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AUDIO-LINGUAL RESULTS IN THE SECOND YEAR OF RESEARCH--1961-62. DENVER-STANFORD PROJECT ON THE CONTEXT OF INSTRUCTIONAL TELEVISION, REPORT NUMBER 8.

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THIS REPORT, BY MEANS OF NUMEROUS STATISTICAL TABLES ANALYZING THE RESULTS OF SPEAKING AND LISTENING COMPREHENSION TESTS, EXPLORES THE RELATIVE EFFECTIVENESS OF VARIOUS INSTRUCTIONAL TECHNIQUES USED TO SUPPLEMENT THE BASIC TELEVISED INSTRUCTION FOR FIFTH- AND SIXTH-GRADE SPANISH PUPILS, AND THE INTERACTION EXISTING AMONG VARIOUS COMBINATIONS OF TECHNIQUES. FOR FIFTH-GRADE PUPILS, THE BASIC 15 MINUTES EACH OF TELEVISED INSTRUCTION AND ECLECTIC CLASSROOM PRACTICE WERE SUPPLEMENTED IN THREE RESEARCH GROUPS RESPECTIVELY BY (1) ELECTRONIC AIDS, (2) A SECOND VIEWING AT HOME, AND (3) BOTH METHODS. BY FAR THE STRONGEST FACTOR INFLUENCING THE EFFECTIVENESS OF EACH METHOD WAS THE PRIOR TRAINING AND EXPERIENCE OF THE CLASSROOM TEACHER. SIXTH-GRADE RESULTS YIELDED THE FOLLOWING CONCLUSIONS--(1) THE EFFECTIVENESS OF ELECTRONIC AIDS DEPENDED ON THE TEACHER'S EXPERIENCE, (2) FOR READING AND WRITING, TEACHER DIRECTION PROVED FAR SUPERIOR TO AUTOMATED INSTRUCTION, AND ALSO INCREASED THE VALUE OF ELECTRONIC AIDS, (3) READING AND WRITING THE WHOLE YEAR IS DEFINITELY SUPERIOR TO READING AND WRITING THE SECOND SEMESTER ONLY. FOR COMPANION DOCUMENTS SEE ALSO FL 000 147, FL 000 813, AND FL 000 820. (RW)

AUDIO-LINGUAL RESULTS IN THE SECOND YEAR OF RESEARCH—1961-62

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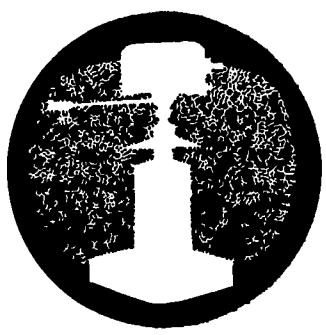

Denver Public Schools • Stanford University

RESEARCH ON THE CONTEXT OF INSTRUCTIONAL TELEVISION

AUDIO-LINGUAL RESULTS IN THE SECOND YEAR OF RESEARCH--1961-62

by

John L. Hayman, Jr.
James T. Johnson, Jr.

DENVER-STANFORD PROJECT ON THE CONTEXT OF INSTRUCTIONAL TELEVISION

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School District Number One
City and County of Denver
Denver, Colorado

Institute for Communication Research
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AUDIO-LINGUAL RESULTS IN THE SECOND YEAR OF RESEARCH--1961-62

by

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The Denver Public Schools and Stanford University's Institute for Communication Research are currently engaged in a joint research project on the context of instructional television. The purpose of the project is to learn how instructional television can best fit into the total teaching situation. A substantial amount of research has established that television is a very effective teaching medium. Ways of combining it with other educational activities must now be considered, and the Denver-Stanford project is a beginning effort in this direction. Kenneth E. Oberholtzer is principal investigator for the Denver Public Schools and Wilbur Schramm is principal investigator for Stanford University. This is one of a number of project progress reports.

The Denver-Stanford Project on the Context of Instructional Television is concerned with teaching Spanish to fifth and sixth grade pupils in the Denver Public Schools, with television the basic instructional medium. The project investigates school and home activities which, as additions to the television instruction, will increase the amount of Spanish the pupils learn.

Two of the most important language skills which pupils must acquire are understanding and speaking, and this report describes research related to the development of these skills. Research in the first year of the project, the 1960-61 school year, together with the background and general hypotheses to be tested in the project were reported previously (1). This report is concerned with 1961-62, the second year of the project.

THE AUTHORS

John L. Hayman, Jr., is director of the Denver-Stanford project for Stanford University and is specifically responsible for research methodology and analysis in the project.

James T. Johnson, Jr., is director of the Denver-Stanford project for the Denver Public Schools and is responsible for coordination of all project activities.

SUMMARY

The Problem

The development of understanding and speaking skills in elementary school Spanish instruction is a major concern in the Denver-Stanford project. Both fifth and sixth grade pupils in the project see a 15-minute television lesson concerned with these skills, and, based on the first year's results, all pupils receive 15 minutes of teacher-directed, eclectic classroom practice following the television lesson.

Still to be determined is the effect of electronic devices, such as record players and tape recorders, and of additional viewings of the television lessons on the ability to understand and speak Spanish. In addition, reading and writing instruction is introduced at sixth grade, and its effect on the audio-lingual skills must be evaluated.

Results

Fifth grade pupils were randomly divided into four groups. One group had no instruction in addition to television and that provided by the classroom teacher. The other three groups had additional practice through, respectively, electronic aids, a second viewing of the television lesson at home in the evening, and a combination of electronic aids and evening viewing. Listening comprehension and speaking tests were given at the end of each semester, and results fell into a meaningful pattern when arranged according to teacher training and experience as well as by instructional method. Pupils with teachers high on the training and experience scale did best when there was no additional activity. Those with teachers in the middle scale position performed best if electronic aids were used. And those with teachers low on the scale profited most from viewing the television lesson again in the evening. Thus the relative effectiveness of each instructional method depended on the classroom teacher's prior training and experience.

