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Elementary Teachers' Concerns About Teaching Science Using The Hands-On Method

Michael A. Foyt
University of Nebraska at Omaha

Elementary Teachers' Concerns About Teaching Science Using The Hands-On Method

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Michael A. Foyt

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Dedication

To the memory of my son Alec.

To my son Matt and my wife Merry
for keeping the special memories coming.

Field Project Acceptance

Accepted for the faculty of the Graduate College, University of Nebraska, in partial fulfillment of the requirements for the degree Specialist in Education, University of Nebraska at Omaha.

Committee

Blaine E. Ward
Name

Ed Admin.
Department

John D. Langan
Name

T.E.D.
Department

Thomas Petrie
Chairman

Nov 20 1991
Date

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Introduction

As we move into the 90's, recent studies have made it very clear that the United States is falling behind both national standards and international norms in the effort to makes its youth literate in science. When viewing studies that compare our students internationally, we rank near the bottom in science (Project 2061, 1989).

Very few elementary teachers have an adequate science background (Stefanich & Kelsey, 1989). As a consequence, elementary science teachers teach science infrequently and often emphasize the memorization of answers rather than learning exploration skills. This type of instruction and over dependence on textbooks can actually impede scientific literacy (Project 2061, 1989).

Examining the educational preparation of elementary science teachers gives a clue as to why there is the infrequent offering of science in the classroom and the little use of hands-on materials. About ten percent of elementary teachers have no college-level science content courses, and about twenty percent have had no science method courses. Furthermore, the majority of elementary school teachers have never been involved in any science inservice programs (Manning, 1981).

If elementary teachers are to adequately teach science, it is necessary to provide teachers with a hands-on background in science so they can teach the subject successfully. Science is best learned from a hands-on approach. Yet research shows time and time again that there is little hands-on teaching going on in most elementary classrooms (Pettus, 1983). On the other hand, elementary teachers that are adequately trained in science use more hands-on materials and spend more time on the subject (Stefanich & Kelsey, 1989). In spite of the need for science, less time is spent on science than any other major curricular area in elementary classrooms. It is conjectured that teachers do not feel sufficiently trained in the subject (Tilgner, 1990). When elementary school teachers have sufficient training in science they have positive attitudes toward science and science teaching (Pettus, 1983).

Elementary science teachers who have participated in activity oriented undergraduate science classes have better attitudes about science than those teachers who have not. Teacher attitude has a significant effect on the learning of science in a teacher's classroom (Simpson & Oliver, 1990). Their students have better attitudes and superior achievement scores in science.

Process skills and hands-on methods of science teaching are now being emphasized in the majority of the science methods courses at teacher training colleges. As a result, more recent teacher graduates are better acquainted with science instruction, and their students should be more literate in science. However, this preparation is not sufficient without further support by way of inservice or other forms of ongoing training (Tolman & Campbell, 1989).

In addition to better science instruction, teachers with a positive attitude toward science spend more time teaching the subject. Science class is thought of as a core subject by those elementary science teachers who possess positive feelings about science (Tilgner, 1990).

It is conjectured that when teachers have more background in science they feel more confident when teaching the subject. The additional knowledge makes these teachers better equipped to teach science and additional support, such as ongoing inservice, helps to ensure that the superior classroom instruction will continue (Tolman & Campbell, 1989).

As we move into the 1990's, citizens need to be better educated in science to become scientifically literate. Therefore, elementary teachers need the background in science that will allow them a favorable attitude to instruct science. For students need to be scientifically literate in a society that is increasingly technological.

<u>Problem Statement</u>

The Millard Public School District administrative staff is committed to the goal of science literacy. Toward this end, effective science teaching in elementary school is encouraged to ensure that the students will be ready for the ever changing world as they move into the future. But, are Millard elementary science teachers adequately trained in science so that their students will be equipped for the future? Do the teachers possess a positive attitude toward science? Furthermore, is preparation related to teacher attitude - or student attitude? Is there a relationship between teacher preparation, teacher concerns, and student attitudes?

Purpose of the Study

The purpose of this study was to test the relationship between teacher concerns toward the use of hands-on science education, the credit hours the teacher has acquired in their undergraduate and graduate programs in science, and the number of inservice hours spent on science inservice provided by the Millard School District.

Hypotheses

1. There was no significant relationship between teacher concern toward the teaching of science using the hands-on method and the number of undergraduate credit hours acquired in science in the teacher's undergraduate plan of study.

2. There was no significant relationship between teacher concern toward the teaching of science using the hands-on method and the number of graduate credit hours acquired in science in the teacher's graduate plan of study.

3. There was no significant relationship between teacher concern toward the teaching of science using the hands-on method and the total number of inservice clock hours spent on science by the teacher in the last three years.

Methodology

To test the hypotheses, the researcher administered the Stages of Concern About the Innovation Questionnaire. The questionnaire determined the attitudinal concerns teachers have about using the hands-on science method. The researcher surveyed 31 intermediate teachers from three different schools in the Millard Public School District.

