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ABSTRACT

Many feel that emotional intensity or attitude toward science and science teaching influences the teaching of science. As a means for changing attitude toward science and science teaching, preservice science education and inservice science education have been recommended. The purpose of this study was to investigate the effect of a yearlong inservice science workshop on the attitudes of elementary teachers toward science and science teaching. The Science Attitude Scale for In-Service Elementary Teacher II and the participants' written cognitive responses were used to measure attitude change. The study found that the workshop had a significant positive effect on the attitudes of the inservice elementary teachers. Also, it helped in reducing apprehension toward science and improving the participants' attitudes toward using science equipment, doing scientific laboratory work, and discussing science topics. The appendix contains a workshop schedule, directions for developing a unit box activity approach to learning, lesson plan for science experiments/activities, and a listing of the cognitive responses of participants. The paper concludes with suggestions to determine the lasting effect of the workshop. (RT)

Yearlong Inservice Science Workshop:

Its Effect on the Attitudes of Teachers K-7

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Emotional intensity (Shrigley & Koballa, 1984) or attitude toward science and science teaching influences the teaching of science (i.e, whether it is taught and how it is taught) (Blackwood, 1964; Gabel & Rubba, 1979; Harty, Beall, & Lawrence, 1985; Hechling & Oliver, 1983; Riley, 1979; Shrigley, 1974; Shrigley & Johnson, 1974; Thompson & Shrigley, 1986. Both preservice science education (Gabel et al., 1979; Lucas & Dooley, 1982; Shrigley, 1974; Westerback, 1982) and inservice science education (Gabel et al., 1979; Hone & Carswell, 1969; Orlich, 1980; Shrigley, 1983; Shrigley et al., 1974) have been recommended as means for changing attitude toward science and science teaching.

How then is attitude change measured? Attitude scales alone are not sufficient means for measuring attitude changes (Petty, Ostrom, & Brock, 1981; Cacioppo, Harkins, Petty, 1981). Petty et al. (1981) and Cacioppo et al. (1981) have recommended the use of cognitive responses in conjunction with attitude scales. One method of collecting cognitive responses is the written listing technique (Cacioppo, 1981). The written listings of the cognitive responses are classified as (e.g., polarity, origin, and target).

The results of the Carnegie Report on High Schools disclosed that the enrollment of twelfth graders was 37% in chemistry and 22% in physics (Boyer, 1983). Also, he found that often high school students include only two science course, general science and biology. Goodlad (1984) found in his study of schools that students preferred learning activities which engaged them actively and yet they ranked science as fifth of six choices in elementary school and seventh of eight choices in both junior high and senior high school. Johnson and Johnson (1982) reported that approximately half of the nine year olds surveyed in the 1976 National Assessment of Educational Progress indicated excitement about and success in science, but, nevertheless, ranked science as their least preferred subject. Hurd (1982) reported that the number of qualified science teachers has decreased and only one-fifth of high school graduates has completed three years of high school science courses. The source of these results may be that approximately one-third of all students dislike science by third grade and only one-fifth enjoy science by the end of fifth grade (Hurd, 1982). An important underlying factor of these results may be science anxiety (Mallow, 1981a, 1981b), anxiety which emanates from the teacher.

With increased mandated requirements in science for high school graduation, one may conclude that attitudes toward science and science teaching will change. Removal of negative attitudes toward science labeled science anxiety (Mallow, 1981b) cannot be mandated. Gabel et al. (1979) warned that a considerable amount of time is needed for attitudes to change. Koballa and Crawley (1985) have identified parents, teachers, and peers as three social interaction sources which foster students' attitudes toward science. Specifically, they explained that teachers affect students' attitudes toward science by how and how much they teach science. Negative attitudes toward science and science teaching can be changed by fostering positive attitudes in both genders as a result of success in science process skills and manipulation of science equipment from kindergarten through college (Harty et al., 1985; Gabel et al., 1979), in high school and college science courses (Westerback, 1982), in preservice science education courses (Lucas et al., 1982; Riley, 1979; Shrigley, 1974; Westerback, 1982; Westerback, Gonzalez, & Primavera, 1985), and in inservice science education courses (Shrigley, 1974; Shrigley, 1983). Science anxiety has resulted in avoidance of high school and college science courses, scientific illiteracy among the general populace, and few female and minority group science majors (Mallow, 1981b). Mallow (1981b) noted that many elementary teachers are women, but often they do not feel qualified to teach science (Berger, 1982). In their study of students in fourth through ninth grades, Czerniak & Chiarelott (1985) found females to be more anxious about science and that this anxiety had begun as early as fourth grade. Also, they found a significant inverse relationship between science anxiety and science achievement. The results of Willson's meta-analysis study (1983) revealed that in elementary school males have more positive attitudes toward science than females. In a study of inservice elementary teachers, Shrigley et al. (1974) found a significant difference in attitudes toward science in favor of the male teachers.

Also, teachers over 40 years of age and intermediate teachers had more positive attitudes toward science. Mallow (1981b) advised that this learned behavior can be changed.

Gabel et al. (1979) emphasized the importance of developing positive attitudes in preservice and inservice teachers toward science and science teaching who in turn will transfer these positive attitudes to their students. Mallow (1981b) advocated illustrating the similarities and differences between the arts and sciences, teaching students to do science which requires analysis and synthesis, and relaxation/desentization techniques. Barrow, Holden, Bitner, Nichols, and Kane 1986) and Bitner, Nichols, and Kane (1984) have recommended procedural study skills, study arrangements, instructional strategies, active participation in labs, and more role models for female students. These recommendations have application for both preservice and inservice teachers.

