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ABSTRACT

The purpose of this causal-comparative study was to compare attitudes that male and female preservice elementary science methods teachers have toward science and science teaching. The stratified random sample (n=80) was drawn from the population of preservice elementary teachers enrolled in an elementary science methods course during fall 1990, spring 1991, and summer 1991. The sample was homogeneous in American College Test (ACT) and College Basic Academic Subjects (C-BASE) test scores. The Science Attitude Scale for Preservice Elementary Teachers-Revised was administered to the population during the first week of classes. The independent t-tests for the total attitude scale, subscale for positive statements, and subscales for negative statements indicated no significant gender differences (p .01). The rationale for no gender differences includes the homogeneity of the sample on ACT and C-BASE tests, the hands-on approach to learning stressed in the teacher education program, and the constructivist process used in several courses designed for the elementary teacher. (Author)

GENDER COMPARISONS: ATTITUDES OF PRESERVICE ELEMENTARY SCIENCE METHODS TEACHERS TOWARD SCIENCE AND SCIENCE TEACHING

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Abstract

The purpose of this causal-comparative study was to compare attitudes that male and female preservice elementary science methods teachers have toward science and science teaching. The stratified random sample ($N = 80$) was drawn from the population of preservice elementary teachers enrolled in an elementary science methods during Fall 1990, Spring 1991, and Summer 1991. The sample was homogeneous in ACT and C-BASE test scores. The Science Attitude Scale for Preservice Elementary Teachers-Revised was administered to the population during the first week of classes. The independent t-tests for the total attitude scale, subscale for positive statements, and subscales for negative statements indicated no significant gender differences ($p < .01$). The rationale for no gender differences includes the homogeneity of the sample on ACT and C-BASE tests, the hands-on approach to learning stressed in the Teacher Education Program, and the constructivist process used in several courses designed for the elementary teacher.

Purposes of the Study

In this causal-comparative study, the attitudes of male and female preservice elementary science methods teachers toward science and science teaching were compared. Also investigated were differences in ACT composite, ACT Science sub-test, C-BASE composite, and C-BASE Science sub-test.

Significance of the Study

Boyer (1983), Hurd (1982), and Mallow (1981b) reported a decline in high school science enrollment, especially in the physical sciences. A preponderance of elementary teachers are women (Mallow, 1981b); however, many of them consider themselves unqualified to teach science (Berger, 1982). Harty and Enochs (1985) reported that

approximately one-third of all students dislike science by the end of third grade and only one-fifth enjoy science by the end of fifth grade. A probable underlying factor of these results is science anxiety or negative attitudes toward science (Mallow, 1981a, 1981b). Attitude, labeled emotional intensity (Shrigley & Koballa, 1984), toward science and science teaching affects whether science is taught, how it is taught, and how much it is taught (Gabel & Rubba, 1979; Harty, Beall, & Scharmann, 1985; Koballa & Crawley, 1985; Mechling & Oliver, 1985; Riley, 1979; Shrigley, 1974; Shrigley & Johnson, 1974; Thompson & Shrigley, 1986). "Attitudes and behavior are correlates" (Shrigley, 1990, p. 97).

History indicates that science is "a male profession" (Rossiter, 1982, p. 74), and recent studies today also reveal male attitudes toward science and science teaching to be somewhat more favorable. Czerniak & Chiarelott (1985) found females in grades four through nine to be more anxious about science, but Willson's meta-analysis findings (1983) indicated that males in the elementary school have more positive attitudes toward science than females. Findings by Shrigley and Johnson (1974) reveal differences in attitude between teachers. They reported that male inservice teachers, teachers over 40 years of age, and intermediate level teachers had more positive attitudes toward science and science teaching.

With a need for more positive attitudes toward science, recommendations for improving attitudes toward science and science teaching have been made. Recommendations have been reported in the studies conducted by Barrow, Holden, Bitner, and Kane (1986); Bitner (1987, 1990); Bitner, Nichols, and Kane (1984); Gabel and Rubba (1979); Hone and Carswell (1969); Koballa and Crawley (1985); Lucas and Dooley (1982); Orlich (1980); Shrigley (1974); Shrigley (1983); Shrigley and Johnson (1974); Stefanich and Kelsey (1989); and Westerback (1982).