At sixth grade, three experimental conditions were established: use of electronic aids versus no aids, introduction of reading and writing instruction the first semester versus introduction of this instruction the second semester, and teacher-directed reading and writing instruction versus automated reading and writing instruction. These conditions were arranged in all possible combinations so that there were eight research groups. Relative to audio-lingual results, the finding of greatest certainty was that reading and writing the entire year is definitely superior to reading and writing the second semester only. A second finding, which corroborated fifth grade results, was that the value of electronic aids varies with the training and experience of classroom teachers. Finally, the use of electronic aids interacted with reading and writing instruction. Electronic aids were most effective and teachers' abilities in using them seemed to increase most in the teacher-directed reading and writing situation. This result is somewhat surprising since electronic aids were used only on Tuesdays and Thursdays, as part of the regular audio-lingual instruction, while both types of reading and writing instruction were conducted on Wednesdays. Evidently pupil-teacher rapport is increased when the teacher handles the reading and writing phase, and the rapport, in turn, influences the teacher's efficiency -- at least in the use of electronic aids -- on Tuesdays and Thursdays.

Fifth grade is the first year in which pupils have foreign language instruction in Denver, and, in accord with FLES (Foreign Language in the Elementary School) recommendations, the first year's instruction is entirely audio-lingual. That is, the first year's instruction is devoted entirely to the development of understanding and speaking skills. During sixth grade, reading and writing are introduced; however, audio-lingual instruction continues, and the understanding and speaking skills are still heavily emphasized.

This report presents the 1961-62 audio-lingual results in separate sections for the fifth and sixth grades. The research designs and interpretations reported in each section are based to some extent on previous results (1).

Fifth Grade

a. Research Design

At fifth grade there were four basic research groups. One of these had eclectic classroom practice only, the second had eclectic practice plus electronic aids (record players with headsets), the third group had eclectic practice and was asked to view the TV lessons again in the evening, and the fourth group had eclectic practice, electronic aids, and evening viewing. The electronic aids were first used during 1961-62, while the second TV viewing was a repeat of 1960-61 research which gave inconclusive results. The research design was the same both semesters.

Fifth grade instruction was entirely audio-lingual; that is, pupils listened to and spoke Spanish but had no reading or writing. This follows the general teaching methodology which calls for at least one year of exclusively audio-lingual instruction.

At the end of each semester, fifth grade pupils were given two tests -- a listening comprehension test to measure their understanding of spoken Spanish, and a speaking test to measure their ability to speak the language. Based on the previous year's experience, no pre-test was given at the beginning of the

year, while the first semester test served as a pre-test for second semester results. Information collected for control purposes included IQ, grade point average (GPA), and Stanford Achievement Test scores in paragraph meaning (PM), word meaning (WM), spelling (SP), and language (L).

Fifth grade research groups and the number of pupils from each in the listening comprehension test analyses are shown in table 1. The first semester numbers represent approximately a 25 per cent random sample of the total fifth grade population. The same individuals were used in each analysis, and the second semester numbers are lower because some pupils did not complete the final test. No additions were made because each group still had more than the 300 pupils considered satisfactory. A random sample of 40 pupils from each group was given speaking tests.

Table 1

EXPERIMENTAL GROUPS AND NUMBERS OF SUBJECTS IN ANALYSES OF THE FIFTH GRADE LISTENING COMPREHENSION TEST

Group	Number of Subjects: First Semester	Second Semester
Eclectic Practice	407	306
Eclectic Practice + Electronic Aids	404	335
Eclectic Practice + Evening TV Viewing	408	330
Eclectic Practice + Evening Viewing + Electronic Aids	410	309
Total	1629	1280

b. First Semester Results

The one-dimensional covariance analysis of differences between experimental groups on the first semester listening comprehension test produced results shown in table 2.

Table 2

COVARIANCE ANALYSIS
OF DIFFERENCES BETWEEN EXPERIMENTAL GROUPS
ON THE FIRST SEMESTER LISTENING COMPREHENSION TEST

Source of Variation	Residual		
	Degrees of Freedom	Sum of Squares	Mean Square
Total	1625	89,442.992	
Within Groups	1622	89,342.902	55.082
Between Groups	3	100.090	33.363

$$F = \frac{33.363}{55.082} = 0.606$$

$$n_1 = 3 \qquad n_2 = 1622$$

$$P > .30$$

Differences among the four experimental groups were not statistically significant. Means of test scores and of control variables used in the analysis are in table 3, and adjusted test scores, standard deviations, and variances are in table 4. Since the covariance analysis indicated that no group differences were significant, no comparison of individual group means was made.

Table 3

UNADJUSTED TEST MEANS
AND MEANS OF THE CONTROL VARIABLES FOR THE
FIFTH GRADE LISTENING COMPREHENSION TEST

Variable	Group				
	Eclectic	Eclectic + Electronic Aids	Eclectic + Evening Viewing	Eclectic + Electronic Aids + Evening Viewing	Total
Test	36.027	36.463	35.951	35.954	36.098
PM	5.331	5.296	5.279	5.123	5.257
GPA	2.675	2.725	2.681	2.546	2.657
IQ	103.568	105.569	102.507	101.637	103.312

Table 4

ADJUSTED TEST MEANS,
STANDARD DEVIATIONS, AND VARIANCES
ON THE FIRST SEMESTER LISTENING COMPREHENSION TEST

	Group			
	Eclectic	Eclectic + Electronic Aids	Eclectic + Evening Viewing	Eclectic + Electronic Aids + Evening Viewing
Test	35.903	36.020	35.974	36.491
σ	9.245	7.736	8.293	8.143
σ^2	85.470	59.846	68.774	66.308

The adjusted test means follow a logical pattern in spite of the lack of significant differences. The eclectic practice alone group is lowest, the eclectic plus evening viewing is slightly higher, eclectic plus electronic aids is still higher, and the combination of all three practices is highest.

Group means, standard deviations, and variances on the speaking test are given in table 5, and tests of significance of differences between groups are in table 6. The mean for pupils with electronic aids was 7.606 and for those without electronic aids was 7.394.

