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In-service teacher education programs are designed to increase teachers' subject matter competency and to develop positive attitudes toward new curriculum plans. This study of such a program attempts to answer two questions: (1) What type of program most efficiently achieves the aims and (2) How are the results affected by location of the program, previous teaching experience, previous science courses, and grade level taught? Elementary school teachers (N=140) participated in training programs using "Science--A Process Approach," a new curriculum developed by the Commission on Science Education for the American Association for the Advancement of Science. Three group programs were conducted: (1) a 6-credit-hour course on a college campus, (2) a 1-week preschool workshop followed up by monthly 1-day visits and group sessions in participating schools, and (3) a released-time in-service plan of 11 half-day sessions throughout the school year. Pre- and posttest batteries along with other findings indicate that for improvement in both science competence and teacher attitude, the released-time format of teacher training is most effective; the campus program, least effective. Previous teaching experience and grade level taught seem unrelated to competence and attitude changes, but previous science training appears to contribute positively to both types of change. Seven references appear in the bibliography. (JS)

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SCIENCE INSERVICE PROJECT
RESEARCH REPORT NO. 3

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Curricula have been developed in the mathematics and sciences by cooperating groups of academicians, psychologists and teachers. The result of these cooperative efforts have been well-designed learning experiences for students. However, a significant point with regard to these curricula is that they have developed outside the context of the local classroom. Since these curricula have been developed for one primary reason - change in classroom practice - it is of interest to ask to what extent are these programs capable of instigating change. Urich and Frymier (1963) raised this question when they said:

> While it is desirable that outstanding scholars of the various disciplines play an important part in the development of instructional materials . . . such programs will not in and for themselves bring improved instruction. (Urich and Frymier, 1963).

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An ineffective teacher will not suddenly become effective with the adoption of new curriculum materials.

A further study of the curriculum materials reveals that a philosophy of teaching is implicit in these programs. These are programs in which the role of the student and that of the teacher are quite different from the traditional pattern.

The student becomes the focal point, and as such he becomes increasingly responsible for learning. The teacher is an effective companion and guide in the learning experience. Since a person tends to take from the printed page only that information which past experience has prepared him to take, what happens to a teacher whose preparation or past experience is at variance with the philosophies of the new programs? Does he change, or does he teach "new" programs in the "old" way? What can be done to assist the teacher in both knowing and experiencing the "new" way?

Inservice education is one answer to the need for classroom teachers to become acquainted with both the programs and their philosophies. Inservice education, however, can be designed in several formats. What type of program will be most efficient in helping the classroom teacher cope with the new curriculum?

Recognizing that the teacher needs additional preparation, one solution has been to bring the teacher back to the college campus for special institutes or conference-type experiences. A second

approach has been to bring the inservice program to the teacher and her classroom. If the inservice teacher education program is the same, does the design alter the result with teachers? Will teachers gain as much from an inservice in a local setting as from a similar program on the college campus?

Noda (1952) has described some additional "blocks" to the implementation of "new" curriculum. This block arises out of the attitude of the teacher and the nature of the teacher relationship with the administrators and with other teachers. To what extent do teachers' attitudes reflect the effectiveness of an inservice program? If their relationship with administrators is a significant factor, then can change be expected in teachers who do not have the support of their administration in using the new program in their classroom? Will those teachers show a difference in their change of attitude when compared to those who do have this type of administrative support or commitment?

The teacher education program exists to help teachers change. What does assessing this change and its relationship to the format of the teacher education program require? Ryans (1963) suggested that teacher effectiveness must be based on a reliable knowledge of the basic character of teachers and the essential components of teaching. When the basic design of the teacher education program is varied, does the teacher's previous teaching experience make a difference?

Will teachers with more formal training in science benefit more from a teacher education program? Will teachers of one grade benefit more than those of other grade levels because the program is more relevant to specific grade level needs?

PROBLEM

New curricula have been developed by cooperating groups that are not part of the local system. Teacher education programs have been developed to assist teachers in implementing the new curricula. To what extent is the anticipated outcome of the teacher education program affected by the location or the agency providing the program?

Anticipated outcomes of a teacher education program include the teacher's competency in the subject matter and change in attitude toward the program. Variables contributing to this anticipated outcome include:

Location of the program,

Previous teaching experience,

Previous science courses, and

Relevance of the teacher education program to grade level taught.

DESIGN OF STUDY

In this study the "new" curriculum was the same for all participants. It was Science - A Process Approach, developed by the Commission on Science Education for the Americian Association for the

Advancement of Science for instruction in elementary schools. This curriculum is one which utilizes science topics to develop specific cognitive skills in science, such as observing, inferring, predicting, classifying, communicating, using numbers, and using space/time relationships. The program emphasizes active student involvement in gathering data from their experience and learning how to organize that data for interpretation.