To test the hypothesis that there was no significant relationship between teacher concern toward the teaching of science using the hands-on method and the number of undergraduate credit hours acquired in science in the teacher's undergraduate plan of study, the researcher surveyed 31 intermediate elementary teachers. The teacher's demographic data includes an estimate of the number of undergraduate credit hours they have acquired in science. The researcher then tested the data to determine if there was a significant relationships between the teacher's undergraduate background in science and their concerns toward the teaching of science using the hands-on method.

Next, the researcher tested the hypothesis that there was no significant relationship between teacher concern toward the teaching of science using the hands-on method and the number of graduate hours acquired in the teacher's graduate studies. The researcher surveyed 31 intermediate teachers. The teacher's demographic data includes an estimate of the number of graduate credit hours they have acquired in science. The researcher tested the data to determine if there was a significant relationship between the teachers' graduate background in science and their concerns toward the teaching of science using the hands-on method.

Finally, the researcher tested the hypothesis that there was no significant relationship between teachers' concern toward the teaching of science using the hands-on method and the total number of inservice clock hours spent on science by the teachers in the last three years. The demographic data includes the teachers' estimate of the total number of inservice clock hours they have spent on science in the last three years. The researcher then tested the data to determine if there was a significant relationship between the teachers' time spent with inservice dealing with science and their concerns toward the teaching of science using the hands-on method.

The Stages of Concern About the Innovation Questionnaire was adapted for use in the study. The Stages of Concern About the Innovation Questionnaire was developed to provide a valid measure of concern. It was preceded by ten years of measurement development and research by

Francis Fuller. The questionnaire was validated over a three year period as Fuller studied concerns of teachers about teaching.

Fuller took potential items, definitions, and scale points from the Concerned Based Adoption Model paper (Hall, Wallace, & Dorssett, 1973).

Definition of Terms

Hands-on approach is a science education method that utilizes materials to be manipulated in order to discover scientific principles.

Achievement score is a standard test score that reflects the proficiency a student has in a subject.

E S S is the Elementary Science Study exploration science program that was begun in the sixties.

S A P A is the Science - A Process Approach exploration science program that was begun in the sixties.

S C I S is the Science Curriculum Improvement Study exploration science program that was begun in the sixties.

Preservice is the undergraduate educational period before a person becomes a certified teacher.

Core subject is any one of the basic subjects needed by a student.

Process skills are the systematic series of actions used to discover a scientific principle.

Inservice is the periodic education given for employed teachers by a school district.

Manipulatives are didactic hands-on materials.

Limitations

This study focuses on intermediate science teachers from the Millard Public School District. The study measured attitudes of teachers toward teaching using the hands-on science method.

Assumptions

The researcher has assumed that all information in the survey is truthful and accurate.

The undergraduate credit hours, the graduate credit hours, and the inservice clock hours of training in science were estimated by the teachers, because it was assumed by the researcher that a higher percentage of the surveys would be returned if the teachers did not have the responsibility of looking up this information.

Chapter 2

Review of Related Literature

A positive attitude by elementary school teachers toward science increases their intensity and commitment to science teaching. But researchers have shown over half the elementary teachers surveyed rank science fourth or fifth out of five subjects when asked to prioritize their curriculum (Pettus, 1983). Many teachers see their role in the teaching of science as merely dispensers of facts (Manning, 1981).

The quantity and quality of science education is declining because science has a low status in the elementary classroom. Less time is spent on science in elementary school than any other major subject area (Tilgner, 1990).

Teachers with positive attitudes toward science tend to spend more time on the subject, and use more hands-on materials in their classrooms. In turn, classrooms in which teachers use hands-on science have students with a good outlook on science. These students have achievement scores that are superior to students in more traditional settings.

Science is best learned and recalled from a hands-on approach, and information is best retained when students are actively involved in the learning process. Yet the hands-on approach to science instruction is used less often than it was in the mid-seventies (Pettus, 1983). Hands-on science programs such as Elementary Science Study (ESS), Science - A Process Approach (SAPA), and Science Curriculum Improvement Study (SCIS) are not in fashion. There is no longer the emphasis on science education by teachers that was present in the sixties and seventies.

The United States can make scientific literacy possible for all students. We need a national commitment and determination to reach this goal (Project 2061, 1989). Most Americans are not scientifically literate. Our students rank near the bottom when compared to other countries' educational performance in science. Very few elementary school teachers have even a rudimentary education in science. Teachers rely heavily on textbooks which may impede scientific literacy. Scientific literacy will not come about until we change elementary teachers' attitudes about science. Teachers in the future will need to be adequately trained in science, so that they can feel confident and comfortable teaching inquiry and exploration skills, as opposed to memorizing answers to questions.

Teacher Training

A good preservice education is the first step in preparing capable teachers of science. Teachers that have participated in activity-oriented science courses have improved attitudes about science. Hands-on science improves the attitudes of students as well (Simpson & Oliver, 1990). Teacher training is essential in the effectiveness of science programs. Teachers must feel comfortable with their teaching of science and have a confidence in their skills to administer a program using manipulatives. If teachers do not feel at ease with science they are not going to give the subject the emphasis it deserves.