Table 5

MEANS, STANDARD DEVIATIONS, AND VARIANCES
ON THE FIFTH GRADE SPEAKING TEST

	Group			
	Eclectic	Eclectic + Electronic Aids	Eclectic + Evening Viewing	Eclectic + Electronic Aids + Evening Viewing
Mean	6.913	7.663	7.875	7.550
σ	2.797	2.020	2.146	2.539
σ^2	7.823	4.080	4.605	6.447

Table 6

SIGNIFICANCE OF DIFFERENCES BETWEEN GROUPS
ON THE FIFTH GRADE SPEAKING TEST

Groups	Difference	D_M	CR	Probability
(Second Viewing) - (Eclectic)	0.962	.395	2.435	<.02
(Second Viewing) - (Eclectic + Electronic Aids + Second Viewing)	0.325	.373	<1.000	>.30
(Electronic Aids) - (Eclectic)	0.750	.386	1.943	<.06
(Eclectic + Electronic Aids + Second Viewing) - (Eclectic)	0.637	.423	1.506	.12
(Second Viewing) - (Electronic Aids)	0.212	.330	<1.000	>.30
(Electronic Aids) - (No Electronic Aids)	0.212	.384	<1.000	>.30

Pupils with eclectic practice alone did not do as well on the speaking test as pupils with other combinations of instructional experience. No significant differences occurred among the other research groups, although those who viewed a second time at night had the highest mean, and electronic aids groups did slightly better than those without electronic aids.

c. Second Semester Results

A more detailed analysis of listening comprehension results was possible at the end of the second semester through use of the teacher training and experience scale (2). Results were divided two ways -- according to research group and to the training and experience of teachers. The covariance analysis of this two-dimensional design, and with first semester performance used as a control variable, is shown in table 7.

Table 7

COVARIANCE ANALYSIS OF THE
SECOND SEMESTER LISTENING COMPREHENSION TEST:
RESEARCH GROUP BY TEACHER TRAINING AND EXPERIENCE

Source of Variation	Residual			F Ratio	Probability
	Degrees of Freedom	Sum of Squares	Mean Square		
Research Group	3	1.203	0.401	< 1.000	>.30
Teacher Training and Experience	2	173.159	86.580	10.722	<.001
Interaction	6	122.723	20.454	2.533	<.05
Within Groups	1266	10,222.386	8.075		

As in the first semester, no significant difference was found among the research groups. Teacher training and experience produced a highly significant difference, however, and the significant interaction means that the effect of teacher training and experience was not consistent from group to group. A careful examination of test means in the two-dimensional design is therefore in order. Unadjusted test scores for the first and second semesters are given in table 8, and adjusted second semester scores are shown in table 9. Since the first semester test was used as a control variable (3), only second semester learning is reflected in table 9.

The inconsistency is easily seen. Pupils with teachers high in training and experience did best with eclectic classroom practice alone. Where teachers were in the middle training and experience position, pupils with electronic aids did best. And for teachers low in training and experience, the group with the second viewing in the evening was superior. Thus the electronic aids were most valuable to the middle group, while a second viewing of the TV lesson (exact repetition) was most valuable to the lower group.

Table 8

UNADJUSTED FIRST AND SECOND
SEMESTER LISTENING COMPREHENSION TEST MEANS:
RESEARCH GROUP BY TEACHER TRAINING AND EXPERIENCE

Teacher Training and Experience		Group				
		Eclectic	Eclectic + Electronic Aids	Eclectic + Evening Viewing	Eclectic + Electronic Aids + Evening Viewing	Total
High	1st Sem.	38.300	37.311	37.521	36.293	37.354
	2nd Sem.	39.087	37.061	37.775	36.980	37.727
Middle	1st Sem.	38.046	35.808	35.583	36.265	36.329
	2nd Sem.	37.862	37.096	36.396	37.197	37.092
Low	1st Sem.	31.468	35.659	35.061	34.786	34.190
	2nd Sem.	32.149	35.268	36.020	34.619	34.503
Total	1st Sem.	37.160	36.454	36.339	36.078	36.502
	2nd Sem.	37.585	36.857	36.933	36.741	37.023

Table 9

ADJUSTED SECOND SEMESTER
LISTENING COMPREHENSION TEST MEANS:
RESEARCH GROUP BY TEACHER TRAINING AND EXPERIENCE

Teacher Training and Experience	Group				
	Eclectic	Eclectic + Electronic Aids	Eclectic + Evening Viewing	Eclectic + Electronic Aids + Evening Viewing	Total
High	37.751	36.390	36.973	37.236	37.091
Middle	36.610	37.625	37.073	37.559	37.243
Low	36.024	35.730	37.023	35.748	36.166
Total	37.080	36.847	37.022	37.155	37.023

The TV repetition results seem to support the 1960-61 finding that an inverse relationship exists between the value of repetition and the use of classroom practice. As an additional test of this relationship, the viewing calendars of both evening viewing groups were examined. These calendars were

given to pupils at the beginning of each semester, and the pupils were asked to mark each date that they watched the evening program. Many of the calendars were not returned, and incomplete data further reduced the usable number to 137. However, as table 10 shows, the information received fits a very consistent pattern. Table 10 gives the relationship between number of evening programs viewed and listening comprehension test score in terms of the Pearson product moment correlation coefficient. (Only children who did not have parent help were used in compiling these results.)

Table 10

CORRELATION BETWEEN
NUMBER OF EVENING PROGRAMS VIEWED
AND LISTENING COMPREHENSION TEST SCORE:
RESEARCH GROUP BY TEACHER TRAINING AND EXPERIENCE

Teacher Training and Experience	Group	
	Eclectic + Evening Viewing	Eclectic + Electronic Aids + Evening Viewing
High	.330	.011
Middle	.170	.137
Low	.677	.259
Total	.303	.179

In each case, the correlation for children with teachers low on the scale is much higher than that of the other groups; and in each comparison, the correlation is lower where electronic aids are an additional factor. This last effect is predictable. The additional factor has an effect on listening comprehension, and this effect, especially since it is inconsistent, would tend to lower the relationship between evening viewing and listening comprehension.

More to the point, a second viewing of the telecast has a much greater effect on those pupils whose teachers are less well trained. These results and the 1960-61 findings suggest some generalizations relative to the value of

repetition as an instructional device. Each Spanish lesson consists of a specific content to be imparted to pupils. That is, there is a maximum amount which can be learned from each lesson. This content is presented first in the telecast, and the same content is presented in a different manner during the 15-minute teacher-directed follow-up. The value of any further instruction will depend on how much of the lesson content the pupils have gained after the first two exposures. If they are at or near the maximum after two exposures, then little more can be gained regardless of the instructional technique used.