The inservice program for teachers was that which has been developed, in part, by the Commission on Science Education of the American Association for the Advancement of Science, and, in part, by the Science Inservice Project of the Science Education Center of the University of Texas. This program has been described by Butts (1967) and Willson (1967). It emphasizes both background knowledge of the "new" curriculum and experience with a variety of strategies for teaching through interaction with students. All in the experimental group participated in inservice sessions based on this teacher education program.

THE SAMPLE

The sample included three groups:

Group A was composed of 33 teachers who participated in the college-credit plan. This was a group, supported by a National Science Foundation grant, that attended a six-hour credit course within a small four-year

church related college. In this six-hour course, the instructor placed emphasis on content in physics. Course content was selected from Science - A Process Approach and other college texts. As part of the weekly three-hour class, sessions of the teacher education program were also used with this group. Each of the participants received a travel and book allowance, six semester hours of advanced or graduate credit in education toward certification or degree purposes. Participants were not committed and in general did not teach the curriculum in their classroom. The participants exhibited a range of teaching experience from 0 to 35 years with a median of 5.5 years. They had from 0 to 72 hours of previous course work in science with a median of 8.5 hours. The grade level distributions can be seen in Table 1.

Group B included 33 teachers who were selected to participate in a week long pre-school workshop. This workshop was comprised of the teacher education program for implementation of Science - A Process Approach. Each teacher received a small stipend for attending. The workshop included instruction and practice in the science processes, informal discussions and evaluations. It was followed by six one-day visits by the workshop

TABLE 1

SURVEY OF DISTRIBUTION OF SAMPLE

	A	B	C
Median Years of Teaching Experience.	5.5 years	6.0 years	5.3 years
Median Hours of Science Courses	8.5 hours	9.3 hours	11.0 hours
Grade Distribution			
N	33	33	74
1	4	8	20
2	6	4	10
3	3	10	11
4	4	6	14
5	2	1	12
6	11	4	7
7	2	-	-
8	1	-	-

consultant to the participating schools. During these monthly visits the consultant observed teaching procedures, gave demonstration lessons, and assisted in pedagogical problems. Hour-long group sessions were conducted after school during each visit. Teachers were committed to the teaching of Science - A Process Approach in the classroom during the academic year, with equipment and other support supplied by the school district. The teachers in this group had from 0 to 38 years teaching experience with a median of 6 years. They had from 0 to 30 hours of college science courses with a median of 9.3 hours. Their grade level distribution is indicated in Table 1.

Group C was comprised of teachers involved in a released-time inservice plan. It included 74 teachers from 17 elementary schools in Austin and the surrounding area. They met for 11 half-day sessions during the school year. Substitute teachers were provided for the participants' classroom during the workshop hours. Teachers received instruction and practice in the processes of science as outlined by the teacher education program which was adapted to the area needs by the Science Inservice Project. Teachers discussed pedagogical problems informally with a consultant and

each other. Classroom teaching of the innovation began after the fourth instructional period. Materials were supplied by the school system. Teachers were on the regular payroll although not in their classroom during their inservice sessions. The inservice program occurred during regular school hours so that no additional stipend was necessary for the participating teachers. Supervisory and administrative personnel within the school system selected the participants. Previous teaching experience of this group ranged from 0 to 34 years with 5.3 years as the median. They had from 0 to 30 hours of science courses with 11 hours as the median. The distribution of these teachers is indicated in Table 1.

DESIGN AND INSTRUMENTATION

A pre-test battery was administered to Groups A, B, and C prior to the involvement of the teacher education program. Following the program a post-test battery was administered to the three groups.

TEACHER PROCESS MEASURE

For the predictor variables of the knowledge in science the Teacher Process Measure was used. THis instrument consists of 26 items designed to assess science competencies of the teacher. (Commission on Science Education. 1967)

SEMANTIC DIFFERENTIAL

For the criterion variable of perception of the innovation, a form of the Semantic Differential was used. The instrument is composed of twelve stimulus, or protocol words, each accompanied by the same twelve pairs of polar words. Responses are indicated on a seven point scale between polar pairs. Scores are expressed in terms of the factors of evaluation, potency and activity.

ANALYSIS

Regression analysis was made of the differences between pre- and post-test scores for each measure.