For the inservice elementar· teacher, often inservice science workshops are the answer. Hone et al. (1969) have recommended that careful consideration be allotted to the following aspects of the inservice workshop: (a) program, (b) personnel, (c) workshop steering committee, (d) time, and (e) place. The program should involve scientific investigation with science equipment. The personnel should represent all who will be involved, including those who are anxious about science and science teaching. The steering committee should include representatives of the group who act as liaison persons between the consultant and other participants. Koballa et al. (1982) labeled this peer influence. A minimum of three workshops of at least four hours each should be required of all participants. The place should be equipped so that scientific investigations can be conducted safely. Orlich (1980) recommended four essential factors of successful inservice programs. These include awareness, application, implementation, and maintenance.

The purpose of this study was to investigate the effect of a yearlong inservice science workshop, funded by the Education for Economic Security Act Grant, on the attitudes of K-7 teachers toward science and science teaching. Three null hypotheses were tested.

1. The yearlong inservice science workshop does not significantly change the attitudes of K-7 teachers toward science and science teaching.
2. The teachers' age (under or over forty) does not significantly affect their attitudes toward science and science teaching.
3. The grade level of the teachers, either K-3 or 4-7, does not significantly affect their attitudes toward science and science teaching.

Method

Sample

A letter explaining the focus of the yearlong science workshop for inservice elementary teachers was mailed to the superintendents of schools in Pope, Yell, and Conway Counties of Arkansas. The focus of the workshop had been jointly contrived by university professors and public school administrators. The superintendents were requested to disseminate the information to the appropriate teachers. In the selection of the sample, preference was given to Grades 4-6 teachers because of the guidelines of the Education for Economic Security Act Grant. The original sample consisted of 41 teachers (39 females and two males) in grades K-7. Because of scheduling conflicts, workshop requirements, and released time requests, the final sample consisted of 33 teachers (only one male) K-7 (11, K-3 and 22, 4-7) in Pope, Yell, and Conway Counties of Arkansas. There was only one male teacher in the sample (N = 33). Upon successful completion of the workshop, all (N = 33) teachers received reimbursement scholarships, travel expenses, and three graduate semester credit hours. Their school districts also received reimbursement for substitute teachers needed during the teachers' absences due to workshop participation. The only cost to the school districts was a nominal fee of $ 50.00 per teacher. This fee was established as a way of getting some commitment from the school districts.

Instrument

The Science Attitude Scale for In-Service Elementary Teacher II (Shrigley et al., 1974) was administered to the sample during August, 1985 and April, 1986. This twenty-six item Likert-type scale consists of sixteen positive and ten negative statements. Shrigley et al. (1974) found a .92

reliability coefficient alpha and a .94 test-retest reliability correlation coefficient. In addition, above .30 coefficient, the limit for Likert-type scales, was found for the adjusted item-total correlation. The t scores ranged between -8.1 and 10.2.

In addition to the Science Attitude Scale for In-Service Elementary Teacher II, the workshop participants were required to write an evaluation of the yearlong workshop. They were instructed to focus on the strengths and weaknesses of the yearlong workshop.

Treatment

The treatment consisted of both required and optional sessions. One full day and five half days of workshops, plus one all day fieldtrip were required. The full day consisted of six hours; the half day consisted of four hours (Hone et al., 1969). Therefore, the total required workshop and fieldtrip hours were thirty-three and a half hours. Two optional all day Saturday fieldtrips, one on the formation and uses of minerals and rocks and the other on wildlife and the environment, were offered. All participants attended at least one of the optional fieldtrips or eight hours. Therefore, the total engagement time was forty-one and a half hours.

The topics for the yearlong workshop included the science skills objectives for Grades 4 through 6 which consist of process skills and life, physical, and earth sciences. Consequently, the workshops and fieldtrips were conducted by five scientists representing the three branches of science and one female science educator who also served as director of the grant and model teacher (Barrow et al., 1986; Bitner et al., 1984; Mallow, 1981b). The first two workshops focused on scientific reasoning and the structure of science. Prior to the third workshop, teacher representatives from the three counties were invited to participate in a formative evaluation of the progress of the workshop (Hone et al., 1969; Koballa et al., 1982). At this meeting, the teacher representatives and the university professors selected a list of priority objectives from the total list of Grade 4 through 6 science skills objectives. Subsequently, a questionnaire which included the selected science skills objectives was disseminated to each of the participants. The teacher participants were requested to select the ten topics of most interest. The topics receiving the most interest were chosen for the subsequent four workshops and three fieldtrips (see Appendix A). The workshop was scheduled around the school calendars of the teacher participants, the Project Director's and professors' schedules, and the workshop participants' other commitments. In addition to the forty-one and a half hours of workshop and fieldtrip engagement time, the teacher participants worked on individual projects in their classrooms during which they were encouraged to request assistance from any of the university instructional team. This approach was taken as one way of tailoring the workshop format to the individual workshop participants needs (Harty & Enochs, 1985).