Science has a low status in the elementary school. It is not thought of as a basic course. Achievement tests do not measure science knowledge as thoroughly as other areas of the curriculum. With an emphasis on achievement test scores, in many cases, science takes a back seat. Research shows that teachers with a positive attitude about science teaching spend more time teaching science and use more hands-on materials. They consider it a core subject in the elementary curriculum (Pettus, 1983).

Methods courses in preparing preservice elementary teachers for science help to lessen anxiety, especially if the courses emphasize the process nature of science. Method courses affect teachers' attitudes positively and make them feel better about teaching science because they have more understanding of the subject. Teachers with negative attitudes about science teach in a more traditional style with little hands-on activities (Stefanich & Kelsey, 1989).

There is a great deal of evidence that teacher expectations and attitudes have a very significant effect on what students learn in science (Simpson & Oliver, 1990). Teachers need better training so that they have confidence in their ability to teach science. Teachers' attitudes impact how their students feel about science, and therefore how much they learn. Elementary teachers do not treat science as a subject that is basic to the overall curriculum. Other subjects are considered more basic to the curriculum because standardized tests give these subjects more emphasis than science (Stefanich & Kelsey, 1989).

Current studies show that after the fourth grade girls are not as interested as boys in science, and do not experience the same success in the science classroom. At this early date, girls tend to be passive observers and are not as actively involved in science experiments and projects (Klein, 1989). Science is viewed as "masculine" by many boys and girls and this seems to be a factor in females becoming less successful in science as they get more mature. Teachers need to be aware of this situation and not let these attitudes about science negatively influence the girls in their classrooms (Chiapetto, 1990).

Elementary teachers are not as interested in teaching science as they are other areas of the curriculum and are reluctant to teach science because they lack the knowledge to teach it adequately. Appropriate science courses are not available for many preservice elementary teachers and when they are, support is not given to new teachers in an ongoing system to assure a continued use and application of knowledge. This fact just continues the cycle of teachers disliking science and these feelings then affecting students in the classrooms negatively.

Positive attitudes can be acquired by having teachers educated in success-oriented, hands-on science courses for preservice as well as inservice elementary science teachers (Shymansky, 1989). Teachers react better and learn more from this type of coursework. When teachers have good attitudes about science learning rates are increased for their students.

Process skills and hands-on methods of teaching science are now emphasized in most science programs at teacher training institutions. This emphasis in such preservice training programs for elementary teachers is not ensuring the same accentuation in classrooms. There has been a ten percent reduction in hands-on science activities used in elementary classes since the mid-seventies (Tolman & Campbell, 1989). An ongoing inservice program is also necessary to insure good science programs.

Teacher inservice programs help teachers to be more effective and therefore have better attitudes about teaching science (Shymansky, 1989). Teachers should have input in inservice programs to insure that their needs are being met. Elementary science teachers need support to make it possible for them to teach science in a manner that is best for the learning of children. Inservice should be an ongoing process. Elementary teachers, on the average, do not have considerable background in science education.

A one-time inservice will not help to relieve anxious feelings and incomplete knowledge. Continuous support from inservices will help to make teachers secure enough to teach science in a process skill and hands-on manner.

Teachers are aware that a process skills and hands-on approach to science education is touted in research, but without the confidence to put this approach into use, most teachers will not use it. A commitment to science must be shown by school districts through continuous science inservices that will make teachers more self-assured, intense, and committed to science instruction.

Hands-On Elementary Science Programs

Three hands-on science programs from the sixties and early seventies are Elementary Science Study (ESS), Science - A Process Approach (SAPA), and Science Curriculum Improvement Study (SCIS). There was federal support to finance the inception of these programs. The programs were part of the reform movement for science education that emphasized process skills and hands-on activities. The programs had a great deal of support from teachers as well as the science community.

The programs lost their popularity gradually after federal support was dropped. It was also thought by many educators that the programs did not teach what was necessary for performance on standardized tests - recall of facts. This added to their decline. Standardized tests test factual recall - memorizing science facts. Hands-on science teaches children process skills. This conflict led many teachers to abandon hands-on science in favor of traditional facts based education. It was thought that their students would need to know these facts to show that they were learning.

Elementary Science Study

The ESS program was designed for student exploration. The program has many hands-on materials that can be used for a wide range of activities. There are no objectives included with the program and the units have no particular sequence.

Students work in a three-stage instructional series called Circle, Triangle, and Square. Students work in small groups, or on their own, with materials and very little teacher guidance during Circle. In Triangle the teacher directs the students individually to develop their ideas with the manipulatives. Finally, the teacher describes the unit concepts after the students have had sufficient time to explore their own ideas. This is done during Square.

In ESS the students use trial and error to develop their own understanding of concepts. The students are relied upon to organize their own activities. This method is thought to give students a greater grasp of the topics than having to passively listen to or watch the teacher present the material.

