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ABSTRACT

A science process skill project was implemented to help elementary teachers in New Mexico meet the competencies for teaching the process approach in science classes. This is the final report of the project and includes information on: (1) the scope of the program (delineating the program's major objectives and tasks); (2) the project's accomplishments (citing successes related to videotaping, workshop manual, skill activities, workshop kit, teacher training, and the workshop sessions); (3) evaluation results; and (4) dissemination procedures. Overall evaluations indicate that the model for delivery of inservice workshops, using elementary teachers as surrogates for science educators, can be effective. The combination of a teacher's experience, knowledge of a science educator, and interesting activities lead to the enhancement of elementary school teachers' science process skill development and instruction. Appendices contain the evaluation results for the effectiveness of both the 2-day training sessions for workshop leaders and the 6-hour inservice workshops for elementary school teachers. (ML)

INSERVICE TRAINING OF ELEMENTARY TEACHERS TO ENHANCE SCIENCE PROCESS SKILL DEVELOPMENT AND INSTRUCTION

Final Report

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Final Report

Introduction

The major goal of the Inservice Training of Elementary Teachers to Enhance Science Process Skill Development and Instruction Project (Science Process Skill Project) was to prepare teachers to implement the process approach to teaching science described by the New Mexico State Education Department in the 1986 proposed competencies for science education in New Mexico. To meet this goal, the project developed and tested an inservice workshop kit that could be used by a teacher to provide an inservice workshop to a small group of other teachers. The kit was designed to provide the expertise of science educators via videotape and printed materials, to allow the teachers to do science process skill activities, and to facilitate discussion of the information and activities by the teachers. In effect, the project attempted to make portable and on demand, a means for providing inservice workshops to elementary school teachers throughout the state in a manner consistent with the budgets of both small and large school districts.

A decision was made at the beginning of the project to use a subskills approach to teaching the basic science process skills. The subskills approach is based on the

breakdown of a general skill (like prediction) into component subskills (collect data, search for a pattern, propose a relationship, make a testable prediction, test the prediction). This approach is not common in science instruction but has been the mainstay of good industrial arts and physical education teaching. The subskills approach was first used by Rowland and Stuessy in 1986 to teach process skills to elementary education majors. The approach appears to be successful not only in helping individuals develop the skills but also in guiding student teachers as they design process skill activities. Anecdotal evidence indicates that process skill instruction is greatly facilitated by teachers who can pinpoint problems students have in executing the process skills. The subskill approach provides the framework for both diagnosis and remediation.

Scope of Work

The objectives of this project were as follows: (1) to develop the basic science process skills of elementary school teachers; (2) to develop and field test videotapes that teach teachers how to develop and use activities that enhance science process skill development in their students; (3) to train teachers to teach other teachers using the videotapes, manual, and process skills kits; (4) to evaluate the effectiveness of using videotapes and activities for developing process skills of teachers; (5) to evaluate the

effectiveness of using teachers to train other teachers in process skill development. (6) Finally, after the period of funding is finished, videotapes, manuals, and science kits for inservice science education will be made available to elementary schools throughout the state of New Mexico.

The objectives were to be met by completing the following tasks:

1. Develop and produce a Basic Science Process Skills videotape.
2. Develop and print a manual to accompany the videotape.
3. Develop and print activities to be carried out by teachers during the training sessions.
4. Assemble a kit containing all materials necessary to conduct the inservice workshop.
5. Train teachers to use the workshop kit.
6. Arrange for the trained teachers to present an inservice workshop to untrained teachers.
7. Evaluate the materials and workshops.
8. Establish dissemination procedures.

Accomplishments

Videotape. During the months of February and March, Paul Rowland, with the assistance of graduate assistant Larry Vick, taught five laboratory sessions of Elementary Science Methods. The teaching of these classes on basic science process skills was videotaped by J. Kim McNutt to

provide information on how to teach the process skills, to obtain footage of teaching the process skills, and to obtain footage of college students doing process skill activities. Carol Stuessy arranged for the college students to visit San Miguel Elementary School (Gadsden Independent School District) to teach science process skills in all of the classes. Permission slips were obtained from parents of children in two of the classrooms and those children were videotaped during the process skill lesson. This videotape and the five videotapes of the class were used by Stuessy to prepare a script for the final videotape. Additional "standup" and "narration" footage was then shot and Rowland developed "treatments" showing audio and video for each of the segments of the videotapes. McNutt then edited the videotapes to produce the final videotape. The master copy of the videotape was completed on March 30.