A lecture/activity based approach to instruction was implemented. The criteria for presenting an experiment or activity are as follows: safe, feasible, and appropriate for the elementary students. To allay the participants' anxieties about teaching science, the equipment or materials for presentation of the materials had to be either available in their schools or readily attainable through the university. To accommodate the eleven K-3 teachers, the instructors were required to suggest ways in which the activities could be modified to meet the needs of younger children.

Evaluation

Both formative and summative evaluations were conducted. The formative evaluation consisted of informal observations of the teacher participants during workshops and fieldtrips and on follow-up laboratory reports. The teacher participants were required to complete either a Unit Box (see Appendix B) or twenty experiments/activities (ten life science and ten physical science) (see Appendix C) as the summative evaluation.

Data Analysis

Statistical programs from Statistics with Finesse (Bolding, 1985) were used. In addition, Shrigley et al.'s (1984) and Thompson et al.'s (1986) recommendations were considered for interpreting the results of the Likert-type attitude scale, but only Thompson et al.'s (1986) were actually used in the present study.

Thompson et al. (1986) recommended the following guidelines: (a) For Likert-type statements to have evaluative quality, the mean should range between 2.00 and 4.00 with a standard deviation around 1.00. (b) Neutral responses should be below 35% (c) The distribution should not be skewed. Neutral responses beyond 35% indicate vagueness or ambiguity, whereas skewed distributions connote a factual level.

The cognitive responses of the workshop participants on the strengths and weaknesses of the yearlong workshop were categorized by polarity dimensions according to the type of polarity comment (i.e., favorable thoughts, neutral thoughts, and unfavorable thoughts). Cognitive responses which were contrary to the established goals of the yearlong workshop were automatically classified as neutral thoughts. Tallies were completed per cognitive responses and then per type of polarity comment (see Appendix D).

Results

Included in the results section are the item analysis, descriptive statistics, the answers to the three null hypotheses, the item total correlations, the varimax rotation of the principal components factor analysis, and the cognitive responses of the workshop participants regarding the strengths and weaknesses of the yearlong inservice workshop.

Item Analysis and Descriptive Statistics

Neutral responses beyond 35% were found for the following statements: 21, 25, and 26 on the pretest and 6, 10, 13, 24, and 26 on the posttest. Statements which had means and standard deviations outside the recommended range are as follows: 8 and 11 on the pretest and 8, 11, 18, and 22 on the posttest. All other statements seemed to be evaluative in nature.

Insert Table 1 about here

Attitude Changes of K-7 Teachers Toward Science and Science Teaching

Also, contained in Table 1 are the results of the dependent t-test for the individual statements and the pretest and posttest. Significant differences were found for the pretest total (M = 91.30) and the posttest total (M = 94.82), $t(33) = 1.98$, $p < .01$ as well as for statement 22 on the pretest (M = 3.76) and the posttest (M = 4.18), $t(33) = 2.60$, $p < .01$, which dealt with apprehension toward science. In addition, significant differences at $p < .05$ were found for statements 2, 5, 10, and 13.

Item-Total Correlation and Principal Components Varimax Rotation

The range of the item-total correlations on the pretest was between -.10 and .78 with only statements 1 (.20), 3 (.12), 13 (-.10), 15 (.14), and 20 (.13) dropping below .30 as recommended by Shrigley et al. (1974). On the posttest, the item-total correlations ranged between .15 and .72. Statements 4 (.19), 13 (.29), 18 (.43), and 25 (.15) fell below .30.

Insert Tables 2 and 3 about here

The pretest and posttest results of the twenty-six statement Science Attitude Scale for In-Service Elementary Teacher II (Shrigley et al., 1974) were submitted to the principal components factor analysis (Kim & Mueller, 1978) and varimax rotation. Statements were assigned to a factor if the loadings were .60 or higher on the factor and .35 or lower on the other three factors (Thompson et al., 1986). The results of the varimax rotation for the pretest are as follows: Statements 5, 14, 16, 17, 19, 21, 25, and 26 loaded on Factor 1. All of these statements dealt with the teachers' science background and their attitude toward science courses. Only statement 6, which focused on enrolling in a graduate science course, loaded on Factor 2. Statements loading on Factor 3 included 3, 7, and 8, which addressed the teachers' attitude toward science equipment, science workshops, and the difficulty of science. Statements 2 and 24, which centered on discussing science topics and working on science curriculum, loaded on Factor 4.

Insert Table 4 about here

On the varimax rotation for the posttest, only eleven statements met the factor loadings criteria as stated above.

Statements 9, 10, 15, and 23 loaded on Factor 1. Statements 1, 7, and 16 loaded on Factor 2. Statements 5, 21, and 26 loaded on Factor 3. Only statement 4 loaded on Factor 4.

Insert Table 5 about here

One-Way Analysis Variance for Age and Grade Level of Teacher

The pretest and posttest results of the one-way analysis of variance for age, i.e., over forty or under forty, and grade level, i.e., K-3 or 4-7) were not significant. Nevertheless, the K-3 teachers scored higher than the 4-7 teachers on both the pretest and posttest. Although age did not have a significant effect on the attitude changes of these inservice elementary teachers, the mean scores of teachers under forty years of age were higher than the mean scores of teachers over forty years of age on both the pretest and posttest.