The in-school television experience is, of course, the same for all pupils. The 1960-61 results proved that a single viewing, though it is effective, fails to impart maximum content. The classroom teacher's efficiency in increasing the amount learned therefore becomes a determining factor. If the teacher imparts most of the remaining content during the classroom follow-up, the evening television viewing can have little effect. Conversely, if the teacher imparts only a small proportion of the remaining content, much can be gained from the second viewing.

Our results on repetition fit this pattern neatly if we make the further assumption that teaching efficiency increases with training and experience. (This is meant only in the group average or statistical sense, of course; there are many individual exceptions at both ends of the training and experience continuum.) To state this idea simply, under conditions of this study the amount of learning produced by exact repetition of the TV lesson will vary inversely with the efficiency of instruction which pupils receive in the classroom.

Returning to table 9 on page eight, the second finding was that electronic aids increased the learning of pupils who had teachers in the middle training and experience group. Though the pattern is not as clear-cut here as for TV repetition, this result can also be explained in terms of content gain and teacher efficiency. (Remember that teacher efficiency is strictly defined as

the ability to induce learning or impart lesson content and is measured in terms of training and experience.)

The material presented through electronic aids was taken from the basic lesson content, the same content used in the telecasts and by classroom teachers in their direct instruction. The electronic aids, then, represented another repetition of this material. It differed from the evening viewing in two respects, however. First, the electronic aids were used in the classroom during the 15-minute follow-up period and thus reduced the direct teaching time of the classroom teacher. Whether pupils learned more with or without the aids would depend, therefore, on the efficiency of the aids relative to that of the teacher. The second point of difference is that the electronic aids presented the material in a different manner than television, and as Carpenter has observed:

> Variations operate to sustain attention, to instigate interest, but also to broaden the pattern of learning. Furthermore, variations of stimulation in all probability aid students to generalize and apply more widely and surely what they have learned (4, p. 368).

According to Carpenter's observation, the electronic aids, if used correctly, should produce more learning than a second viewing of the telecast because they vary the presentation. But they would not necessarily produce more learning than the teacher-directed approach from this point of view, since the teacher also uses a variation. One must know how to use the electronic aids, however, so again teacher efficiency enters the picture.

Evidently teachers low on the training and experience scale even with limited inservice training, were unable to use the aids correctly; teachers in the middle category apparently were able to use the aids to advantage, and, in fact, their direct teaching was less efficient than the aids; and teachers high on the scale were so efficient in direct instruction that their pupils learned more if aids were not used.

In a further analysis of the listening comprehension test results, IQ rather than teacher training and experience was used as the secondary variable.

The IQ breakdown produced differences significant beyond the .001 level. However, group differences were not significant, and no significant interaction occurred. This indicates that higher IQ pupils generally performed best and that the trend was consistent from group to group.

As mentioned previously, a speaking test was administered in May to the same pupils who had one in January. Absences and pupil transfers reduced the original 160 pupils to 139 on this test. The limited numbers, necessary because of the time and effort required to administer and score this kind of test, unfortunately made a division by teacher training and experience impossible, so the only comparison was among the four research groups.

A covariance analysis was made, with the first semester score as the control variable. The F ratio for differences among groups was less than one, with a corresponding probability greater than .30. Thus, as on the listening comprehension test, no significant differences were found. Adjusted group means on the test are given in table 11.

Table 11

ADJUSTED SECOND SEMESTER
SPEAKING TEST MEANS

Group				
Eclectic	Eclectic + Electronic Aids	Eclectic + Evening Viewing	Eclectic + Electronic Aids + Evening Viewing	Total
18.897	17.704	17.879	18.367	18.201

d. Summary and Conclusions

At fifth grade in 1961-62, all pupils viewed the in-school television lesson and had 15 minutes of teacher-directed eclectic practice in the classroom immediately following the telecast. Research groups were arranged so that the value of electronic aids (record players), as a part of the classroom

instruction, and evening viewing of the television lesson, as an addition to in-school activities, could be assessed. This assessment was measured by improvement in listening and speaking skills.

Results fell into a meaningful pattern when arranged according to teacher training and experience as well as by instructional method or combinations of method. Pupils with teachers high on the training and experience scale did best when there was no additional activity. Those with teachers in the middle scale position gained through the use of electronic aids. And those with teachers low on the scale profited from viewing the program again in the evening.

Remembering that both classroom practice and electronic aids involved repetition of material first presented in the telecast, and assuming that the efficiency of classroom teachers increases with training and experience, the results suggest the following generalization. The value of a second viewing of the telecast will depend on the extent to which pupils have already learned the subject material of a particular lesson; and pupils with teachers in the middle or high scale position learn enough from their classroom experience so that another viewing is of relatively little value to them. The value of electronic aids cannot be stated in absolute terms since their use involves reducing the instruction time of the classroom teacher. The amount of learning in this case depends on the efficiency of the electronic aids relative to that of the classroom teacher. The teacher enters this relationship in another way in that certain skills are required to make effective use of the electronic aids.

Both a second viewing of the telecast and use of electronic aids will, therefore, increase learning under particular sets of circumstances. And in a large school system such as Denver, these sets occur with considerable frequency.

Sixth Grade

a. Research Design

At sixth grade all pupils viewed the in-school TV lessons and all had teacher-directed eclectic practice in the classroom. Groups differed according to whether or not they had electronic aids in the classroom and according to their reading and writing instruction. Half of the pupils began reading and writing instruction the first semester, and the other half did not begin until the second semester.

Reading and writing was handled two ways each semester. Approximately half of the pupils used the programed texts, and the other half were taught by their classroom teachers. Since reading and writing results were discussed in a previous report (2), they will not be repeated here. However, reading and writing had an effect on audio-lingual results, and that effect must be considered in evaluating techniques and devices which were primarily designed to improve listening and speaking skills.

Since programs were telecast each Tuesday and Thursday, all pupils had 30 minutes of TV instruction weekly. The 15 minutes following each telecast were devoted to eclectic audio-lingual instruction, so all pupils also had 30 minutes of this type of instruction each week. The 30-minute period on Wednesday, however, was used in different ways by different groups the first semester. Pupils with no reading and writing received 30 minutes of additional audio-lingual instruction during this period while the others were receiving reading and writing instruction. This arrangement meant that pupils without reading and writing the first semester had one-third more time devoted to the development of listening and speaking skills than the others. During the second semester, since all pupils had reading and writing on Wednesday, the time devoted to each skill was equated.