Design and Procedures

Design

In this causal-comparative study, gender differences in attitudes toward science and science teaching were investigated. Also differences in critical variables (i.e., ACT composite, ACT Science, C-BASE composite, and C-BASE Science) were analyzed.

Sample

The population for this causal-comparative study consisted of preservice elementary teachers enrolled in "Teaching Science in the Elementary School" during the Fall 1990, Spring 1991, and Summer 1991 semesters at in a midwestern university with a student enrollment of approximately 20,000. This university certified more teachers during 1989-1990 than any other institution in the State. The Teacher Education Program has an enrollment of approximately 2,500. Of those, approximately 1,200 are elementary education majors. For admittance into the Teacher Education Program, students must have completed 45 credit hours with a GPA of 2.4, an American College Test (ACT) composite of 20, and a College Basic Academic Subjects (C-BASE) composite of 235. In the science area, elementary education majors are required to complete the elementary science methods course plus three science courses.

The stratified random sample (N = 80) of male and female preservice elementary teachers was drawn from the population of preservice elementary teachers who completed the Science Attitude Scale-Revised (Johnson & Shrigley, 1986). The mean age for the males was 24.47 (SD = 5.21, range = 21 - 39). The average age for the females was 23.80 (SD = 4.88, range = 20 - 40). For males, the mean and range of credit hours in earth, physical, biological sciences, and total science hours were (a) 3.33, 0 - 14; (b) 4.73, 0 - 32; (c) 5.15, 0 - 47; and (d) 13.10, 5 - 83, respectively. Seventy-four percent had completed 5 -12 credit hours; 21% had completed 13-22 credit hours; 2% had completed more than 22 credit hours. The mean and range of credit hours in earth, physical, and biological sciences as well as the total for the females were (a) 2.85, 0- 14; (b) 3.95, 0 - 9; (c) 4.80, 4 - 17; and (d) 11.60, 6 - 30, respectively. Seventy-eight percent had completed 6 - 12 credit hours; 8% had completed 14 - 22; 8% had completed more than 22 credit hours. The mean GPA for the males was 3.34 (SD = .38). The mean GPA for the females was 3.49 (SD = .44). The mean grade in the science methods for the males was 3.41 (SD = .64). The average grade for the females was 3.59 (SD = .55).

Instrumentation

Prior to admittance to the Teacher Education Program, the preservice elementary teachers had taken the ACT and C-BASE. During the first week of classes, the Science Attitude Scale for Preservice Teachers (Thompson & Shrigley, 1986) was administered to the population of students enrolled in the elementary science methods course during the 1991 Fall, 1991 Spring, and 1991 Summer semesters.

Because the ACT is a widely used and accepted test for college entrance, the validity and reliability of the instrument will not be discussed. The mean is 20 with a standard deviation of six.

C-BASE, a criterion-referenced test, measures knowledge and skills in four academic areas, i.e., English, mathematics, science, and social studies (Osterlind & Mertz, 1990). It is used to assess the knowledge and competencies in the four academic areas covered in the general education component of an undergraduate degree program. For information regarding the validity and reliability, refer to Osterlind and Mertz (1990).

The Science Attitude Scale consists of 22 attitude statements (12 positive and 10 negative). The factor analysis of the revised 22 statement attitude scale revealed four subscales: (a) comfort-discomfort (1, 3, 6, 7, 9, 11, 14, 18, and 19); (b) need (2, 8, 15, 21, and 22); (c) time (4, 13, and 20); and (d) equipment (5, 10, 12, 16, and 17). The mean and standard deviations of each subscale were: (a) comfort-discomfort (M = 30.9, SD = 5.9); (b) need (M = 18.8, SD = 3.2); (c) time (M = 11.2, SD = 6.4); and (d) equipment (M = 17.0, SD = 3.3). They reported a coefficient alpha of 0.89 for the Science Attitude Scale, 0.85 for the subscale of positive statements, and 0.75 for the subscale of negative statements. Convergent and divergent validities were established. The majority of the interitem correlations among the 22 statements were positive. The means on the 22 statements were positive. The means on the 22 statements ranged from 2.63 (statement 18) to 4.59 (statement 21).