Science - A Process Approach

The curriculum of SAPA is sequential with the goals focusing on the development of cognitive processes to enable the learner to use information in a purposeful way. The skills are in a hierarchy from simple to complex. The students learn from manipulating hands-on materials through different activities. There is a preplanned sequence with each activity that is structured to meet specific objectives. The activity progresses from simple content to more difficult content.

Science Curriculum Improvement Study

SCIS has a systematic sequence of instruction for the teacher to follow. There are three phases in the instructional process. The Exploration phase is when students use hands-on materials to become acquainted with the context of the content. Invention is when the teacher and possibly the students, describe the concept. Discovery is the final phase when the teacher furnishes additional materials to the students. The students work with these materials to expand their understanding of the concept that was earlier "invented."

The units in SCIS provide specific content that can be applicable to broader scientific concepts. The two general themes are physical science and biological science. SCIS has a deductive instructional sequence with examples and applications that proceed the development of concepts.

These three programs were used widely in the sixties and seventies. The approaches were part of the reform movement in science of the time. There is now a movement, again, to reform the science curriculum of elementary schools and it seems appropriate to look at these programs that had a great deal of support from the science and education communities (Kyle, Jr., Bonnstetter, Gadsden, Jr. & Shymansky, 1988).

These programs have similarities in content and process but are different in cognitive requirements. ESS has the students act as scientists. The knowledge is acquired inductively. SAPA has the students learn deductively with information given in a hierarchy. SAPA minimizes the effects of prerequisite learning. The SCIS program uses an inductive-deductive practice sequence of instruction that stresses concept acquisition.

Process skills are a focal point with each of the programs. Each program uses planned, hands-on activities to acquire skills as a result of students' direct experience.

<u>Summary</u>

The science experience for students in most elementary schools is very limited. It typically consists of a textbook out of which students read and memorize facts. Science is often taught near the end of the day with limited equipment that is not often used. The science teacher often has little training in science, feels anxious about the subject, and has little interest in teaching it.

Hands-on science is shown to be much more interesting to students than simply reading about science facts in a text. Elementary students in inquiry-oriented, process-approach science classes develop interest and achievement in science that is an important influence to high school science success (Simpson & Oliver, 1990). Data indicates that elementary students much prefer a hands-on approach (Wilson & Chalmers-Neubauer, 1990).

These activity-based programs were quite popular in the sixties and seventies with support from both the science and education communities. The hands-on programs dwindled in use because federal support for teacher inservice began to be removed.

Continuing inservice is important to insure the success of hands-on science programs. Studies strongly suggest that teacher inservices do make a difference in effectiveness of a science program (Shymansky, 1983). Inservice is a costly item in school budgets that are already stressed, but inservice helps increase the probability that teachers will be more committed, intense, and effective in the science programs. Teachers must have input into what is covered in inservices to insure that it meets their needs.

Another factor that caused hands-on science to fall from favor was early research that suggested students in these process-oriented programs did not perform as well on standardized tests as students in traditional programs. Research is now showing that students that have been involved with a hands-on science program actually out perform their counterparts on standardized tests (Shymansky, Kyle & Alport, 1983). In addition, students have a much better attitude about science and display higher levels of creativity as judged by Torrence Tests (Wilson & Chalmers-Neubauer, 1990).

Many elementary teachers have poor attitudes about science and feel inadequate to teach the subject. Therefore, little time is being spent on science. The time that is being spent on instruction is often of a low quality. The anxiety elementary teachers feel toward science can be alleviated, if as undergraduate students, they are taught in a very sequential manner using hands-on materials designed to teach science process skills (Westerback, 1980). Elementary teachers need not be experts in the field of science, but they do need many firsthand experiences they can draw on to teach their students. Teachers that have an extensive and diverse assortment of activities can provide meaningful science activities for their students.

In conclusion, students now, and in the future, must be literate in science. Childhood experience with science is a major influence on how students achieve in, and feel about, science as they proceed with their education. There must be more of a commitment to science in elementary school to insure that citizens in the future will be competent in science and view it with positive attitudes.

Chapter 3

Design of the Study

The purpose of this study was to test the relationship between teacher concerns toward the use of hands-on science education, the credit hours the teacher has acquired in their undergraduate and graduate programs in science, and the number of inservice hours spent on science inservice.

The researcher assessed three criteria used in the study. The criteria were developed from the review of literature. The study was designed to see what effect training in science had on teacher concerns in using hands-on science methodology.

Procedure

The study tested the following:

1. There was no significant relationship between teacher concern toward the teaching of science using the hands-on method and the number of undergraduate credit hours acquired in science in the teacher's undergraduate plan of study.

2. There was no significant relationship between teacher concern toward the teaching of science using the hands-on method and the number of graduate credit hours acquired in science in the teacher's graduate plan of study.

3. There was no significant relationship between teacher concern toward the teaching of science using the hands-on method and the total number of inservice clock

hours spent on science by the teacher in the last three years.

The Stages of Concern About the Innovation Questionnaire, developed by Francis Fuller, was adapted to assess the hypotheses dealing with concerns of Millard intermediate science teachers.