FINDINGS

1. Does the opportunity to use the program in the classroom affect a teacher's competence in science? Based on analysis of the difference scores on the Teacher Process Measure, it appears that opportunity to use the program in the classroom does affect a teacher's competence in science. Beta weights indicate that the variables of training group make a significant contribution to a change in teacher competence in science with Group B (pre-school) showing the greatest gain, all other variables held constant. (Tables 2 and 3)

2. Does previous teaching experience affect a teacher's competency in science? Analysis of the data of this study indicated that there is no relation between previous teaching experience and competency in science. (Table 3)

TABLE 2

GROUP DIFFERENCES IN TEACHER PROCESS MEASURE
CHANGE SCORES
N=140

GROUP	BETA WEIGHTS
A	-0.3398
B	11.7451
C	2.3023

TABLE 3

VARIABLE EFFECT ON COMPETENCY IN SCIENCE AS
MEASURED BY THE TEACHER PROCESS MEASURE
N=140

Variable	B Weight	Probability Level
Training Group	(See Table 1)	<.01
Years Teaching Experience	-	ns
Hours Science	.1474	<.03
Grade Level Taught	-	ns

3. Does previous science training effect a teacher's competency in science? Analysis of the data of this study indicates that the greater the amount of previous science training the greater will be the teacher's competence in science as measured by the Teacher Process Measure. (Table 3)

4. Does the grade level a teacher teaches affect competence in science? Analysis of the data of this study indicates that there is no relation between the grade level taught and a teacher's competency in science. (Table 3)

5. Does the opportunity to use the curriculum in the classroom affect teacher's attitude? In this study significant relations were found between the treatment groups and change scores in thirteen of the thirty-six criterion varible of the Semantic Differential. (Table 4) The released-time group (Group C) showed a positive gain in eleven of the thirteen significant relations. Regression of attitude for Group C was evident only with regard to the value and impact this group perceived in the principal's view of the curriculum innovation. The college-credit group (Group A) showed a positive gain, though not as pronounced, in nine of the thirteen significant relations. Negative attitudes were revealed for this group in their perception of the acitvity of science, teaching, inservice training, and the communities view of the curriculum innovation. The pre-school workshop group (Group B) showed regressive attitudes in ten of the thirteen significant relations. Slight positive change in attitude was evident

TABLE 4
COMPARISON OF TREATMENT GROUPS RESPONSES TO CHANGE SCORES IN EIGHT PROTOCOLS OF THE SEMANTIC DIFFERENTIAL
N=140

Semantic Differential		A	B	C	Probability
Protocol	Factor	B Weight	B Weight	B Weight	Level
Science	Activity	-.4050	.1025	2.1010	<.01
Teaching	Activity	-.0401	.8996	2.7454	<.01
Inservice	Evaluation	.0693	-2.6204	.1736	<.01
Inservice	Activity	-.0878	-2.2055	.2735	<.05
Scientist	Potency	.3286	-.0608	2.6371	<.01
Science - A Process Approach	Potency	.0468	-.5540	1.4848	<.04
Science - A Process Approach	Activity	.3236	-.6330	1.9472	<.02
Laboratory	Activity	.8467	-.5718	1.8620	<.05
Principal's view of Science - A Process Approach	Evaluation	.3551	-1.8366	-2.7619	<.02
Principal's view of Science - A Process Approach	Potency	2.4740	.0369	-.1224	<.01
Town's attitude toward Science - A Process Approach	Evalulation	1.1035	-1.4717	2.0687	<.01
Town's attitude toward Science - A Process Approach	Potency	0.	-3.5457	.4815	<.01
Town's attitude toward Science - A Process Approach	Activity	-1.0997	-3.8771	.3042	<.01

for this group in their perception of the activity of science and teaching and in the value they placed on their principal's view of the curriculum innovation.

6. Does previous teaching experience affect a teacher's attitude? Analysis of the data of this study indicates that in six of the thirty-six criterion variables of the Semantic Differential there is a greater gain in a teacher's attitude for those teachers who have had previous teaching experience. (Table 5)

7. Does previous science training effect a teacher's attitude? Evidence from this study indicates that a greater amount of previous science training will promote a more positive value of science but tend to create a negative evaluation of a community's view of the curriculum innovation. (Table 5)

8. Does the grade level a teacher teaches affect a change in attitude? In this study significant relations were evident for only two of the thirty-six criterion variables of the Semantic Differential and grade level taught. The value which a teacher places on the curriculum innovation and on the principal's view of that curriculum innovation stimulated a positive change in attitude for first and fourth grade teachers. For second, third, fifth amd sixth grade teachers there was a distinct regression in attitude for these criterion variables. (Table 6)