Pupils were measured on their understanding of spoken Spanish (listening

comprehension), their ability to speak Spanish, and their ability to read and write Spanish. The fifth grade final listening comprehension test was administered in September as a pre-test, and sixth grade listening comprehension tests were developed and administered at the end of each semester. All pupils took these tests. Speaking tests were administered to a random sample of 40 pupils from each research group at the end of each semester.

One rather important side study was conducted during the first semester. Ten classes were chosen at random from the groups with automated reading and writing and were given a short phonics introduction to the written word during the first two weeks of the semester. It was felt that the phonics introduction might help prevent anglicizing and therefore improve Spanish pronunciation.

b. First Semester Results

Listening Comprehension.--Two separate covariance analyses were made with the listening comprehension test as the dependent or criterion variable and IQ, paragraph meaning score on the Stanford Achievement Test (PM), grade point average (GPA), and pre-test (PRE) as control variables. One dimension of the analysis (i.e., the primary independent variable) in each run was the different experimental treatments, and the second dimension was, respectively, sex and IQ. On the analysis with IQ as a secondary independent variable, it was not used for control.

The number of subjects from each experimental group in these first semester analyses is shown in table 12. Table 13 gives the analysis of differences between experimental groups.

Table 12

NUMBER OF SUBJECTS FOR ANALYSES
IN EACH EXPERIMENTAL GROUP

Experimental Group		Number of Subjects in Analyses
Eclectic Classroom Practice	(E)	300
Eclectic Classroom Practice + Automated Reading and Writing	(E+A)	300
Eclectic Classroom Practice + Teacher-Directed Reading and Writing	(E+TD)	238
Eclectic Classroom Practice + Electronic Aids	(E+EA)	300
Eclectic Classroom Practice + Electronic Aids + Automated Reading and Writing	(E+EA+A)	300
Eclectic Classroom Practice + Electronic Aids + Teacher-Directed Reading and Writing	(E+EA+TD)	284
Total		1722

Table 13

COVARIANCE ANALYSIS OF DIFFERENCES BETWEEN
EXPERIMENTAL GROUPS ON THE FIRST SEMESTER
LISTENING COMPREHENSION TEST

Source of Variation	Residual		
	DF	Sums of Squares	Mean Square
Total	1711	50,654.606	
Within Groups	1706	49,743.830	29.158
Between Groups	5	910.776	182.155

$$F = \frac{182.155}{29.158} = 6.247$$

$n_1 = 5 \qquad n_2 = 1706$

$P < .001$

The differences between groups were significant with probability less than .001, and individual group comparisons are therefore in order. Unadjusted test means and means for each control variable are shown for each group in table 14, and adjusted test means plus standard deviations and variances are in table 15.

Table 14

UNADJUSTED LISTENING COMPREHENSION TEST MEANS
AND MEANS OF CONTROL VARIABLES
FOR EACH EXPERIMENTAL GROUP
IN THE FIRST SEMESTER

Variable	Group						
	E	E+A	E+TD	E+EA	E+EA+A	E+EA+TD	Total
Test	31.490	33.003	34.660	32.147	31.513	35.637	32.938
PM	6.122	6.277	6.593	6.184	6.720	7.372	6.524
GPA	2.545	2.587	2.791	2.603	2.580	2.869	2.654
IQ	101.017	102.527	103.761	100.433	103.117	107.496	102.889
PRE	32.437	34.550	35.563	32.950	33.010	34.894	33.800

Table 15

ADJUSTED LISTENING COMPREHENSION TEST MEANS,
STANDARD DEVIATIONS, AND VARIANCES
FOR EACH EXPERIMENTAL GROUP
IN THE FIRST SEMESTER

	Group					
	Eclectic	Eclectic + Automated	Eclectic + Teacher Directed	Eclectic + Electronics	Eclectic + Electronics + Automated	Eclectic + Electronics + Teacher Directed
Test	32.532	32.522	33.177	32.911	32.157	34.458
σ	8.612	8.311	8.109	8.615	8.299	7.450
σ^2	74.167	69.073	65.756	74.218	68.873	55.503

The means in table 15 show that those pupils with eclectic practice but no reading and writing did slightly better than those with eclectic practice and automated instruction. Those with teacher-directed reading and writing,

however, did better than the others, and the difference is rather large for the electronic practice groups. Reading and writing instruction, then, appears to have an effect on listening comprehension skills, though not the adverse effect predicted by some of our consultants. Pupils with teacher-directed reading and writing seem to show improvement in their understanding of spoken Spanish.

Electronic aids also appear to have made some difference here, though again the largest gain is among those pupils who had teacher-directed reading and writing. The mean for all pupils with electronic aids was 33.154 and for pupils without electronic aids was 32.712.

Significance of differences between means are given in table 16. Pupils with teacher-directed reading and writing plus electronic aids performed significantly better than any other group, including the teacher-directed group without electronic aids. No other differences were statistically significant. However, pupils with reading and writing instruction did better than those with no reading and writing. This last point is particularly important since the opposition to beginning reading and writing with only one year of audio-lingual instruction was based on the premise that it would adversely effect listening and speaking skills.

Results of the two-dimensional analyses are given in table 17. For each secondary categorization, adjusted means for the categories, frequency ratio, and probability of interaction between the categorization and experimental treatment are shown. No differences were statistically significant.

It should be remembered in reading table 17 that the mean scores are adjusted for differences on control variables. In raw score, the high IQ group was almost seven points higher than the low IQ group, but this difference is accounted for by the control variables.