The questionnaire was developed to have teachers rate their concern about 35 statements related to hands-on science. The scale was from zero to seven, with zero being the least level of concern and seven being the highest level of concern.

Next, an instrument was designed to have teachers estimate the number of undergraduate and graduate hours of college credit and inservice training hours each teacher had accumulated in science.

The questionnaire was administered to the intermediate science teachers at four Millard Elementary Schools by the researcher. The scores were tabulated and a mean was established. The mean was rated from zero to 100 with 100 being the highest possible level of concern (See Table 1, page 26).

<u>Population</u>

Four elementary schools from the Millard Public Schools were selected for the field study. Intermediate science teachers from the schools were surveyed. Two schools surveyed had fourth and fifth grade teachers take part. The other two had fourth, fifth, and sixth grade teachers as participants. The former two schools do not have a sixth grade class of students. The breakdown of teachers for each grade level were as follows:

fourth grade - 12 teachers

fifth grade - 14 teachers

sixth grade - 5 teachers

Instrument

The Stages of Concern About the Innovation Questionnaire was used to assess the level of concern intermediate teachers have using hands-on science. The questionnaire was developed to provide a quick-scoring measure of levels of concern.

The questionnaire was validated over a three year period by Francis Fuller. This was preceded by a ten year period of measurement development and research. Fuller studied concerns teachers have about teaching. The questionnaire was tested for validity, reliability, and internal consistency.

The instrument was developed to be a quick-scoring pencil-and-paper questionnaire, and to have an objective scoring procedure for classifying responses of concern. The result was a questionnaire that accurately measures concern about educationally related topics.

The survey has 35 statements related to the teaching of hands-on science. The comments are grouped under seven categories: Awareness, Informational, Personal, Management, Consequence, Collaboration, and Refocusing.

Each comment is rated from zero to seven. The range is from Irrelevant, Not true of me now, Somewhat true of me now, to Very true of me now. The rating is then found on the Margin for Scoring Chart under one of the seven categories and is rated from zero to 100.

General Setting

The setting for this study was four elementary public schools in Millard. Two of the schools have a sixth grade population and two of the schools are completed at the fifth grade. After their last year at the respective schools, the students go on to middle school.

Method of Data Analysis

The researcher put the teachers in rank order according to their undergraduate credit hours in science, graduate credit hours in science, and total clock hours of science inservice training in the last three years. The rank order of the three groups was correlated with the teachers' concern score using Pearson's Product-Moment Coefficient of Correlation. The level of significance was then derived for each of the three groups.

Chapter 4

Analysis of Data

The purpose of this study was to determine if the amount of training a teacher receives in science made a difference in the level of concern a teacher had in teaching hands-on science.

Table 1 (page 26) reflects the scored responses given by the 31 teachers. The 35 responses assess concern in seven different categories. Five responses are organized under each category. The five responses were then averaged. Finally, the averages of the seven categories were averaged to find an overall mean for each teacher's responses.

To test the first hypothesis that there was no significant relationship between teacher concern toward the teaching of science using the hands-on method and the number of undergraduate credit hours acquired in science in the teacher's undergraduate plan of study, a rank order correlation was used to test the relationship between the concern score of a teacher and the number of undergraduate credit hours in science a teacher has received.

Table 2 reveals the rank order of teachers, according to their undergraduate credit hours in science and their concerns about using the hands-on science method. When this rank order was correlated with their concern score using Pearson's Product-Method Coefficient of Correlation, the correlation was -.161. The level of significance for

Table 1

Surveyed Teachers' Responses

Teacher	Areas of Concern							Mean
	Awareness 0	Informational 1	Personal 2	Management 3	Consequence 4	Collaboration 5	Refocusing 6	
1.	99	54	41	56	19	84	81	62
2.	81	72	57	56	30	28	84	58
3.	99	72	85	99	76	98	99	90
4.	99	72	72	90	96	88	99	74
5.	98	72	72	77	30	48	90	56
6.	98	27	5	5	90	88	22	48
7.	99	27	41	90	92	88	96	76
8.	99	27	5	90	1	28	65	31
9.	99	97	94	97	54	48	84	82
10.	98	97	57	99	30	48	96	75
11.	81	27	41	56	54	68	92	60
12.	98	72	57	90	30	48	84	68
13.	77	51	52	47	2	5	65	43
14.	97	48	45	23	71	68	60	59
15.	99	57	83	69	30	3	84	61
16.	99	63	25	56	38	3	90	53
17.	98	45	59	96	43	5	84	61
18.	99	75	57	98	54	9	96	70
19.	98	97	21	60	19	3	84	55
20.	93	43	57	77	7	28	65	53
21.	99	57	57	99	92	48	99	79
22.	89	96	25	98	3	1	96	58
23.	99	69	45	73	76	16	84	66
24.	66	54	80	85	66	59	92	72
25.	81	48	55	85	19	19	38	49
26.	37	57	67	92	11	28	57	50
27.	72	57	76	92	38	44	60	63
28.	37	43	63	88	33	59	52	54
29.	60	72	67	92	16	64	69	63
30.	81	51	67	94	27	44	65	61
31.	81	54	72	92	24	55	42	60

rejection of the null hypothesis was .05 (See Table 2, page 28).

