validity may be demonstrated in the following manner:

> One can manipulate communications, for example, in order to change attitudes. If attitude scores change according to theoretical prediction, this would be evidence of the construct validity of the attitude measure, since the scores would probably not change according to the prediction if the measure were not measuring the construct.[7]

The field test involved a group of thirty-one elementary school teachers participating in a Cooperative College-School Science project in Butler County, Ohio. The Scales were administered to the participants in the spring of 1971 as a pre-pre-test, at the start of the four-week summer session as a pre-test, and again at the end of the four-week summer session as a post-test.* This is a type of time-series design in which the hypotheses are:

1. There will be no significant difference between the pre-pre-test and the pre-test total scores on the Science Teaching Attitude Scales, and
2. There will be a significant increase from pre-test to post-test on the total scores on the Science Teaching Attitude Scales.

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*The study actually used an instrument titled, What Is Your Attitude Toward Science and Science Teaching? This instrument combined the six Scales of this study with eight scales from the Scientific Attitude Inventory.

Acceptance of both of these hypotheses would be taken as evidence of the construct validity of the attitude Scales.

The treatment given the participants was not specifically designed to develop the attitudes assessed by these Scales. That is, they were not propagandized in order to produce changes on the attitude Scales. However, the participants did receive intensive preparation for teaching the Science Curriculum Improvement Study materials, and this preparation was consistent with the attitudes assessed by the Scales. Therefore, positive change from pre-test to post-test was expected.

Campbell and Stanley classify the time-series design as a quasi-experimental design. Yet, they have this to say for it:

> The prevalence of this design in the more successful sciences should give us some respect for it . . . . It should also be remembered that, in their use of it, a single experiment is never conclusive . . . If the more advanced sciences use tests of significance less than do psychology and education, it is undoubtedly because the magnitude and the clarity of the effects with which they deal are such as to render tests of significance unnecessary. If our conventional tests of significance were applied, high degrees of significance would be found. It seems typical of the ecology of the social sciences, however, that they must work the low-grade ore in which tests of significance are necessary.[8]

The use of this design in this study gains some credence from the fact that the ore is fairly "high-grade," as can be seen in the results of the field test.

RESULTS OF THE FIELD TEST

The Science Teaching Attitude Scales are scored by giving a respondent three points if he agrees strongly with an attitude statement intended to assess a positive position and zero points if he agrees strongly with an attitude statement intended to assess a negative position. The respondent receives two points if he agrees mildly with a statement intended to assess a positive position, and so on. The sum of the scores on the five attitude statements intended to assess each position is determined. Thus, the maximum score for each scale is fifteen, and the minimum score is zero. The highest possible score for the six scales combined is ninety.

The means for the total score on the six Scales for each administration are presented in Table 1. The mean increased from a pre-pre-test mean of 58.03 to a pre-test mean of 60.14, to a post-test mean of 74.66. To test the significance of the differences among the means, an analysis

TABLE 1

TOTAL SCORE MEANS FOR PRE-PRE-TEST, PRE-TEST AND POST-TEST ADMINISTRATIONS OF SIX SCIENCE TEACHING ATTITUDE SCALES

Mean		
Pre-Pre-Test	Pre-Test	Post-Test
58.03	60.14	74.66

of variance for repeated measures was carried out according to the method described by Winer.[9] The analysis of variance for repeated measures for the total scores on the six Science Teaching Attitude Scales is presented in Table 2. As indicated in Table 2, the F ratio of 113.20 is significant beyond the 0.01 level.

Since a significant F ratio was found in the analysis of variance for repeated measures for the total scores on the six Scales, the same analysis of variance was repeated

ANALYSIS OF VARIANCE FOR PRE-PRE-TEST, PRE-TEST, AND POST-TEST ADMINISTRATIONS OF SIX SCIENCE TEACHING ATTITUDE SCALES

Source of Variation	SS	df	MS	F
Between People	3598.81	30	119.96	
Within People	6427.50	62	103.67	
Treatments	5081.00	2	2540.50	
Residual	1346.50	60	22.44	113.20
Total	10026.31	92		

for each of the scales. Then, in each instance where a significant F ratio was found, the Duncan multiple range test of significance for differences between means was carried out for the pre-pre-test vs pre-test pairs, and the pre-test vs post-test pairs according to the method described by Winer.[10] (The difference between the pre-pre-test and post-test is not of interest to this study.) These tests are summarized in Table 3.

TABLE 3

DUNCAN MULTIPLE RANGE TESTS OF SIGNIFICANCE FOR DIFFERENCES BETWEEN MEANS FOR PRE-PRE-TEST, PRE-TEST, AND POST-TEST ADMINISTRATIONS OF SIX SCIENCE TEACHING ATTITUDE SCALES

Scale	Mean	F ratio	q.01	Differences Between Means
1-P	Pre-Pre-Test = 7.05 Pre-Test = 8.03 Post-Test = 10.84	48.29*	1.05	0.98 2.81*
1-N	Pre-Pre-Test = 11.76 Pre-Test = 12.13 Post-Test = 13.97	12.93*	1.24	0.37 1.84*
2-P	Pre-Pre-Test = 10.92 Pre-Test = 11.22 Post-Test = 11.16	0.22	----	---- ----
2-N	Pre-Pre-Test = 5.35 Pre-Test = 4.97 Post-Test = 11.66	62.09*	1.81	0.33 6.69*
3-P	Pre-Pre-Test = 13.26 Pre-Test = 13.26 Post-Test = 13.52	0.30	----	---- ----
3-N	Pre-Pre-Test = 9.69 Pre-Test = 10.53 Post-Test = 13.52	46.71*	1.09	0.84 2.99*
TOTAL	Pre-Pre-Test = 58.03 Pre-Test = 60.14 Post-Test = 74.66	113.20*	3.19	2.11 14.52*

*Significant beyond the 0.01 level.