Cognitive Responses of Workshop Participants

The cognitive responses of the workshop participants were classified according to polarity dimensions per type of comment (see Appendix D). There were a total of 124 favorable thoughts, 25 neutral thoughts, and 31 unfavorable thoughts. The favorable comments mentioned most frequently pertained to the following: workshop leaders (16), value or worth of workshop (15). fieldtrips (14), hands-on materials (9) and director (9). The duration of the workshop (10) was given most often as the neutral thought. Under unfavorable thoughts, disorganization of the yearlong workshop at the beginning (11) was mentioned most frequently.

Discussion

Unlike the results of a four week NSF science workshop for inservice elementary teachers (Gabel et al., 1979), this yearlong inservice science workshop did have a significant positive effect on the attitudes of the 33 inservice elementary teachers. Perhaps inservice science workshops of less intensity and longer duration can effectuate more attitude change. In addition, the yearlong workshop had a significant positive effect in reducing apprehension toward science and increasing the participants' attitudes toward using science equipment, doing scientific laboratory work, and discussing science topics. The activity based approach to the yearlong workshop was expected to produce these favorable results.

Gender differences could not be investigated in this study since there was only one male in the sample (N = 33) Gender differences in attitude toward science has been found in favor of male elementary students (Czerniak et al., 1985; Willson, 1983) and male inservice elementary teachers (Shrigley et al., 1974). In general, Mallow (1981a, 1981b) found that females were more anxious about science.

In regards to the effect of age, the results of this study and Shrigley et al.'s (1974) differed. Shrigley et al. (1974) found that inservice elementary teachers who were over forty years of age had more favorable attitudes toward science, whereas in this study just the opposite was found.

The results of the polarity dimensions indicated that the workshop participants had the most negative attitudes toward the lack of organization at the beginning of the workshop. When the workshop commenced, it was established that quizzes and tests would be administered. This plan of which the teachers were unaware created such anxiety that it was dropped. Instead of paper-and-pencil tests, the participants were judged on their workshop participation and final project. The duration of the workshop was classified as a neutral thought because the yearlong workshop schedule was implemented to accommodate the school districts, not the director and the other professors. The workshop participants described the workshop instructors very favorably. As suggested by Hone et al. (1969), the director selected the workshop leaders not only on the basis of their scientific expertise but also because of their reputations as effective university professors. A comment closely related to the effectiveness of the workshop leaders is the worth or value of the workshop sessions. The participants commented on the usefulness, the value, the news ideas learned from the workshops, and the practicality of the workshop presentations. These comments were expected since the workshop sessions and fieldtrip were designed for effective coverage of the science skills objectives for Grades 4 through 6 in Arkansas; efficient use of materials, equipment, and the processes of science; and relevancy to the elementary teacher's needs, the content areas of life, physical, and earth sciences, and the science processes. The fieldtrips were great successes. The fieldtrips were used to reinforce and apply scientific concepts, laws, and principles which had been presented during a workshop in the laboratory. As recommended by Orlich (1980), the yearlong workshop had a focus on awareness, application, implementation, and maintenance. Two other areas which received considerable favorable comments from the participants are the hands-on approach and the director's enthusiasm and desire to meet the needs of the elementary teacher. The use of science process skills as recommended by Harty et al. (1985), Gabel et al. (1979), Lucas et al. (1982), Riley (1979), Shrigley (1974), Shrigley (1983), Westerback (1982), and Westerback et al. (1985) was utilized to implement the hands-on approach to elementary science. The female science educator as the workshop director and a workshop presenter seemed to reduce the elementary teachers' science anxiety (Barrow et al., 1986; Bitner et al., 1984; Mallow, 1981a, 1981b). Overall the workshop participants seemed to offer favorable comments regarding the yearlong workshop.

The yearlong inservice science workshop produced positive attitude changes in the 33 inservice elementary teachers. Now, follow-up is needed to determine the lasting effect of this yearlong inservice science workshop.

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Table 1

Means, Standard Deviations, Percent of Neutral Respones, and t-Values for the Twenty-Six Statements

(N = 33)		Pretest		Neutral Responses		Post-test		Neutral Responses		
Statement		*M*	*SD*	*n*	*%*	*M*	*SD*	*n*	*%*	*t*
1.	Demonstrations	3.79	.96	7	21	3.94	.93	3	9	.82
2.	Science topics	3.48	.87	10	30	3.76	.61	5	15	1.79*
3.	Workshop	3.55	.87	8	24	3.45	.97	11	33	-.42
4.	Laboratory	3.97	.88	4	12	4.00	.71	5	15	.23
5.	Background	3.18	1.07	10	30	3.64	1.03	4	12	2.17*
6.	Graduate	3.55	.83	10	30	3.42	.87	15	45	-.64
7.	Equipment	3.73	.88	6	18	3.88	.60	5	15	1.04
8.	Difficult	4.27	.80	1	3	4.36	.65	3	9	.55
9.	Barometer	3.45	1.06	11	33	3.76	.94	4	12	1.47
10.	Consultant	3.79	.74	10	30	3.52	.76	12	36	-2.18*
11.	Difficult	4.33	.65	3	9	4.36	.65	3	9	.27
12.	Equipment	3.64	.78	6	18	3.91	.58	4	12	2.18*
13.	Laboratory	3.00	1.15	9	27	3.45	.97	14	42	1.74*
14.	Science courses	3.91	.77	5	15	3.91	.72	4	12	.00
15.	In-service	3.73	1.01	3	9	3.61	.90	7	21	-.51
16.	Teaching	3.85	.67	7	21	3.76	.75	8	24	-.57
17.	Favorite subject	2.64	.93	7	21	2.64	.90	9	27	.00
18.	Science-boring	3.94	.83	3	9	4.09	.58	4	12	.90
19.	Science teaching	2.42	1.03	6	18	2.45	1.09	8	24	.16
20.	Hamster	3.42	1.12	8	24	3.79	1.08	8	24	1.51
21.	Departmentalized	2.64	1.19	12	38	2.85	1.23	11	33	.89
22.	Apprehensive	3.76	.79	9	27	4.18	.77	1	3	2.60**
23.	S & C	3.79	.96	6	19	3.85	.76	3	9	.36
24.	Curriculum	3.27	.98	11	34	3.15	1.00	15	45	-.57
25.	Improvement	3.45	.87	14	42	3.52	.91	10	30	.29
26.	Team leader	3.24	.83	18	55	3.39	.75	19	53	1.04
	Total	91.30	10.57	--	--	94.82	11.36	--	--	1.98**