Table 16

SIGNIFICANCE OF DIFFERENCES BETWEEN GROUPS
ON THE FIRST SEMESTER LISTENING
COMPREHENSION TEST

Groups	Difference	σ_{D_M}	CR	P
(E+TD) - (E)	0.645	.723	< 1.000	>.30
(E+TD) - (E+A)	0.655	.711	< 1.000	>.30
(E+EA+TD) - (E+EA)	1.547	.650	2.380	<.02
(E+EA+TD) - (E+EA+A)	2.301	.652	3.529	<.001
(E+EA) - (E)	0.379	.703	< 1.000	>.30
(E+A) - (E+EA+A)	0.365	.691	< 1.000	>.30
(E+EA+TD) - (E+TD)	1.281	.686	1.867	.06
Electronic - No Electronic	0.442	.406	1.089	>.25
Reading - No Reading	0.300	.429	< 1.000	>.30

Table 17

TESTS OF DIFFERENCES AND INTERACTIONS
FOR TWO-DIMENSIONAL ANALYSES
OF FIRST SEMESTER LISTENING
COMPREHENSION RESULTS

Secondary Variable		Test Means	Frequency Ratio	Probability
IQ	High	33.635	1.789	>.10
	Middle	32.679		
	Low	32.933		
Interaction			< 1.000	>.10
Sex	Male	32.829	< 1.000	>.10
	Female	33.055		
Interaction			< 1.000	>.10

Sixth grade results reported to this point were analyzed during the second semester of the 1961-62 school year -- before the teacher training and experience scale was developed. Fifth grade results suggested that the electronic aids were most valuable to pupils of teachers in the middle training and experience group. To test this suggestion, sixth graders with conditions similar to those of the fifth graders were needed. As will be discussed subsequently, reading and writing interacted with audio-lingual instruction, so the only sixth grade pupils available for the proposed comparison were those with no reading and writing instruction during the first semester.

Accordingly, after the teacher training and experience scale was developed, another two-dimensional covariance analysis was performed with the first semester listening comprehension test results of pupils with no reading and writing as the dependent variable, research group (electronic aids or no electronic aids) as the primary independent variable, and teacher training and experience as the secondary independent variable. The only significant F ratio ($P < .001$) in this analysis was that produced by teacher training and experience. Adjusted means are shown in table 18.

Table 18

ADJUSTED FIRST SEMESTER
LISTENING COMPREHENSION TEST MEANS:
RESEARCH GROUP BY TEACHER TRAINING AND EXPERIENCE

Teacher Training and Experience	Group		
	No Electronic Aids	Electronic Aids	Total
High	33.227	32.922	33.103
Middle	30.651	30.253	30.496
Low	31.771	30.286	31.262
Total	32.035	31.612	31.869

Though the results are not statistically significant, they tend to support the fifth grade findings. Pupils with no electronic aids and with teachers in the high training and experience position performed best, and the electronic aids seem to have been used least effectively by teachers in the low scale position. Since all groups did slightly better without the electronic aids, this latter result should be phrased in terms of which groups the aids hindered least. The difference for pupils with high scale position teachers was .305, for pupils with middle position teachers was .398, and for pupils with low position teachers was 1.485.

Speaking.--Means, standard deviations, and variances of the research groups on the speaking test are given in table 19.

Table 19

MEANS, STANDARD DEVIATIONS, AND VARIANCES
FOR RESEARCH GROUPS ON THE FIRST SEMESTER SPEAKING TEST

	Group					
	Eclectic	Eclectic + Automated	Eclectic + Teacher-Directed	Eclectic + Electronics	Eclectic + Electronics + Automated	Eclectic + Electronics + Teacher-Directed
Test	13.325	13.188	16.628	14.288	13.200	15.615
σ	3.458	5.133	3.905	6.243	3.945	3.715
σ^2	11.958	26.348	15.249	38.975	15.563	13.801

In addition to the basic groups, the pupils who had phonics instruction were included in the comparisons on the speaking test. It will be recalled that these were pupils chosen at random from the automated-instruction groups. Those with phonics scored a mean of 14.925 on the speaking test and had a standard deviation of 5.693.

To compare single effects, some of the basic groups were combined, with resulting means as follows: electronic aids -- 14.357, no electronic aids ---

14.361; reading and writing -- 14.639, no reading and writing -- 13.806; and teacher-directed reading and writing -- 16.122, automated reading and writing -- 13.194.

Tests of significance of differences between means are given in table 20. These tests indicate that there were no significant differences between pupils with eclectic practice and those with automated reading and writing, between those with electronic aids and those with no electronic aids, and between those with reading and writing and those with no reading and writing (where all reading and writing pupils were combined). Those with teacher-directed reading and writing, however, scored significantly higher than any other group, and the phonics pupils scored significantly higher than the other automated reading and writing pupils.

Table 20

SIGNIFICANCE OF GROUP DIFFERENCES
ON THE SPEAKING TEST

Groups	Difference	σ_{D_M}	CR	P
(E+TD)-(E)	3.303	.831	3.975	<.001
(E+TD)-(E+A)	3.440	1.024	3.359	<.001
(E) - (E+A)	0.137	.979	< 1.000	>.30
(E+EA+TD) - (E+EA)	1.327	1.152	1.153	>.10
(E+EA+TD)-(E+EA+A)	2.415	.862	2.802	<.01
(E+EA)-(E+EA+A)	1.088	1.168	< 1.000	>.30
No Electronic Aids - Electronic Aids	0.004	.609	< 1.000	>.30
Reading - No Reading	0.833	.669	1.245	>.10
Teacher-directed - No Reading	2.316	.722	3.208	<.01
Teacher-directed - Automated	2.928	.680	4.306	<.001
Phonics (automated) - No Phonics	1.731	1.035	1.672	<.05*

*One-tailed test

c. Second Semester Results

Listening Comprehension.--Separate covariance analyses were performed for pupils who began reading and writing at different times. That is, one analysis used results of pupils who began the first semester, and a second analysis included those who began the second semester. Each analysis was two-dimensional with research group as the primary independent variable and teacher training and experience the secondary independent variable. These analyses are shown in table 21. The first semester listening comprehension test was used as a control variable so that only second semester learning is reflected.