Manual. A manual was developed to assist the presentor of the inservice workshop. The manual began with an introductory chapter that described the purpose and rationale of the workshop and the use of the workshop kit. The remainder of the manual consisted of six chapters, one for each of the basic science process skills. Each of these chapters provided background information for the trainer (this section included the information provided by the videotape), the objectives of the segment of the videotape,

an outline for a discussion of the videotape, an introduction to the activites for that skill, an outline of how to design an activity for that skill, and instructions on how to present the workshop. The appendices included the information in the trainees handbook: outlines of skills and subskills, performance objectives, a sample activity sheet, and ten activities. The manual was written by Rowland and edited by Stuessy.

Activities. Although a number of process skill activities are available from the popular Learning Science Process Skills workbook by Funk et al., a decision was made to develop two strands of science process skill activities: one strand focusing on a life science subject (the human body) and one focusing on a physical science subject (electricity). This decision was made to ensure that the teaching of the science process skills would be integrated with the teaching of science content. This has not always been the case; many of the activities in the aforementioned workbook are not based on science content. In addition, this approach ensured that teachers would realize that all of the skills could be taught in one subject area. (Each strand included five activities, one each for observation, classification, communication, prediction, and inference.) Each activity selected had to meet several criteria. First, the activity had to use inexpensive materials that were

easily replaced and were not perishable. Second, the activity had to be completed in thirty minutes. Third, the activity had to present the skill in such a way that the subskills would be evident. Fourth, the activity had to presume no science background but still be interesting to those with a science background. With these constraints in mind, Rowland and Vick selected and developed activities for each of the strands. After editing by Stuessy, the activities were printed in an Outlines and Activities booklet to be used by the trainees.

Workshop Kit. After the activities were selected, a materials list was developed and materials were ordered to produce ten kits (later five more kits were produced). The kits contained a copy of the videotape, the manual, copies of the Outline and Activities booklet, Learning Science Process Skills workbook, and the materials to carry out the activities described in the booklet. The kit was designed to be used by 8-12 trainees in a 5-6 hour workshop; however we have subsequently found that the workshop could be much longer. The kits were assembled by Vick with assistance from Rowland.

Training. Arrangements were made by Stuessy with the Gadsden Independent School District to have the district select at least one teacher from each of their elementary schools to become trained in the use of the kit. These nine

teachers, who would present an inservice workshop to peers in their school, were selected by building principals. Two, six-hour days of training were conducted on April 28 and 29 at New Mexico State University by Rowland with assistance from Stuessy. During the training, the teachers took part in what is best described as an embellished workshop. Much of the time was spent modelling the presentation of the workshop and answering questions about the teaching of science process skills.

Workshops. On Saturday, May 16, 44 elementary teachers from the GISD assembled at Anthony Elementary School at eight o'clock to undergo inservice training in basic science process skills. Prior to this, the teachers had been given a pretest of their basic science process skill ability. Because fewer teachers participated than expected and fewer VCR's were available, groups of teachers were combined so that trainers could work in pairs with up to 12 teachers in a group. This ad hoc decision was probably a good one and may have contributed to the success of the workshops. Trainers used the format described in the manual for presenting the workshop except that the "Design an Activity" sections were omitted because of time constraints. For each of the process skills, the trainers would show the videotape, discuss the information from the tape, do the two activites for developing that skill, and discuss the

criteria for a good activity emphasizing that skill. The workshops lasted about six hours.

Evaluation. Four evaluations were conducted for this project. Change in process skill ability was measured for both the trainers and the trainees. Evaluations of the materials developed by the project and of the training sessions or workshops were also done by the trainers and trainees.