Statistical Analysis of Data Procedures

Thompson and Shrigley (1986) advised that for a Likert-type attitude scale to be evaluative in nature it should have (a) a mean between 2.00 and 4.00 with a standard

deviation hovering around 1.00; (b) neutral responses below 35%; and (c) non-skewed distribution. Neutral statements beyond 35% connote vagueness or ambiguity; skewed distributions imply a factual level. For the 12 positive statements (i.e., 2, 5, 7, 8, 10, 12, 13, 15, 16, 18, 19, and 22), the ratings ranged from strongly agree (5) to strongly disagree (1). The reverse ratings, strongly agree (1) to strongly disagree (5), were used for the ten statement (i.e., 1, 3, 4, 6, 9, 11, 14, 17, 20, and 21), reflecting negative attitudes toward science and science teaching.

Frequency and independent t-test programs (SPSS, 1990) were used to analyze the data. Means, standard deviations, and neutral responses were computed on the Science Attitude Scale. Independent t-tests were used to analyze gender differences in attitudes toward science and science teaching as well as gender differences in ACT and C-BASE scores.

Results

Results of Independent T-Tests: ACT Composite, ACT Science, C-BASE Composite, and C-BASE Science

Significant differences in ACT composite, ACT Science, C-BASE composite, and C-BASE Science between the genders were not found. The means and standard deviations on the ACT were 22.65, 2.20 (males) and 22.63, 3.02 (females). The means and standard deviations on the ACT Science were 23.48, 3.48 (males) and 22.70, 4.61 (females). On the C-BASE, the means and standard deviations were 322.60, 45.05 (males) and 316.70, 43.05.74 (females). On the C-BASE Science, the means and standard deviations were 322.78, 52.96 (males) and 326.80, 55.74 (females).

Means, Standard Deviations, and Percent of Neutral Responses on Science Attitude Scale

In Table I are reported the means, standard deviations, and percent of neutral responses on the Science Attitude Scale. The mean for the positive statements was 46.90 (SD = 10.27), with a possible range from most positive (60) to least positive (12). The means for the positive statements for the males ranged from 2.90 (item 18, science preferred subject to teach) to 4.43 (item 2, importance of teaching science processes), with a mean total of 46.80 (SD = 4.71). The means for the positive statements for

females ranged from 3.13 (item 18, preferred subject to teach) to 4.50 (item 2, importance of teaching science process), with a mean total of 47.00 (SD = 6.31). A rating of five is most positive; a rating of one is least positive. Neutral responses exceeding 35% for the positive statements included 7, and 18 (males) and 7 (females). Positive statements with means greater than 4.00 included 2 (importance of process), 5 (enjoy lab period I teach), 15 (science as important as the 3 R's), and 19 (excite students about science) for both genders; 22 (integrate science into other areas) for males; and 13 (willing to spend time setting up equipment for a lab) for females. The mean (SD = 5.46) for the negative statements was 37.86 with the range from least negative (50) to most negative (10). The means for the negative statements for males ranged from 2.63 (item 14, afraid students will ask question cannot answer) to 4.48 (item 21, children not curious about scientific matters). For the females, the negative statements ranged from 3.18 (item 17, fear science experiments won't work) to 4.53 (item 20, teaching science takes too much time; item 21, children not curious about scientific matters). A rating of five is least negative; a rating of one is most negative.

Results of the Independent T-Tests: Attitude Scale

The independent t-tests for the total attitude scale, positive statement subscale, negative statement subscale were not significant at the .01 level (see Table I). The standard deviations for the subscales and total attitude scales of the females were larger than that of the males.

Conclusions

Contrary to the related research findings that males have more favorable attitudes toward science and science teaching reviewed for this study, this researcher after eight years of informal observation of preservice elementary teachers questioned these findings. This doubt was the impetus for the present study.

Significant gender differences ($p < .01$) in aptitude, achievement, and attitudes were not found. The ACT composite, ACT Science sub-test, C-BASE composite, C-BASE Science sub-test scores were very similar for the genders. The variance in means on the Science Attitude Scale, subscales, and individual statements for the genders was small.