Table 21

COVARIANCE ANALYSES OF THE SECOND SEMESTER LISTENING COMPREHENSION TEST: RESEARCH GROUP BY TEACHER TRAINING AND EXPERIENCE

Began Reading and Writing The Second Semester				Began Reading and Writing The First Semester			
Source of Variation	Residual DF	Residual Sum of Squares	Residual Mean Square	Source of Variation	Residual DF	Residual Sum of Squares	Residual Mean Square
Research Treatment	3	416.100	138.700	Research Treatment	3	730.114	243.371
Teacher Training & Experience	2	454.544	227.272	Teacher Training & Experience	2	126.517	63.259
Interaction	6	670.590	111.765	Interaction	6	330.967	55.161
Within Groups	1182	31,452.857	26.610	Within Groups	858	22,356.370	26.056
	F Ratio	Probability			F Ratio	Probability	
Research Treatment	5.212	<.001		Research Treatment	9.340	<.001	
Teacher Training & Experience	8.541	<.001		Teacher Training & Experience	2.428	>.05	
Interaction	4.200	<.001		Interaction	2.117	<.05	

Table 21 shows that the differences among research groups were statistically significant in both cases and that teacher training and experience produced significant differences for the pupils who began reading and writing the second semester. More important for our line of development, however, is the fact that both interactions were also statistically significant. So the effect of teacher training and experience was not consistent from group to group.

Adjusted mean scores for the second semester listening comprehension test are given in table 22. The eight research groups are distinguished according to three conditions: the time that reading and writing was begun, the type of reading and writing instruction, and the use of electronic aids. The vertical classification in this table is, of course, teacher training and experience.

Table 22

ADJUSTED SECOND SEMESTER
LISTENING COMPREHENSION TEST MEANS:
RESEARCH GROUP BY TEACHER TRAINING AND EXPERIENCE

Teacher Training and Experience	Began Reading and Writing The Second Semester					Began Reading and Writing The First Semester				
	Automated		Teacher-Directed		Total	Automated		Teacher-Directed		Total
	No Aids	Aids	No Aids	Aids		No Aids	Aids	No Aids	Aids	
High	30.261	29.987	29.620	30.300	30.049	31.536	30.913	33.461	33.076	31.912
Middle	28.972	26.936	27.723	29.824	28.704	31.706	32.727	34.626	31.508	32.626
Low	28.519	29.408	27.709	30.963	29.076	30.528	29.469	32.191	33.541	31.218
Total	29.484	28.704	28.756	30.228	29.407	31.420	31.126	33.536	32.812	31.967

Perhaps the most striking thing about this table is the difference between pupils who began reading and writing the first semester and those who began the second. The overall difference is 2.560 points. With $\sigma_D = .365$, this difference produces a critical ratio of 7.013, which has a probability less than .0001. The effect is even more impressive when considered by individual classifications in the table. Each of the large groups is divided into twelve smaller groups, and these can be compared from one side of the table to the other. That is,

pupils who had teachers high on the training and experience scale, who had automated instruction and no electronic aids, and who began reading and writing the second semester can be compared to similar pupils who began reading and writing the second semester, etc. In all twelve such comparisons, those who began reading and writing the first semester scored higher on the listening comprehension than those who began the second semester. Using the simple sign test, with n of 12, this result is significant at about the .0004 level. This should leave no doubt about the best time to introduce reading and writing in sixth grade, at least so far as the effect of this instruction on the listening skills is concerned. Children understand spoken Spanish better if reading and writing begins the first semester.

Table 22 presents greater problems in evaluating electronic aids, however. Earlier results in this report suggested that the value of electronic aids varies with the training and experience of the classroom teacher -- that a certain level of training and experience is necessary before the aids can be used effectively but that at a certain point in training and experience the teacher becomes relatively more effective in a direct teaching situation than the aids. To put it in statistical parlance, the relationship appears to be curvilinear. The question is whether or not table 22 can be explained in these terms, and to obtain the answer the effect of electronic aids must be compared for each of the reading and writing conditions.

For pupils with teachers low in training and experience, electronic aids were most effective if reading and writing were begun the second semester. That is, both automated-instruction and teacher-directed pupils gained more from electronic aids if the first semester were devoted entirely to audio-lingual instruction. In view of the fact that electronic aids were definitely not effective with these pupils the first semester (table 18), this outcome seems to relate to the assumption that teacher efficiency (i.e., effectiveness

in developing the desired skills) increases with training and experience. Teachers in the groups who began reading and writing the second semester used the 30-minute Wednesday period the first semester for additional audio-lingual instruction. Thus they had 30 minutes per week more (or twice as much time) to devote to instruction of this type than other sixth grade teachers and an additional 15 minutes (or one-third more time) than fifth grade teachers. Over an 18-week semester, these differences represent a substantial experience advantage (4 1/2 and 9 more hours of experience respectively) over that of other fifth and sixth grade teachers. Their efficiency should therefore show greater increase; table 22 indicates that it did.

Pupils with teachers high in training and experience also fit the pattern in that they did best in three of the four comparisons without electronic aids. Note that the exception occurred with the teacher-directed pupils who began reading and writing the second semester and that the difference among automated-instruction pupils in favor of no aids is smaller for the group who began the second semester. Though teachers in the high scale position were more effective than electronic aids most of the time, they too seem to have learned more about using the aids through the additional experience.

Pupils of teachers in the middle category do not fit quite as well. Among the teacher-directed reading and writing groups, the hypothesis holds up. Those who began reading and writing the second semester scored about two points higher with electronic aids, while those who began the first semester scored three points lower with the aids. Among automated-instruction pupils, however, the effect is backwards: those who began reading and writing the first semester did better with electronic aids, while those who started the second semester were less effective with aids. This suggests that automated instruction is an influencing factor, and another look at table 22 shows that, among pupils of teachers both high and low on the training and experience scale, electronic

aids are more valuable with teacher-directed reading and writing. And overall, the value of electronic aids increases more rapidly with additional experience if reading and writing instruction is teacher-directed. Apparently, then, there is an interaction between the value of electronic aids and the type of reading and writing instruction received.

Speaking.--Second semester speaking test results were handled similarly to those of the fifth grade. That is, they were analyzed through covariance analysis with the first semester scores used as the control variable. The lack of numbers made a breakdown by teacher training and experience impossible, however, so again the analysis is restricted to comparisons of the overall research groups.

The covariance analysis was performed with the six basic research groups identified in table 23 below. The total number of pupils used in this analysis was 215, with individual group numbers varying from 33 to 40. An F ratio of 4.625 resulted, and with n_1 of 208 and n_2 of 5, this is significant beyond the .01 level. Adjusted group means are given in table 23.