*$p < .05$, one-tailed. **$p < .01$, one-tailed.

Table 2

Intercorrelation Matrix for the Twenty-Six Statements on the Pretest

Statements	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1.00												
2	-.02	1.00											
3	.14	.14	1.00										
4	.21	.02	.27	1.00									
5	.19	.20	-.14	.14	1.00								
6	.07	.14	.14	.45	.03	1.00							
7	.26	-.07	.37	.47	.29	.17	1.00						
8	.24	-.15	.41	.19	.23	.05	.60	1.00					
9	-.09	.33	-.24	.11	.23	.21	.04	-.04	1.00				
10	.11	.07	.19	.23	.01	.24	.34	.31	.13	1.00			
11	.22	.20	.11	.13	.54	.12	.33	.54	.18	.28	1.00		
12	.06	.27	.25	.48	.34	.36	.44	.21	.24	.29	.37	1.00	
13	-.06	.25	-.06	.43	-.18	.10	.06	-.44	.23	.11	-.25	.14	1.00
14	.06	.07	.22	.23	.59	.23	.43	.35	.05	.08	.51	.36	-.29
15	.13	.01	-.25	.03	.36	-.26	-.02	-.02	.00	.13	.10	.03	-.11
16	.09	.02	-.07	.15	.43	.21	.30	.14	.28	-.07	.19	.25	-.25
17	.23	.15	.18	.25	.38	.35	.45	.26	.11	.25	.31	.33	-.26
18	.06	-.00	-.17	.04	.19	-.04	.24	.36	-.07	.13	.45	.06	-.30
19	.19	.11	.05	.25	.44	.30	.34	.20	.30	.20	.30	.39	-.24
20	-.03	-.15	-.12	.30	.04	.41	-.10	.24	.07	-.11	-.03	.25	.27
21	.09	.17	-.07	.37	.49	.36	.32	.14	.53	.12	.20	.52	.05
22	.09	.22	-.03	.21	.57	.25	.35	.40	.17	.44	.59	.36	-.24
23	.12	.35	.14	.40	.34	.46	.15	.24	.40	.15	.42	.52	.00
24	.10	.28	.15	.19	.25	.23	.05	-.02	.21	.47	.25	.38	.34
25	.08	.15	-.09	.22	.68	.25	.29	.18	.24	.20	.56	.34	-.19
26	-.09	-.08	-.06	.10	.47	.07	.22	.18	.05	.14	.37	.19	-.26
Pretest	.20	.30	.12	.40	.59	.46	.52	.35	.42	.30	.60	.64	-.10

Table 2 (cont.)

Intercorrelation Matrix for the Twenty-Six Statements on the Pretest

Statements	14	15	16	17	18	19	20	21	22	23	24	25	26
14	1.00												
15	.13	1.00											
16	.40	.17	1.00										
17	.52	.06	.56	1.00									
18	.09	.28	.21	.21	1.00								
19	.45	.05	.46	.79	-.07	1.00							
20	-.17	-.23	.05	-.09	-.07	.11	1.00						
21	.34	.10	.63	.61	.10	.69	.28	1.00					
22	.53	.42	.28	.56	.31	.55	-.09	.50	1.00				
23	.40	.29	.44	.47	.14	.38	.03	.64	.55	1.00			
24	.12	.20	-.13	.04	-.17	.16	.21	.30	.33	.46	1.00		
25	.67	.36	.72	.56	.21	.51	.08	.59	.66	.57	.29	1.00	
26	.58	.16	.58	.52	.34	.42	.19	.56	.52	.34	.11	.75	1.00
Pretest	.68	.14	.64	.68	.30	.65	.13	.75	.67	.69	.32	.78	.60