First, the development of process skills as a result of training was evaluated for the nine teachers who participated in the training session. The detailed results of that evaluation are given in Appendix A. The evaluation was a pretest/posttest design that engaged the subjects in a demonstration of the process skills. It was clear that the two days of training greatly improved the level of science process skills for all of the participants.

Second, the development of the process skill level of teachers participating in the inservice workshop was measured using a modification of the test taken by the trainers. These results, detailed in Appendix B, showed that a six-hour workshop could contribute to the enhancement of the teachers' process skill ability.

Third, the trainers were asked to evaluate the training and the materials they received. Appendix C contains the results of this evaluation. All trainers rated their

training as "adequate" or higher in all areas. In addition, all components were rated as "somewhat useful" or "useful" by the trainers. It appears that the trainers felt that they were prepared to teach the workshop.

Fourth, the trainees were asked to evaluate the inservice workshop and the materials used in it. Their responses are summarized in Appendix D. It is clear from these evaluations that the project met a real need of these teachers, to prepare them to teach the process skills, and that the teaching of the workshops by peers was well received. More than 70 percent of the teachers rated the workshop as "above average" for inservice workshops. The activities were rated "good" by 93 percent of the teachers. Even the videotape, a passive medium for presenting information, was well received (40 percent rated it fair while 58 percent rated it good). These evaluations indicate that the methods and materials used in this workshop are useful for enhancing teachers' science process skills.

Dissemination Procedures. The ultimate usefulness of this project depends on other teachers finding out about the availability of the kits so they can use them in their school district. Plans are currently underway for notification by the State Education Department (SED) of the availability of the kits for loan to schools wishing to deliver inservice instruction. Already, SED has used the kits with teachers at its Title II workshops and its

leadership conference. Las Cruces Public Schools used some of its local Title II money to sponsor workshops using the kits for its teachers. Thus far, the kits have been used with teachers from more than 15 school districts (see Appendix E for record of kit usage) and many of those teachers have indicated an interest in using the kits in their school districts in the fall.

The Learning Resource Center at the College of Education, New Mexico State University has agreed to serve as depository and distributor of the kits. A total of twenty kits have been constructed. Until the level of use for this fall has been established, the five kits designated for distribution to other colleges of education in New Mexico will not be sent out. If, or when, they are not scheduled for use by schools, they will be sent to the appropriate institutions.

Fortunately, some relief from over-demand has been furnished byt he Teacher's Center of the Las Cruces (NM) Public Schools. The center is assembling ten complete kits for use in that districts 20 schools during Fall 1987.

Conclusions and Recommendations

The results of this project have convinced the project staff that this project has produced a desirable and cost effective means for delivering a needed service to the teachers of New Mexico. The evaluation results indicate

that the model for delivery of inservice workshops, using elementary teachers as surrogates for science educators, can be effective. Indeed, some teachers indicated a preference for inservice workshops led by their peers over workshops led by university professors. Our observations of kit use by the trainers showed that all trainers had used their kits with children in their school prior to delivery of the workshop. In fact, after the training session, one teacher said, "I know what I'm doing in school tommorrow," while pointing at the activities from the kit. This experience allowed the trainers to discuss the use of the activities in their own classrooms. This "real school" experience provides the teacher with a distinct advantage over the college professor, paricularly in terms of credibility with other teachers. One trainer commented that the videotape was useful because it "backed-up" what she was saying. The videotape may provide the trainer with some credibility based on its "authoritative" nature (i.e. statements are made by a professional science educator). The combining of a teacher's experience, the knowledge of the science educator, and interesting activities (a key for many participants) appears to be a winning combination for enhancing elementary school teachers science process skill development and instruction.

There are two areas of need that should be addressed in the future. First, research needs to be conducted to verify

the impressions produced by this project that the use of surrogates for the presentation inservice workshops is as effective as presentation by professional teacher educators. Second, there is a crucial need for this project to be expanded to provide inservice instruction in the integrated science process skills. This project focused on the basic skills that are taught in primary grades. Although these skills are essential at higher grade levels, they are not sufficient. New Mexico competencies require the use of the integrated process skills by grade 5, and by high school students are assumed to have mastered all of the science process skills. Teachers at the intermediate and secondary levels have expressed a need for inservice instruction in teaching the integrated process skills. The funding of a project to produce an integrated science process skill inservice workshop kit should be done as soon as possible. Not only would the kit fill the perceived need of many teachers, but it would do so in the most cost effective manner.