TABLE 5

EFFECT OF YEARS OF TEACHING AND HOURS IN SCIENCE ON TEACHER ATTITUDE AS MEASURED BY THE SEMANTIC DIFFERENTIAL

N=140

Semantic Differential		Years of Teaching		Hours in Science	
Protocol	Factor	B Weight	Probability Level	B Weight	Probability Level
Science	Evaluation	-	-	.6667	<.03
Inservice	Protocol	.1136	<.01	-	-
Inservice	Activity	.0954	<.01	-	-
Science - A Process Approach	Potency	.0797	<.02	-	-
Principal's view of Science - A Process Approach	Evaluation	.1274	<.01	-	-
Principal's view of Science - A Process Approach	Potency	.1073	<.01	-	-
Principal's view of Science - A Process Approach	Activity	.1227	<.01	-	-
Town's attitude toward Science - A Process Approach	Evaluation	-	-	-.1312	<.01

TABLE 6

EFFECT OF GRADE ON TEACHER ATTITUDE
N=140

Semantic Differential		1	2	3	4	5	6	
Protocol	Factor	B Weight	B Weight	B Weight	B Weight	B Weight	B Weight	Probability Level
Science - A Process Approach	Evaluation	.0657	0.	-.6885	.0469	-3.4220	-.7614	<.04
Principal's view of Science - A Process Approach	Evaluation	2.8735	-.0783	-.2252	1.5825	-.8517	-1.9235	<.01

CONCLUSIONS

The format of the teacher education program does appear to contribute to change in the teacher's competence in science and attitude for the curriculum innovation. The significant relationship between the change in the teacher's perception of the principal's attitude toward the new curriculum and the commitment of the school district would seem to indicate that a teacher takes more from an inservice program when she is aware of the appropriateness and approval of the administration for her to use the knowledge gained from the inservice in her classroom.

In this study previous teaching experience and grade level taught appear to have no relevance to a teacher's competency in science. This suggests that the philosophy of the curriculum innovation is such that it represents a common challenge in science for all teachers regardless of past teaching experience. With regard to recency of training, it also suggests that, those teachers who had fewer years teaching experience are equally unprepared for the philosophy of the new curriculum as those with more years of teaching experience. The program also appears to be equally relevant for all grades as far as competence in science is concerned.

The amount of previous science training appears to be a significant contributor to the effect of the teacher education program. This supports the inference that an extensive knowledge base provides a greater potential for change.

The greatest gain among the treatment groups of this study in competence in science was evident for the pre-school workshop group. Although this finding is strongly supported by the data, it is puzzling that this same group shows significant regression in attitude toward inservice work, the curriculum innovation, the principal's view and the community's attitude toward the curriculum innovation. Increased competence in science, to a lesser degree, was also evident for the released-time group. However, this group indicated the greatest gain in attitude. It may be possible that the pre-school workshop group advanced significantly in science competence due to a condensed period of training, but suffered a regression in attitude due to an inability to immediately apply their new found competence in the classroom. Is it possible that a smaller and more gradual increase in science competence is more conducive to a greater gain in teacher attitude? For an improvement in both competence in science and teacher attitude it appears that the released-time format of teacher training is more effective.

Further analysis of teacher attitude indicates that those teachers with more previous teaching experience are more perceptive of the impact of an inservice program and their active involvement in it. They are also more aware of the impact of the curriculum innovation and are much more concerned about how their principal views the curricular innovation than are those teachers with little previous experience.

Previous science training does appear to enhance a teacher's attitude toward wanting to be involved in a curriculum innovation that focuses on science. However, teachers with previous science training appear to have a less positive image of the community's attitude toward the curriculum innovation.

The value a teacher places on the curriculum innovation and on the principal's view of that innovation resulted in a positive feeling for first and fourth grade teachers. For all other grade levels this feeling is negative. There is no clear deliniation between primary and intermediate teachers, and there is insufficient evidence from this study to identify specific reasons for grade level differences in teacher attitude.

SUMMARY

New curricula have been prepared by cooperating groups of scientists and science educators. These curricula reflect a teaching philosophy that is different from that maintained by many teachers. A teacher education program has been developed to meet this need. The question of this study is: What conditions affect the impact of the teacher education program when it's impact is described in terms of competency in science and attitude toward both the curriculum innovation and the teacher education program?

Organization and location of the teacher education program is a relevant condition. For an improvement in both competence in science and teacher attitude it appears that the released-time format of teacher training is more effective. Previous science courses appear to be a relevant condition for increased competence in science and, to a limited extent, for a more positive attitude toward science. Previous teaching experience and grade level taught do not appear to be related to competence in science but are related to a teacher's attitude.

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