Table 3

Intercorrelation Matrix for the Twenty-Six Statements on the Post-test

Statements	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1.00												
2	.25	1.00											
3	.20	.30	1.00										
4	.05	-.14	-.18	1.00									
5	.17	.15	-.27	-.04	1.00								
6	.19	.32	.39	.05	.14	1.00							
7	.32	.43	-.17	.00	.33	.28	1.00						
8	-.07	.23	.37	-.07	.39	.38	.12	1.00					
9	.13	.22	.30	-.14	.20	.48	.22	.56	1.00				
10	.00	.21	.27	.29	.05	.23	-.06	.24	.36	1.00			
11	-.12	.07	.27	.07	.34	.27	.12	.78	.40	.50	1.00		
12	.16	.02	.30	.08	.15	.08	.15	.42	.48	.47	.42	1.00	
13	.10	.24	.04	.50	-.02	.25	.15	.08	.02	.10	-.07	.13	1.00
14	.45	.23	.28	.06	.16	.26	.55	.27	.24	.37	.40	.50	.11
15	.23	.39	.64	-.10	.11	.54	.26	.52	.44	.45	.46	.53	.07
16	.47	.28	-.06	.06	.49	.26	.35	.12	.18	.23	.12	.31	.20
17	.42	.23	.02	.35	.33	.25	.50	.07	.12	.18	.23	.12	.31
18	.13	.06	.26	.08	.11	.36	.21	.24	.04	.10	.32	.31	.04
19	.19	.32	-.24	.21	.50	.19	.48	.29	.11	.21	.25	.17	.28
20	.17	-.03	.06	.24	-.16	.23	.25	.07	.13	.29	.16	.32	.33
21	-.04	.12	-.12	.11	.45	.18	.23	.38	.18	.39	.34	.29	.09
22	.06	.16	.26	-.06	.36	.35	.32	.36	.28	.26	.55	.32	.01
23	.12	.32	.35	.12	.09	.20	-.04	.24	.26	.47	.12	.32	.18
24	.14	.37	.15	.18	.30	.32	.29	.39	.41	.43	.34	.35	.22
25	.15	-.11	.05	-.29	.21	.07	-.05	.15	.15	.24	.31	.09	-.13
26	-.10	-.06	.00	.35	.36	.17	.11	.27	.01	.29	.34	.30	.26
Post	.37	.38	.37	.19	.43	.52	.47	.57	.51	.59	.60	.61	.29

Table 3 (cont.)

Intercorrelation Matrix for the Twenty-Six Statements on the Post-test

Statements	14	15	16	17	18	19	20	21	22	23	24	25	26
14	1.00												
15	.57	1.00											
16	.42	.18	1.00										
17	.62	.28	.61	1.00									
18	.32	.43	.27	.25	1.00								
19	.34	.16	.42	.67	.03	1.00							
20	.41	.07	.28	.43	.33	.28	1.00						
21	.30	.31	.33	.35	.06	.63	-.00	1.00					
22	.31	.33	.35	.37	.59	.32	.42	.20	1.00				
23	.20	.55	.10	.10	.03	.13	-.08	.31	-.00	1.00			
24	.32	.52	.22	.17	.30	.34	.09	.58	.37	.40	1.00		
25	.12	.10	.05	.08	.03	-.02	.02	-.01	.04	-.20	-.09	1.00	
26	.13	.10	.29	.41	.20	.40	.18	.58	.42	.05	.38	-.03	1.00
Post	.72	.71	.55	.69	.43	.54	.38	.57	.54	.43	.57	.15	.48

Table 4

Varimax Rotation of the Principal Components Factor Analysis for the Twenty-six Statements on the Pretest

	Factors				
Label	F 1	F 2	F 3	F 4	COMM.
1. Demonstrations	0.07	-0.04	0.38	0.04	0.16
2. Science topics	0.03	-0.00	-0.04	0.60*	0.36
3. Workshop	-0.16	0.18	0.72*	-0.04	0.58
4. Laboratory	0.18	0.52	0.43	0.27	0.57
5. Background	0.68*	-0.23	0.04	0.28	0.60
6. Graduate	0.26	0.60*	0.23	0.20	0.53
7. Equipment	0.31	0.11	0.72*	-0.01	0.64
8. Difficult	0.24	-0.27	0.77*	-0.12	0.73
9. Barometer	0.29	0.23	-0.23	0.47	0.41
10. Consultant	0.01	-0.08	0.50	0.46	0.47
11. Difficult	0.45	-0.33	0.43	0.30	0.59
12. Equipment	0.35	0.34	0.38	0.44	0.57
13. Laboratory	-0.37	0.49	-0.14	0.50	0.46
14. Science courses	0.65*	-0.12	0.35	0.04	0.57
15. In-service	0.25	-0.55	-0.15	0.37	0.52
16. Teaching	0.81*	0.12	-0.06	-0.13	0.69
17. Favorite subject	0.73*	0.12	0.33	-0.01	0.66
18. Science-boring	0.33	-0.42	0.18	-0.07	0.32
19. Science teaching	0.71*	0.21	0.19	0.08	0.59
20. Hamster	0.12	0.64*	-0.20	0.04	0.46
21. Departmentalized	0.76	0.37	-0.00	0.29	0.81
22. Apprehensive	0.63	-0.28	0.30	0.42	0.75
23. S & C	0.54	0.12	0.17	0.54	0.63
24. Curriculum	0.03	0.09	0.13	0.79*	0.66
25. Improvement	0.86*	-0.10	0.04	0.27	0.82
26. Team leader	0.80*	-0.07	0.00	-0.05	0.64
Eigen Values	6.25	2.57	3.18	2.96	14.96

