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ABSTRACT

Presented are the procedures, results, and conclusions of an experimental study designed to (1) determine the effects of the 1967-68 science inservice program of the Archdiocese of San Francisco, and (2) compare the effects of three seventh-grade science programs utilizing different laboratory materials. The experimental group consisted of 499 seventh-grade students in seven parochial schools in San Francisco. These students used the text and laboratory materials supplied through the inservice program. Their performance on the Portland Science Test was contrasted with the performance of other seventh grade students in two control groups. The first control group consisted of 475 severth-grade students of the previous year in the same schools. The second control group consisted of 127 seventh-grade students of the academic year 1967-68 in four parochial schools located away from San Francisco by matching the socio-economic level, the preparation of the teachers, and the use of the text. Major findings of the study were (1) that there were significant differences between the mean scores in 1968 and 1967, (2) that, in every instance, the mean score achieved in 1968 was lower than the score in 1967, and (3) that there were no significant differences between the mean scores of the experimental group and the mean scores of the second control group. (LC)

THE COMPARATIVE EFFECTS OF THREE SEVENTH-GRADE SCIENCE PROGRAMS WITH DIFFERENT LABORATORY MATERIALS

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Problem of this Study

In the parochial schools of the Archdiocese of San Francisco during the academic year of 1966-1967, most of the seventh-grade students were receiving little or no instruction in science. To introduce quickly the best available new science program, a unique in-service program was organized to help these schools. This study was designed to measure the effects, if any, of the 1967-1968 science in-service program of the Archdiocese of San Francisco. The crash program involved 188 teachers of more than 14,000 students in 146 schools. Each month, the teachers attended a meeting of three hours duration. At each meeting they received laboratory materials for the experiments to be carried out during the month, the opportunity to perform each experiment, and a test for their students. These tests and the textbook emphasized the quantitative approach to science. The textbook used in this program was the pilot edition of Patterns and Processes of Science, Laboratory Text No. 1, which demands a laboratory-centered course and the process of inquiry.

Selection of Samples

The students of seven schools in the Archdiocese of San Francisco

were selected as the representative sample of the entire population of students receiving benefits from the science in-service program. There were three criteria used in selecting these seven schools. First of all, they had to represent the various socio-economic strata found in the parochial schools of the San Francisco Bay Area. These strata were defined by Schallert in A Statistical Study of the Catholic Parishes of the City of San Francisco, California 1960-1965. Secondly, the teachers had to represent the variations in years of teaching experience and in preparations for science teaching. Finally during the year 1966-1967 the teachers had to have followed sincerely the Tentative Outlines Grade 7 - Science by Sister Mary Clarice, a science program which presented traditional general science with little laboratory work.

The last criterion was necessary for two reasons. First of all, most of the seventh-grade teachers of the Archdiocese of San Francisco who were using the directions of Tentative Outlines Grade 7 - Science could provide a sharp contrast between the older program stressing the products of science and the new program emphasizing the process of science. Secondly, to counterbalance the Hawthorne effect, the seven schools were selected on the basis of ambitious interest in the teaching of science during the year before the in-service program. Moreover, the experimental design of the Posttest Only Control Group also limits the Hawthorne effect.

The 499 seventh-grade students in these seven schools during

the academic year of 1967-1968 constituted the experimental group. These students used the laboratory materials supplied through the in-service program. Their performance on the Portland Science Test was contrasted with the performances of other seventh-grade students in the two control groups. The first control group consisted of the 475 seventh-grade students of the previous year in the same schools. The second control group consisted of 127 seventh-grade students of the academic year 1967-1968, in four parochial schools located at a distance from the San Francisco school by matching the socio-economic level, the preparation of the teachers, and the use of the text, Patterns and Processes of Science, Laboratory Text No. 1. The San Francisco teacher differed from the distant teacher primarily because of the San Francisco in-service program which helped in the obtaining and understanding of the laboratory materials. This comparison was made to isolate the effect of the in-service program.

The Test

The Portland Science Test was selected as the best available instrument for comparing the effects of three seventh-grade science programs with different laboratory materials. The most obvious contrast between the old and new programs in these schools was the change in emphasis from the products of science to the processes of science. The Portland Science Test distinguishes between the process and product. It evaluates knowledge of the ways in which scientists learn (processes) as well as what scientists have learned (products).

The Portland Science Test consists of pictures and a series of questions about the pictures. The process items require the student to link together a sequence of two or more mental responses in order to select the best possible answers set forth in the test. The product items demand only simple recall. Hutchinson[2] has provided an evaluation of this test and description of its content. He also explains the establishment of its reliability and validity by studies on students in the Portland Public Schools during tne years of 1961 through 1965. This test is relatively independent of reading skill and is appropriate for seventh-grade students.

Hypotheses

The performances on the Portland Science Test by the seventh-grade students in the experimental group were compared with the performances by the students of the same schools in the first control group to test a major null hypothesis. To shorten the wording of the null hypothesis the following definitions will be used: "Old program" is here defined as the use of Tentative Outlines Grade 7 - Science written by Sister Mary Clarice in 1962; these outlines were used during the year 1966-1967 in the parochial schools of the Archdiocese of San Francisco. "New text" is here defined as Patterns and Processes of Science, Laboratory Text No. 1 by J. A. M. Brock, Donald W. Paulsen, and Fred T. Weisbruch. The pilot edition was published by D. C. Heath and Company for use during the year 1967-1968. "In-service materials" is here defined as the equipment and materials

obtained or produced by the staff of the in-service program in the Archdiocese of San Francisco during the year 1967-1968 and distributed to the teachers through the monthly in-service workshop meetings. "Performances" in all of the following null hypotheses is qualified by the phrase "as measured by the Portland Science Test."