In an attempt to explain these findings, the scores on the prerequisite tests (ACT and C-BASE), the age of the subjects, the nature of the Teacher Education Program for preservice elementary teachers, and the constructivist process used in several science courses designed for the elementary teacher at this university will be discussed. The scores on the ACT composite, ACT Science sub-test, C-BASE composite, and C-BASE Science sub-test indicated homogeneity on these critical variables.

The mean age was 24. Fifty-one percent of the sample was 25 - 40 years old. Fourteen percent was 30 or older. Less than 1% was younger than 24.

The curricula in the Teacher Education Program for preservice elementary teachers emphasizes hands-on experiences, the developmental approach to learning, integration of the disciplines, and reflective decision-making. In particular, those students with an emphasis in Early Childhood appreciate the need for hands-on activities. In the Language Arts Methods course, the use of tradebooks is stressed as a means for integrating the disciplines.

At least two professors who teach science courses for the preservice elementary teacher utilize the constructivist process. My informal assessment of those preservice elementary teachers who have completed courses where the constructivist process is used was that their attitudes toward science and science teaching are positive. The results of the present study seem to support this.

The congruence in focus between the Teacher Education Program and the identified science courses seems to be at the heart of these findings. If the explanations for the present findings have merit, then would preservice elementary teachers have even more positive attitudes toward science and science teaching if all their science courses were taught using the constructivist process?

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TABLE I

Means, Standard Deviations, Neutral Responses, and t-values (N=80)

	Male (n = 40)		Neutral Responses		Female (n = 40)		Neutral Responses		
STATEMENT	M	SD	f	%	M	SD	f	%	t-value
1. Uncomfortable	3.68	0.92	7	17	3.48	1.09	9	22	.89
2. Processes	4.43	0.75	0	0	4.50	.93	0	0	-.40
3. Fear	3.70	0.79	8	20	3.45	1.15	4	10	1.13
4. Time	4.35	0.58	2	5	4.28	.82	3	7	.47
5. Lab	4.23	0.70	6	15	4.30	.85	4	10	-.43
6. Difficult	3.75	0.87	3	7	3.83	.96	1	2	-.37
7. Content	3.20	0.88	17	42	3.33	.94	16	40	-.61
8. Experimental	3.70	0.85	4	10	3.85	.77	9	22	-.83
9. Dread	4.23	0.62	4	10	4.15	.86	0	0	.45
10. Phenomena	3.90	0.74	7	17	3.83	.84	9	22	.42
11. Forward	3.83	0.96	6	15	3.93	1.00	3	7	-.46
12. Construct	3.95	0.64	3	7	3.85	.92	5	13	.56
13. Equipment	3.98	0.53	3	7	4.18	.59	1	2	-1.59
14. Questions	2.63	1.00	7	17	3.55	.96	4	10	-.52
15. Important	4.28	0.64	1	2	4.15	.80	4	10	.77
16. Manipulating	3.70	0.76	7	17	3.55	.96	3	10	.78
17. Expected	3.18	0.96	9	52	3.18	.98	10	25	.00
18. Preferred	2.90	0.98	11	70	3.13	1.24	9	22	-.90
19. Excite	4.50	0.51	0	0	4.40	.50	0	0	.89
20. Effort	4.15	0.58	1	2	4.53	.78	2	5	.58
21. Curious	4.48	0.55	1	2	4.53	.78	2	5	-.33
22. Integrate	4.05	0.78	5	15	3.95	.71	8	20	.60
Positive Statements	46.80	4.71			47.00	6.31			-.16
Negative Statements	37.95	4.81			37.78	6.10			.14
Total Attitude	84.75	8.72			84.78	11.65			-.01

Note. Positive statements include 2, 5, 7, 8, 10, 12, 13, 15, 16, 18, 19 and 22. The ratings for these statements are SA = 5, A = 4, N = 3, D = 2, SD = 1.

Note. Negative statements include 1, 3, 4, 6, 9, 11, 14, 17, 20, and 21. The reversed ratings for these are SA = 1, A = 2, N = 3, D = 4, SD = 5.

Note. The t-values were not significant at .01.