To test the second hypothesis, there was no significant relationship between teacher concern toward the teaching of science using the hands-on method and the number of graduate credit hours acquired in science in the teacher's graduate plan of study, a rank order correlation was used to test the relationship between the concern score of a teacher and the number of graduate credit hours in science a teacher has received.

Table 3 reveals the rank order of teachers, according to their graduate credit hours in science and their concerns about using the hands-on science method. When this rank order was correlated with their concern score using Pearson's Product-Method Coefficient of Correlation, the correlation was -.190. The level of significance for rejection of the null hypothesis was .05 (See Table 3, page 29).

To test the third hypothesis that there was no significant relationship between teacher concern toward the teaching of science using the hands-on method and the total number of inservice clock hours spent on science by the teacher the last three years, a rank order correlation was used to test the relationship between the concern score and the total number of inservice clock hours spent on science by the teacher in the last three years.

Table 2

Teacher Concern and Undergraduate Preparation

Teacher	Undergraduate Hours X	Concern Score Y	X^2	Y^2	XY
15	30	61	900	3,721	1,830
21	18	79	324	6,241	1,422
8	12	31	144	961	372
12	12	68	144	4,624	816
13	12	43	144	1,849	516
23	9	66	81	4,356	594
30	9	61	81	3,721	549
2	6	58	36	3,364	348
5	6	56	36	3,136	336
10	6	75	36	5,625	450
11	6	60	36	3,600	360
18	6	70	36	4,900	420
20	6	53	36	2,809	318
22	6	58	36	3,364	348
25	6	49	36	2,401	294
26	6	50	36	2,500	300
27	6	63	36	3,844	372
28	6	54	36	2,916	324
29	6	63	36	3,969	378
31	6	60	36	3,600	360
1	3	62	9	3,844	186
6	3	48	9	2,304	144
7	3	76	9	5,776	228
9	3	82	9	6,724	246
14	3	59	9	3,481	177
16	3	53	9	2,809	159
17	3	61	9	3,721	183
19	3	55	9	3,025	165
24	3	72	9	5,184	216
3	0	90	0	8,100	0
4	0	74	0	5,476	0
	$\Sigma X=207$	$\Sigma Y=1,910$	$\Sigma X^2=2,366$	$\Sigma Y^2=121,945$	$\Sigma XY=12,411$

$r = -.161$ $t = -.878$

Table 3

Teacher Concern and Graduate Preparation

	Graduate Hours	Concern Score			
Teacher	X	Y	X^2	Y^2	XY
20	15	53	225	2,809	795
15	9	61	81	3,721	549
6	6	48	36	2,304	288
7	6	76	36	5,776	456
11	6	60	36	3,600	360
12	6	68	36	4,624	408
13	6	43	36	1,849	258
2	3	58	9	3,364	174
5	3	56	9	3,136	168
29	3	63	9	3,969	189
31	3	60	9	3,600	180
1	0	62	0	3,844	0
3	0	90	0	8,100	0
4	0	74	0	5,476	0
8	0	31	0	961	0
9	0	82	0	6,724	0
10	0	75	0	5,625	0
14	0	59	0	3,481	0
16	0	53	0	2,809	0
17	0	61	0	3,721	0
18	0	70	0	4,900	0
19	0	55	0	3,025	0
21	0	79	0	6,241	0
22	0	58	0	3,364	0
23	0	66	0	4,356	0
24	0	72	0	5,184	0
25	0	49	0	2,401	0
26	0	50	0	2,500	0
27	0	63	0	3,969	0
28	0	54	0	2,916	0
30	0	61	0	3,969	0
	$\Sigma X=66$	$\Sigma Y=1,910$	$\Sigma X^2=522$	$\Sigma Y^2=122,318$	$\Sigma XY=3,825$

$r = -.190$ $t = -1.04$

Table 4 reveals the rank order of teachers, according to their inservice training in science and their concerns about using the hands-on science method. When this rank order was correlated with their concern score using

Pearson's Product-Method Coefficient of Correlation, the correlation was -.260. The level of significance for rejection of the null hypothesis was .05 (See Table 4, below).