* .60 loadings or higher and .35 or lower on the other three factors

WORKSHOP SCHEDULE

PhySc 6883

8-28-85	Scientific Reasoning and the Structure of Science (Betty L. Bitner, Glyn Turnipseed, and James Willcutt) Dardanelle High School, 10-12 a.m., 1-5 p.m.
9-27-86	Scientific Reasoning and the Fundamentals of Chemistry (Betty L. Bitner and Leo Bowman) McEver Hall, Arkansas Tech University 7:30-11:30
10-15-85	Formative evaluation of the workshop Selected teacher representatives and professors McEver Hall, Arkansas Tech University 3:30-5:30 p.m.
11-21-85	Rocks and Minerals (Betty L. Bitner) McEver Hall, Arkansas Tech University 12:30-4:30 p.m.
1-23-86	Where do you live, how do you fit, and why? (Environment, Plants, Natural Resources, & Water Cycle) (Glyn Turnipseed) McEver Hall, Arkansas Tech University 12:30-4:30 p.m.
2-07-86	8:00-10:00 a.m.--What Research Says to the Elementary teacher? (Betty L. Bitner) 10:00-3:30 p.m.--Field Experience to apply information on Where you live, how do you fit, and why? (Glyn Turnipseed)
3-08-86	Geology Fieldtrip (Victor Vere) 8:00-4:00 p.m.
3-13-86	McEver Hall, Arkansas Tech University Weather and the Universe (Don Rickard) 12:30-4:30 p.m
3-15-86	Holla Bend Wildlife Refuge Fieldtrip (Glyn Turnipseed) 8:00-4:00 p.m.
4-17-86	McEver Hall, Arkansas Tech University Energy and Heat (James Willcutt) 12:00-4:30 p.m.

Grading Procedure:

1. 1/2 workshop participation and laboratory reports
2. 1/2 Unit Box or 20 experiments or activities (10 life and 10 physical)

PhySc 6833
Betty L. Bitner

N. B.: The lesson plans, references, letter to the parent, description of the unit box, and the background information for the teachers must be typed.

UNIT BOX APPROACH TO LEARNING

One of the course requirements is the development of a stand alone instructional unit for elementary school science. This Unit Box should represent an activity approach to teaching/learning. The purpose of your Unit Box is to have the students (1) utilize the processes of science, (2) improve their thinking skills, and (3) increase their scientific literacy. Since many of the students with whom you will be working will be at the Piagetian concrete operational level of reasoning, the manipulative orientation to learning is essential. Therefore, the activities in your Unit Box should allow the students to interact with and act upon real objects, i.e., persons, places, and things, as they solve real scientific problems.

These directions are modeled after the concept of Unit Boxes of Mitch Batoff and Lloyd Barrow. Batoff and Barrow have published several articles on Unit Boxes. Some of the better sources are as follows:

School Science and Mathematics (1974, December), 74, 667-679.
Educational Technology (1975, May), 15, 9-17.
Science and Children (1974, November), 12, 7-8.
Current/The Journal of Marine Education (1983, Winter), 4, 10-11.

The following is a list of sources other than those by Barrow and Batoff:

Science and Children (1982), 20(1), 18-20.
Science and Children (1984), 21(6), 15-16.

Your unit box will consist of the following integrated components:

1. Description of the Unit Box: title, grade level, brief description of each lesson, etc.
2. Background Information for the Teacher
3. Lesson Plans (8-10): behavioral objectives, set, data-gathering techniques, data-processing techniques, closure, evaluation techniques, content outline, and list of materials and/or resources
4. One or more related teachers' guides (SAVI/SELPH Modules, SCIS, SAPA, ESS, textbooks, etc.)
5. Manipulative materials for each child or group of children

6. A letter to the parent(s)/guardians to the introduce the unit: An excellent source is Beisenberz, Paul (1980). Getting parents involved: Mission impossible? Science and Children, 17(15), 9-11.
7. References: Use APA style (textbooks, trade books, etc.)
8. A set of record sheets or worksheets for the students
*9. A tape cassette, associated worksheets, and manipulative materials
*10. A set of overhead transparencies
*11. Trade or library books for pupils (three or more with readability levels for each): The article Integrating science activities through literature webs. (1982). School Science and Mathematics, 82(1), 65-70 describes a method for incorporating trade books into science. Another source is Behold the world! Using science trade books in the classroom (1982), Science and Children, 19(6), 5-6. Use the readability software program in the Computer Lab to complete the readability.
*12. Provide names, addresses, title, telephone numbers, and other pertinent information regarding potential sources of fieldtrip(s), resource speakers and/or audio-visual materials.
*13. A set of vocabulary cards and a vocabulary game
14. Detailed bulletin board plans (two copies)
15. Task cards for poor readers (at least three different cards): A source which will help you is Zinzt, M. L., & Maggart, Z. R. (1984). The reading process: The teacher and the learner, 4th edition. Brown Publishers.
16. A large sturdy box, smaller containers, and a file, all labeled and organized for containing all of the above items (The boxes should be motivational in design.)

* optional items, but essential for a grade of A

N. B.: A copy of the Unit Box topic, the target grade level, and the general goal of the Unit Box should be submitted to me by **February 3, 1986.**

Your Unit Box should contain **all** necessary materials for approximately eight to ten lessons. Each of the above sixteen items will be evaluated on the basis of their **thoroughness and appropriateness** for the target grade level of the activities. Your Unit Box will be due no later than **May 1, 1986.**

SCIENCE EXPERIMENTS/ACTIVITIES

Grades 4-6

SUBJECT: TIME NEEDED:

SKILL NUMBER & SKILL:

MATERIALS:

SKETCH OF EXPERIMENT:

PROCEDURE:

Step 1:

Step 2:

Step 3:

Step 4:

OBSERVATIONS & EXPECTATIONS:

POSSIBLE PROBLEMS:

SOURCE:

TEXTBOOK CORRELATION:

Cognitive Responses of the Sample (N = 33)

Polarity Dimensıons: The number following the statement represents the number of participants who wrote the particular comment.