APPENDIX A

The Effects of a Two-day Training Workshop on the Process Skill Level of Potential Workshop Trainers

A group of nine trainers, selected by building principals in the Gadsden Independent School District, were trained at New Mexico State University for two, six-hour days in how to present an inservice-workshop on basic science process skills. A process skill pre-test and post-test were administered to the trainers. The test required the trainers to demonstrate an understanding of the process skills and to demonstrate proficiency in using the skills.

As shown in Table I, several interesting changes occurred during the two days. Observation skills showed great improvement in that both more qualitative and quantitative skills were employed. Classification skills also showed marked improvement, with more completions of the multistage and serial classifications. Communication became more precise as indicated by the fewer number of words required to make a clear identification possible. More trainers could distinguish between inferences and observations at the end of the workshop. In addition, prediction skills were better and reasons for having confidence in a prediction improved. Each skill was

correctly identified by more people at the end of the workshop.

These results indicate that the two-day training workshop helped improve the process skills of these teachers who trained their peers in teaching process skills.

Table I. Comparison of Pre-test and Post-test Results

Evaluation Category	PRE	POST
Observation		
PERCENTAGE showing time of observation	44	78
AVERAGE NUMBER of senses used	2.3	3.1
AVERAGE NUMBER of quantitative observations	1.3	5.1
Classification		
PRECENTAGE completing binary classification	67	100
PERCENTAGE completing multistage classification	11	89
PERCENTAGE completing serial classification	22	67
Communication		
AVERAGE NUMBER of words to provide description	17.2	11.2
Inference		
PERCENTAGE clearly distinguishing inferences	22	67
Prediction		
PERCENTAGE making correct prediction	11	33
PERCENTAGE givng correct reason for confidence	22	67
Skill Identification		
PERCENTAGE identifying observation	55	89
classification	0	78
inference	22	100
prediction	11	44

APPENDIX B

The Effects of a Six-hour Workshop on the Process Skill Level of Elemantary School Teachers

Forty-four teachers from the Gadsden Independent School District were given an inservice workshop by nine of their trained peers. A process skill pre-test and post-test were administered to the trainees. The test required the trainees to demonstrate an understanding of the process skills and to demonstrate proficiency in using the skills. The results are shown in Table II. Changes in observation and classification skills are most obvious. The increases in identification of all four skills are especially noticable.

Discussion

The results show that teachers can improve their process skill proficiency and knowledge as a result of a peer-taught, six-hour workshop. It should be noted that at the beginning of the workshop, some skills were especially poor. In particular, few teachers could construct classifications or identify the use of the various skills. When these problems are added to the low level of quantification in pre-test observation, we see a clear problem in expecting these teachers to become teachers of process skill science. Although this training session shows

that science process skills of elementary teachers can be significantly improved, the training is only a beginning.

Table II. Comparison of Pre-test and Post-test Results

Evaluation Category	PRE	POST
Observation		
PERCENTAGE showing time of observation	30	63
AVERAGE NUMBER of senses used	2.2	2.5
AVERAGE NUMBER of quantitative observations	1.2	4.1
Classification		
PERCENTAGE completing serial classification	14	58
PERCENTAGE completing multistage classification	0	72
Inference		
Score on distinguishing inferences/observations	6.4	6.5
Prediction		
PERCENTAGE making correct prediction	27	16
Skill Identification		
PERCENTAGE identifying observation	38	81
classification	7	65
inference	14	56
prediction	20	76

APPENDIX C

Summary of Trainer Evaluations of Training and Materials

The nine trainers were asked to evaluate the training they received and the materials included in the kit. Evaluations were filled out immediately following their presentation of the workshops.