Table 4

Teacher Concern and Inservice Preparation

	Inservice Clock Hours	Concern Score			
Teacher	X	Y	X^2	Y^2	XY
25	9	49	81	2,401	441
27	9	63	81	3,969	567
20	6	53	36	2,809	318
21	6	79	36	6,241	474
18	3	70	9	4,900	210
19	3	55	9	3,025	165
24	3	72	9	5,184	216
26	3	50	9	2,500	100
29	3	63	9	3,969	126
1	2	62	4	3,844	124
6	2	48	4	2,304	96
8	2	31	4	961	62
12	2	68	4	4,624	136
28	2	54	4	2,916	108
31	2	60	4	3,600	120
30	1	61	1	3,969	63
2	0	58	0	3,364	0
3	0	90	0	8,100	0
4	0	74	0	5,476	0
5	0	56	0	3,136	0
7	0	76	0	5,776	0
8	0	82	0	6,724	0
10	0	75	0	5,625	0
11	0	60	0	3,600	0
13	0	43	0	1,849	0
14	0	59	0	3,481	0
15	0	61	0	3,721	0
16	0	53	0	2,809	0
17	0	61	0	3,721	0
22	0	58	0	3,364	0
23	0	66	0	4,356	0
	$\Sigma X=58$	$\Sigma Y=1,910$	$\Sigma X^2=304$	$\Sigma Y^2=122,318$	$\Sigma XY=3,326$

r = -.260 t = -1.46

The undergraduate credit, the graduate credit, and the inservice clock hours of training were estimated by the teachers. It was felt by the researcher that very few surveys would be returned if the responsibility of looking up all the data was given to the teachers.

The first hypothesis tested was that there is no significant relationship between teacher concern toward the teaching of science using the hands-on method and the number of undergraduate credit hours acquired in science in the teacher's undergraduate plan of study. The level of significance was measured at .878. The level of significance needed to be 2.042 at the .05 alpha level to be rejected. Therefore, the hypothesis was accepted.

The second hypothesis tested was that there is no significant relationship between teacher concern toward the teaching of science using the hands-on method and the number of graduate credit hours acquired in science in the teacher's graduate plan of study. The level of significance was measured at 1.04. Again, the level of significance did not meet the .05 alpha level that is needed for rejection, so the hypothesis was accepted.

The final hypothesis tested was that there is no significant relationship between teacher concern toward the teaching of science using the hands-on method and the total number of inservice clock hours spent on science in the teacher's school district's inservice program in the last three years. The level of significance was measured at

1.46. The level of significance did not meet the .05 alpha level needed for rejection, so the hypothesis was accepted.

In summary, there was no significant relationship between the number of undergraduate credit hours in science, graduate credit hours in science, or the number of clock hours of inservice in science teachers had accumulated and teacher concern toward the teaching of science using the hands-on method.

Chapter 5

Summary, Conclusions, and Recommendations

Science is central to all aspects of our society. It influences every facet of our lives. There are examples of the importance of science all around us such as our transportation, clothing, food, and medicines. We must insure a proper science education for all children because science is closely related to our welfare and standard of living. Scientific literacy is basic for living in the modern world, yet appreciation of science education has declined.

Conclusions

The purpose of this study was to test the relationship between the educational background in science a teacher has and the concerns they have using the hands-on method of teaching science.

While research is replete with data about the need for elementary teachers of science to feel comfortable in their teaching of science, and teachers with sufficient training in science have more positive attitudes about science, this was not confirmed with this sample of Millard intermediate science teachers.

Recommendations

This study indicates that the amount of training a teacher receives in science does not make a difference in the level of concern a teacher has in teaching hands-on science.

Therefore, the following recommendations are made:

1. Replicate the study using a different population to learn if similar results would be obtained in other settings.

2. Administer the survey at several different times during the school year to determine what effect this might have on responses.

3. Administer the survey before and after a school district's science inservice to test the impact of the training.

4. Replicate the study having surveyed teachers indicate their sex, age, and years of employment to analyze the data for each category.

Discussion

Notwithstanding that the literature advocates greater science training for elementary science teachers, the data in this study did not reveal this relationship. It is conjectured that the job expectations and rewards in science may not be sufficiently strong to elicit concern enough to make an impact. Therefore, a study of the relationship between teachers' concerns and science that is assessed by standardized tests would be informative.

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Appendix A

EVALUATION INSTRUMENT

CBAM Hands-on Science Education

Directions: Circle the indicator which most accurately describes your feelings today. Mark on this sheet.

0	1	2	3	4	5	6	7
Irrelevant		Not true now		Somewhat true now		Very true now	

1.	I am concerned about students' attitudes toward hands-on science.	0 1 2 3 4 5 6 7
2.	I now know of some other approaches that might work better.	0 1 2 3 4 5 6 7
3.	I don't even know what hands-on science is.	0 1 2 3 4 5 6 7
4.	I am concerned about not having enough time to organize hands-on science lessons.	0 1 2 3 4 5 6 7
5.	I would like to help other faculty in their teaching of hands-on science.	0 1 2 3 4 5 6 7
6.	I have very limited knowledge about hands-on science.	0 1 2 3 4 5 6 7
7.	I would like to know the effect of my knowledge of hands-on science on my professional status.	0 1 2 3 4 5 6 7
8.	I am concerned about conflict between my interests and responsibility with hands-on science education.	0 1 2 3 4 5 6 7
9.	I cam concerned about revising my science instruction.	0 1 2 3 4 5 6 7
10.	I would like to develop working relationships with both our faculty and outside faculty who are interested in hands-on science education.	0 1 2 3 4 5 6 7
11.	I am concerned about how hands-on science education will affect students.	0 1 2 3 4 5 6 7
12.	I am not concerned about hands-on science.	0 1 2 3 4 5 6 7
13.	I would like to know who will make decisions about the appropriateness of my teaching with hands-on science.	0 1 2 3 4 5 6 7
14.	I would like to discuss the possibility of using hands-on science education.	0 1 2 3 4 5 6 7