Favorable thoughts: (124)

1. Workshop leaders: genuinely interested in giving us useful knowledge, sensitive to our needs, professional in the presentations, enthusiastic, good delivery, excellent scientific background, and well prepared (16)
2. Workshop sessions: worthwhile, valuable, useful, new ideas about how to teach science, and practical (15)
3. Fieldtrips: ideas for my class, educational, and fun (14)
4. Hands-on materials: most functional and exciting (9)
5. Workshop dırector: planning and effort, flexibility, met needs of teachers, scheduled workshops around teachers' schedules, and enthusiasm (9)
6. Experiments: useful in generating learning in her students, especially The Glob (7)
7. Sparked interest to teach science (4)
8. Gave me self-confıdence to teach science (4)
9. Provided opportunity to share ideas with fellow teachers and work with other teachers on experiments (3)
10. Interesting and refreshing (3)
11. Would recommend this workshop to any teacher (3)
12. Informative and enjoyable ((3)
13. Final project met individual teacher's needs (3)
14. Released time to attend workshops (2)
15. Balanced treatment of life, earth, and physical sciences (2)
16. Lectures: interesting and informative (2)
17. Time span of workshop: time to read, experiment, and reinforce learnings; assimilate each topic; and extend each activity (2)
18. Handouts (2)
19. Final project will aid in evaluating textbooks (1)
20. Tuition paid (1)
21. Rock collections (1)
22. Hints for chemistry units (1)
23. Rock unit plans: easy to implement (1)
24. Will incorporate chemical experiments into unit next year (1)
25. Concepts sequentially developed (1)
26. Children and adults learn best with hands-on experiences. (1)
27. Unit Box: a terrific idea (1)
28. Required assignment: activities/experiments correlated with the state course guidelines (1)

29. Would enroll in a similar course again (1)
30. Formative evaluation of the workshop progress with input from workshop participants (1)
31. Option in final project--experiments or Unit Box (1)
32. Concluded science should be not only knowledge but also experimenting and discovering new things in our environment. (1)
33. Schedule of workshops were announced far in advance. (1)
34. Half-day workshops (1)
35. Wants more hands-on experience (1)
36. Stimulated me to arouse students' interest and curiosity about science, to motivate them to respond by research and experimentation, and to encourage students to develop scientific thinking based on logical and critical procedures (1)
37. Influenced me to be a better teacher (1)
38. Appreciated instructors who allowed time for application of the scientific concepts and principles. (1)
39. Resource materials and resource people (1)

Neutral Thoughts: (25)

1. Duration of the workshop: should have been only one semester not two semesters (10)
2. Lessons were hard for lower grade children, but it made me think of some things I can do with my second graders (2)
3. Materials geared to intermediate grades (2)
4. Wanted workshop to help correlate basal texts to basic skills objectives in science (2)
5. Instructions for unit box interpretable several ways (1)
6. Desired to receive lecture notes prior to workshop (1)
7. Plan another workshop specifically for Grades K-3 and 4-6 (1)
8. Follow-up sessions immediately following fieldtrips (1)
9. More manipulatives ready for use in the classroom (1)
10. Projects: time-consuming (1)
11. More resource materials (1)
12. Present workshops in elementary classrooms (1)
13. Thought we'd use our science textbooks (1)

Unfavorable Thoughts: (31)

1. Disorganization at the beginning (11)
2. Missed too much school because of workshops (2)
3. Ignorance and unwillingness to learn on part of some colleagues (2)
4. Equipment used in some experiments not available in elementary schools. (2)
5. Confusion over lab report format (1)

6. No time for teacher interaction (1)
7. Poor attitude of some colleagues (1)
8. Didn't receive as many materials as expected (1)
9. Was content vs. education oriented (1)
10. At beginning not released in time to eat lunch before workshop session (1)
11. One professor talked down to the teachers and whistled to get our attention. (1)
12. Large amount of material covered during the first workshops (1)
13. Fieldtrip during inclement weather (1)
14. Make fieldtrips half day rather than whole day (1)
15. No need to do end project
16. Anxious at the beginning of the course (1)
17. The sessions without teacher (student) involvement (1)
18. Some instructors didn't understand the restraints of the elementary teacher. (1)

Southwest Missouri State
UNIVERSITY

Elementary and Secondary Education
(417) 836-5795

June 21, 1988

Ms. Rita Kundle
ERIC-SMEAC
1200 Chambers Rd.
Columbus, OH 43212

Dear Ms. Kundle:

If the attached two papers are accepted for publication, I am authorizing you to change my name on the attached two papers to Betty L. Bitner-Corvin.

I do appreciate your kindness in this matter.

Sincerely yours,

Betty L. Bitner-Corvin

Betty L. Bitner-Corvin, Ed.D.
(417) 836-5137 or 5795

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Springfield, Missouri 65804-0095