Training

The trainers were asked to respond to the following question: How well did the training session prepare you for the workshop?

a. to present the workshop

b. to understand the process skills

c. to teach the process skills

d. to answer questions during your workshop

Response choices were: 1=poorly 2=adequately 3= well

The distribution of responses was as follows:

	1	2	3
a. to present the workshop	0	3	6
b. to understand the skills	0	1	8
c. to teach the skills	0	2	7
d. to answer questions	0	3	6

Materials

The trainers were asked to evaluate the materials included in the kit by indicating whether they found them not useful (1), somewhat useful (2), or useful (3). Their responses were as follows:

	1	2	3
videotape	0	1	8
manual	0	3	6
activities	0	0	9
kit materials	0	0	9

In addition, questions were asked about each of these components to identify how they were useful. These questions and the responses follow:

Videotape

a. Did the videotape help you understand the process skills?

no - 0 maybe - 0 yes - 9

b. Did the videotape help you teach the workshop?

no - 0 maybe - 0 yes - 9

c. Did the videotape help your trainees?

no - 0 maybe - 1 yes - 8

Manual

a. Did the manual help you understand the process skills?

no - 1 maybe - 1 yes - 7

b. Did the manual help you teach the workshop?

no - 1 maybe - 0 yes - 8

Activities and Kit Materials

a. Did the activities and kit materials help you understand the process skills?

no - 1 maybe - 0 yes - 8

b. Did the activities and kit materials help you teach the workshop?

no - 0 maybe - 0 yes - 9

c. Did the activities and kit materials help your trainees learn the process skills?

no - 0 maybe - 0 yes - 9

d. Will the activities and materials help your trainees become teachers of process skills?

no - 0 maybe - 1 yes - 8

Finally, the trainers were asked their thoughts on the use of the kit without the training. Three emphatically responded that the kit could not be used without the training. Four responded with a qualified yes. Two gave an unqualified yes for their response.

Discussion

The trainer evaluation supports the usefulness of all components of the training and the workshop kit. The manual was rated lowest but that is probably because this group received training from the author of the manual and they probably found its contents redundant to the training and the videotape.

APPENDIX D

Summary of Trainee Evaluations of Workshop and Materials

Elementary school teachers who participated in inservice workshops presented by their trained peers were asked to evaluate the workshop and the materials used in the workshop immediately after the workshop. The questions and the distribution of responses follows (N=44):

Please respond to the following by circling the number of your choice: 1 = not likely
2 = somewhat likely
3 = likely

1. Next year will you be teaching science process skills?
   1 (0) 2 (17) 3 (27)
2. Next year will you be doing any of the activities from the workshop?
   1 (1) 2 (16) 3 (26)
3. Next year will you be using a subskill approach to teaching science process skills?
   1 (0) 2 (14) 3 (29)
4. Next year will you be using the science process skill evaluation techniques as described in the workshop?
   1 (0) 2 (18) 3 (25)

5. Next year will you be developing or adapting activities so that they become process skill activities?

1 (0) 2 (11) 3 (32)

Rate the following components of the workshop by circling your rating number 1 = poor 2 = fair 3 = good

6. Videotape	1 (1)	2 (17)	3 (25)
7. Discussion of video	1 (1)	2 (15)	3 (26)
8. Activities	1 (0)	2 (3)	3 (40)
9. Discussion of activities	1 (0)	2 (7)	3 (36)

10. Compared to other inservice workshops, how would you rate this workshop?

below average (1) average (11) above average (31)

In addition, 18 (42%) indicated that they would be spending more time teaching science next year.

APPENDIX E

Users of Basic Science Process Skills

An Inservice Workshop Kit

TRAINER	LOCATION	DATE USED	# TRAINED	SCH. DISTRICT
Rowland	NMSU	4/28-29	9	Gadsden
Stuessy	NMSU	5/15	10	Silver City
Various	Anthony	5/16	44	Gadsden
Stuessy	Las Cruces	6/2-5	60	Las Cruces
Stuessy	Santa Fe	6/8-10	39	Albuquerque Pojoaque Gadsden W. Las Vegas Las Cruces Gallup Santa Fe Jemez Mountain Taos Las Vegas Carlsbad Santa Rosa Lovington Magdelena
Stuessy	Farmington	6/15-17	12	Farmington Aztec Bloomfield Central
Stuessy	Ruidoso	7/13-15	48	various
		Total	222	