> There is no significant difference in the performances between students enrolled in the old program and those using the new text with the in-service materials.

The performances on the Portland Science Test by the seventh-grade students in the experimental group were compared with the performances by the students of the distant schools in the second control group to test the following major null hypothesis:

> There is no significant difference in the performances between students using the new text with in-service materials and those using the new text without these materials.

Both of the major null hypotheses had two related minor null hypotheses. The first considered the students' performances in using the processes of science. The second minor null hypothesis considered the students' performances in learning the products of science. For example, the two minor hypotheses related to the second major null

hypothesis are the following:

a. There is no significant difference in the performances in using the processes of science between students using the new text with in-service materials and those using the new text without these materials.

b. There is no significant difference in the performances in learning the products of science between students using the new text with in-service materials and those using the new text without these materials.

Results

Stronck's[3] analysis of the test results required the rejection of the first major null hypothesis and its related minor null hypotheses. Table I gives the results of tests for significance of mean differences in San Francisco schools using the Portland Science Test in 1967 and 1968. In every instance the score achieved in 1968 was lower than the score in 1967. When the scores of all students of 1967 are compared to the scores of all students of 1968, there are significant differences at the one percent level of confidence for the process questions, the product questions, and the total of all questions. In most of the seven schools there is a significant difference between the means on the process questions and between the

means on the product questions.

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Insert Table I about here.
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Many teachers have suggested that the decline in performances was chiefly from the fact that the items of the Portland Science Test favor the contents of the older science program. The new science program of 1967-1968 stressed the development of the quantitative approach; the students learned to do the processes of measuring, analyzing graphs, calculating areas, volumes and densities. But the Portland Science Test did not require any of the quantitative processes. Because of its emphasis on quantitative problem, the new text Patterns and Processes of Science is a radical departure from the materials usually considered in a general science course. The difficulty of comparing it with the older programs was not apparent until after the testing. Earlier the contrast between process and product was judged as most important.

The second major null hypothesis and its two related minor null hypotheses were accepted. Table II gives the results of tests for the significance of the mean difference in the paired schools using the Portland Science Test in 1968. The acceptance of this major null hypothesis indicates that the in-service program seemed to produce results similar to those in distant schools where enthusiastic and capable teachers freely chose the use of Patterns and Processes

Table I

Results of Tests for Significance of Mean Difference in San Francisco Schools Using the Portland Science Test in 1967 and in 1968.

School	Test	N 1967	Mean 1967	N 1968	Mean 1968	t Statistic
A	Process	31	17.419	38	15.078	3.2199**
A	Product	31	17.612	38	16.157	1.8036*
A	Total	31	35.032	38	31.236	2.8790**
B	Process	87	16.241	90	13.555	4.3911**
B	Product	87	17.873	90	14.022	6.4718**
B	Total	87	34.114	90	27.577	5.9247**
C	Process	79	15.632	82	14.243	2.1095**
C	Product	79	16.189	82	16.048	0.2003
C	Total	79	31.822	82	30.292	1.2153
D	Process	35	16.000	35	14.914	1.2396
D	Product	35	16.914	35	15.514	1.4591
D	Total	35	32.914	35	30.428	1.5010
E	Process	49	16.693	49	14.061	3.4862**
E	Product	49	17.469	49	15.959	2.2305**
E	Total	49	34.163	49	30.020	3.2526**
F	Process	84	14.916	85	13.823	1.9493*
F	Product	84	14.773	85	14.752	0.0376
F	Total	84	29.690	85	28.576	1.1270
G	Process	110	13.818	120	13.466	0.7304
G	Product	110	15.036	120	14.008	1.9773**
G	Total	110	28.854	120	27.475	1.5546
all	Process	475	15.450	499	13.953	6.0469**
all	Product	475	16.258	499	14.933	5.1495**
all	Total	475	31.709	499	28.887	6.1882**

* Significant at the 5% level of confidence.
**Significant at the 5% and the 1% level.

of Science. Careful investigation revealed that the teachers in only eleven parochial schools at a distance from San Francisco were using the same modern textbook during the same year. Correspondence with these teachers revealed that they were teachers of unusual qualities of talent and interest in science. Without the help of an in-service program, they spent many hours in ordering laboratory materials, composing examinations and attempting to understand the contents of the program.

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Insert Table II about here.
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Conclusion

The great achievement of the in-service program was the sudden introduction of modern science education into the 146 Catholic schools of the San Francisco Bay Area. This in-service program saved the teachers both time and money. Without these savings, few of these teachers could have presented the new science course even if they had the knowledge and interest needed to present the course. The statements made by the teachers strongly indicated that the in service program was necessary in order to make possible a laboratory-centered curriculum.

This study led to the following conclusions: (1) A quantitative general science course provides significantly less scientific facts and processes than a descriptive general science course. (2) An in-service program can suddenly introduce a radically new laboratory-centered program into all the schools of a large district.

Table I

Results of Tests for the Significance of the Mean Differences in [illegible] Paired Schools Using the Portland Science Test in 1968.

Test	San Francisco School	N	Mean	Distant School	N	Mean	t Statistic
Process	A	38	15.078	H	17	16.352	1.3746
Product	A	38	16.157	H	17	16.235	0.0684
Total	A	38	31.236	H	17	32.588	0.7700
Process	D	35	14.914	K	31	15.290	0.4517
Product	D	35	15.514	K	31	15.870	0.3376
Total	D	35	30.428	K	31	31.161	0.4357
Process	E	49	14.061	L	45	14.755	0.8415
Product	E	49	15.959	L	45	16.022	0.0855
Total	E	49	30.020	L	45	30.777	0.5428
Process	G	120	13.466	M	34	13.441	0.0355
Product	G	120	14.008	M	34	13.323	0.9477
Total	G	120	27.475	M	34	26.764	0.5549

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