15.	I would like to know what resources are available if I decide to use more hands-on science.	0 1 2 3 4 5 6 7
16.	I am concerned about my inability to manage all components of teaching hands-on science.	0 1 2 3 4 5 6 7
17.	I would like to know how my teaching is supposed to change when I use hands-on science.	0 1 2 3 4 5 6 7
18.	I would like to familiarize other teachers with the progress of using hands-on science in my classroom.	0 1 2 3 4 5 6 7
19.	I am concerned about evaluating the impact of hands-on science.	0 1 2 3 4 5 6 7
20.	I would like to revise the hands-on science approach.	0 1 2 3 4 5 6 7
21.	I am completely occupied with other things.	0 1 2 3 4 5 6 7
22.	I would like to modify the use of hands-on science based on my students' experiences.	0 1 2 3 4 5 6 7
23.	Although I don't know about hands-on science instruction, I am concerned about using the technique.	0 1 2 3 4 5 6 7
24.	I would like to excite my students about their part in hands-on science education.	0 1 2 3 4 5 6 7
25.	I am concerned about time spent working with nonacademic problems related to teaching using hands-on science.	0 1 2 3 4 5 6 7
26.	I would like to know what the use of hands-on science will require in the immediate future.	0 1 2 3 4 5 6 7
27.	I would like to coordinate my effort with others to maximize hands-on science education in my classroom.	0 1 2 3 4 5 6 7
28.	I would like to have more information on time and energy commitments required by hands-on science.	0 1 2 3 4 5 6 7
29.	I would like to know what other faculty are doing with hands-on science teaching.	0 1 2 3 4 5 6 7
30.	At this time, I am not interested in learning about hands-on science.	0 1 2 3 4 5 6 7

31. I would like to determine how to supplement, enhance or replace hands-on science. 0 1 2 3 4 5 6 7

32. I would like to use feedback from students to change how I teach using hands-on science. 0 1 2 3 4 5 6 7

33. I would like to know how my role will change when I am using hands-on science. 0 1 2 3 4 5 6 7

34. Coordination of tasks and people will take too much of my time when I use hands-on science. 0 1 2 3 4 5 6 7

35. I would like to know how hands-on science is better than what I do now. 0 1 2 3 4 5 6 7

A. Estimate the number of undergraduate credit hours you have in science. __________

B. Estimate the number of graduate credit hours you have in science. __________

C. Estimate the total number of inservice clock hours you have accumulated over the last three years in science. __________

Appendix B

SCORING CHARTS

Margin for Scoring Page 1

|A| DATE:______
SITE: Millard SSN:______
INNOVATION:______

|B|

Items	Percentiles for Stage 0	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
0	10	5	5	2	1	1	1
1	23	12	12	5	1	2	2
2	29	16	14	7	1	3	3
3	37	19	17	9	2	3	5
4	46	23	21	11	2	4	6
5	53	27	25	15	3	5	9
6	60	30	28	18	3	7	11
7	66	34	31	23	4	9	14
8	72	37	35	27	5	10	17
9	77	40	39	30	5	12	20
10	81	43	41	34	7	14	22
11	84	45	45	39	8	16	26
12	86	48	48	43	9	19	30
13	89	51	52	47	11	22	34
14	91	54	55	52	13	25	38
15	93	57	57	56	16	28	42
16	94	60	59	60	19	31	47
17	95	36	63	65	21	36	52
18	96	66	67	69	24	40	57
19	97	69	70	73	27	44	60
20	98	72	72	77	30	48	65
21	98	75	76	80	33	52	69
22	99	80	78	83	38	55	73
23	99	84	80	85	43	59	77
24	99	88	83	88	48	64	81
25	99	90	85	90	54	68	84
26	99	91	87	92	59	72	87
27	99	93	89	94	63	76	90
28	99	95	91	95	66	80	92
29	99	96	92	97	71	84	94
30	99	97	94	97	76	88	96
31	99	98	95	98	82	91	97
32	99	99	96	98	86	93	98
33	99	99	96	99	90	95	99
34	99	99	97	99	93	97	99
35	99	99	99	99	96	98	99

Margin for Scoring Page 2

|B|

0	1	2	3	4	5	6
3 ___	6 ___	7 ___	4 ___	1 ___	5 ___	2 ___
12 ___	14 ___	13 ___	8 ___	11 ___	10 ___	9 ___
21 ___	15 ___	17 ___	16 ___	19 ___	8 ___	20 ___
23 ___	26 ___	28 ___	25 ___	24 ___	27 ___	22 ___
30 ___	35 ___	33 ___	34 ___	32 ___	29 ___	31 ___

|C| ___ ___ ___ ___ ___ ___ ___

|D|

0	1	2	3	4	5	6
___	___	___	___	___	___	___

|E|