As indicated in Table 3, the difference between the pre-pre-test and the pre-test total score means is not significant. On the basis of this evidence, the hypothesis that there will be no significant difference between the pre-pre-test and the pre-test total scores on the Science Teaching Attitude Scales is accepted. Also, as indicated in Table 3, the difference between the pre-test and post-test total score means is significant beyond the 0.01 level. On the basis of this evidence, the hypothesis that there will be a significant increase from pre-test to post-test on the total scores on the Science Teaching Attitude Scales is accepted.

In Table 3, it can be seen that the analysis of variance for repeated measures for the six attitude Scales produced an F ratio which is significant beyond the 0.01 level for four of the six Scales, the 1-P, 1-N, 2-N, and 3-N scales. Application of the Duncan multiple range test of significance for differences between means indicates that the differences between the pre-pre-test and pre-test means are not significant on any of the four scales for which a significant F ratio was obtained. The Duncan multiple range test of significance for differences between means indicates that the difference between the pre-test and

the post-test means are significant beyond the 0.01 level on each of the scales for which a significant F ratio was obtained.

Reliability

The pre-pre-test and pre-test scores were used to estimate the reliability of the total scores on the six scales using the test-retest method described by Winer.[11] The test-retest reliability coefficient obtained by this method is 0.816.

DISCUSSION OF RESULTS AND CONCLUSIONS

Acceptance of the hypothesis that there will be no significant difference between the pre-pre-test and pre-test total scores on the Science Teaching Attitude Scales and acceptance of the hypothesis that there will be a significant increase from pre-test to post-test on the total scores on the Science Teaching Attitude Scales is taken as evidence of the construct validity of the Scales. That four of the six Scales are the main contributors to the construct validity of the group of Scales has been demonstrated by considering the scales individually through a data analysis similar to that used for all the Scales con-

sidered as a group. The question remains as to what, if any, validity may be attributed to the remaining scales, i.e., the 2-P and 3-P scales which did not contribute to the demonstrated validity of the group of Scales in this study. It should be evident that while the validity of these two scales was not demonstrated in this study, one cannot conclude that they have no validity. The data simply indicated that the messages coming through to the teachers were not strong enough to produce measurable changes in these positions with these scales.

It is worth noting that the pre-test mean on the 3-P scale is 13.26 on a 15-point scale, and that is higher than the pre-test mean on any of the other scales. This leads one to wonder whether there is enough room at the top of this scale to allow a significant change to be demonstrated with this particular group. In any event, the positive nature of this group's attitude toward position 3-P has been demonstrated.

It is hoped that researchers will find these Scales useful in assessing teachers' science attitudes in projects similar to the CCSS project in which these Scales were field tested, in methods courses, and in in-service work with elementary school teachers. This study demon-

strates the usefulness of the method used to prepare valid and reliable attitude scales as described in the author's dissertation.[12] If the reader does not find these particular Scales to be useful, perhaps he will be able to develop another set of scales to suit his particular needs. The development of additional scales compatible with those developed in this study would be a welcome addition to the literature of science education. It would allow researchers and instructors greater latitude in selecting scales for use in assessing the extent to which they are able to ". . . develop in teachers an appreciation for the historical, philosophical, and current significance of science to society, and positive attitudes about science. . ."[13]

REFERENCES

1. American Association for the Advancement of Science. Preservice Science Education of Elementary School Teachers. AAAS Miscellaneous Publication 70-5, 1970, p. 14.

2. Schwirian, Patricia M., "Characteristics of Elementary Teacher Trainees," Journal of Research in Science Teaching, 6, 203-213 (1969).

3. Hughes, Earl F., "Role Playing as a Technique for Developing a Scientific Attitude in Elementary Teacher Trainees," Journal of Research in Science Teaching, 8, 113-122 (1971).

4. Moore, Richard W., and Sutman, Frank X., "The Development, Field Test and Validation of an Inventory of Scientific Attitudes," Journal of Research in Science Teaching, 7, 85-94 (1970).

5. Gega, Peter C., Science in Elementary Education. John Wiley and Sons, Inc., New York, 1970, p. 550.

6. Ref. 1, p. 12.

7. Kerlinger, Fred N., Foundations of Behavioral Research. Holt, Rinehart and Winston, Inc., New York, 1964, p. 451.

8. Campbell, Donald T., and Stanley, Julian C., Experimental and Quasi-Experimental Designs for Research. Rand McNally and Co., Chicago, 1963, p. 42.

9. Winer, B.J., Statistical Principles in Experimental Design. McGraw-Hill Book Co., New York, 1962, pp. 105-132.

10. Ref. 9, pp. 77-85.

11. Ref. 9, pp. 124-127.

12. Moore, Richard W., "The Development, Field Test and Validation of the Scientific Attitude Inventory." Unpublished Doctor's dissertation. Philadelphia, Pa.: Temple University, 1969.

13. Ref. 1.