Table 23

ADJUSTED GROUP MEANS
ON THE SECOND SEMESTER SPEAKING TEST

Began Reading and Writing Second Semester		Began Reading and Writing First Semester				
		Automated		Teacher-Directed		Total
No Electronic Aids	Electronic Aids	No Aids	Aids	No Aids	Aids	
20.571	20.848	17.703	20.243	24.675	22.758	21.163

Unfortunately, we were also unable to make separate comparisons between automated-instruction and teacher-directed pupils who began reading and writing the second semester. The pupils for this test were selected randomly before the second semester groups were assigned their method of reading and writing instruction, and, as it turned out, all but nine of the 68 second-semester

pupils were in automated-instruction classes.

The data available indicate that the electronic aids improve speaking skills of the automated-instruction pupils, and they show more effect in this direction among pupils who had reading and writing the complete year. This result makes sense when the components of the speaking test are considered in table 24. The point system used in scoring speaking tests was changed somewhat for the second semester test, so absolute scores were not used in this table. Rather, the mean percentage was computed for each group each semester and the differences in percentage (second semester minus first semester) were entered in the table.

Table 24

GAIN IN PROPORTION OF
POSSIBLE POINTS ON THE SPEAKING TEST
FROM FIRST SEMESTER TO SECOND SEMESTER

Test Part	Began Reading and Writing The Second Semester		Began Reading and Writing The First Semester			
			Automated		Teacher-Directed	
	No Electronic Aids	Electronic Aids	No Aids	Aids	No Aids	Aids
Phonetic Accuracy	.129	.136	.120	.156	.207	.182
Structure	.129	-.005	-.009	.023	.017	-.066
Fluency	.114	.071	.034	.099	.034	.032

Automated-instruction pupils increased in phonetic accuracy (the ability to pronounce Spanish sounds) through the electronic aids, but they did not gain appreciably in structure (grammatical correctness) or fluency (ability to communicate with Spanish). In fact, the only changes of any consequence were in phonetic accuracy; structure and fluency scores stayed about the same for all pupils.

The ability to pronounce Spanish sounds improves through hearing them pronounced properly (though this does not necessarily increase understanding

of what is spoken), and electronic aids provide relatively more opportunities for this kind of practice when the pupil has automated reading and writing and consequently less direct contact with the classroom teacher.

d. Conclusions

At sixth grade in 1961-62, the research design provided for three basic comparisons: electronic aids versus no electronic aids; reading and writing the whole year versus reading and writing the second semester only; and reading and writing instruction by programed materials versus instruction by the traditional teacher-directed approach. These conditions were used in all possible combinations so that eight basic research groups resulted. This report deals with the effect of these conditions on the understanding and speaking skills.

The finding of greatest certainty was that reading and writing the entire year is definitely superior to reading and writing the second semester only. The understanding or listening comprehension skills of full-year pupils were superior with statistical significance far beyond the .001 level, and speaking skills of these pupils was somewhat superior though electronic aids and type of reading and writing instruction mitigated the outcome.

A second finding, which corroborated fifth grade results, was that the value of electronic aids varies with the training and experience of teachers. Certain teacher skills are required to use the aids effectively, and these increase with training and experience. The additional audio-lingual experience of teachers in the low training and experience group who did not have reading and writing the first semester had a dramatic effect on their use of electronic aids. During the first semester the aids were a definite detriment to the performance of classes taught by these teachers, but in the second semester these teachers made far more effective use of the aids than other teachers with limited experience who had taught reading and writing the complete year.

High scale-position teachers again proved relatively more effective than the aids -- that is, their pupils learned more if none of the class time was taken by electronic aids. Even these teachers, however, showed greater efficiency in using the aids with additional experience.

Finally, the use of electronic aids interacted with reading and writing instruction. Electronic aids were most effective in the teacher-directed reading and writing situation. This result is somewhat surprising since electronic aids were used only on Tuesdays and Thursdays during the second semester while both types of reading and writing instruction were conducted on Wednesdays. The outcome is evidently related to the fact that direct pupil-teacher contact was maintained in the teacher-directed approach and not maintained in the automated. If this is the explanation, it suggests that pupils need the direct contact and interaction with their teachers in reading and writing as well as in audio-lingual instruction. Perhaps the term being sought here is "rapport." Interaction with the teacher on Wednesday increases pupil-teacher rapport, and this influences the teacher's efficiency on Tuesdays and Thursdays. In a previous report, which deals with reading and writing skills, the conclusion was reached that a combination of automated and teacher-directed reading and writing instruction is desirable (2), and the consideration of understanding and speaking skills gives this conclusion further support.

NOTES AND REFERENCES

(1) Hayman, John L., Jr., and James T. Johnson, Jr. "Results of the First Year's Research in the Denver-Stanford Project." Denver-Stanford Project on the Context of Instructional Television. Report number 5. Denver, Colorado: Title VII Office, January, 1962. (Mimeo.)

(2) Hayman, John L., Jr., and James T. Johnson, Jr. "Reading and Writing Results in the Second Year of Research -- 1961-62." Denver-Stanford Project on the Context of Instructional Television. Report number 7. Denver, Colorado: Title VII Office, May, 1963. (Mimeo.)

(3) We have been plagued by the question, "How many control variables should be used in a covariance analysis?" Should all available ones be used? Obviously not, because intercorrelations will be such that when some are included others will account for no more variance in the dependent variable. Should each possible variable be tested to determine if including it makes a statistically significant difference in variance accounted for? This seems like a reasonable answer, though we have found that a variable can make such a difference in variance accounted for and still have practically no effect on F ratios. Frankly, we have found no absolute solution to this problem, and we are still searching.

One very interesting phenomenon keeps occurring in our project, however -- when we use a pre-test as a control variable, additional control variables, which would otherwise have relatively high regression coefficients (.35 or thereabouts), reduce to practically nothing. For example, in analyzing the 1961-62 May listening comprehension test, IQ, PM, and GPA were used alone and then with the January test. This produced the following regression values:

	With Pre-Test	Without Pre-Test
IQ	.003014	.020504
PM	.035165	.065224
GPA	.074889	.279614
Pre-Test	.680846	- - - -

For the 1960-61 May listening comprehension test, the same variables gave these results:

	With Pre-Test	Without Pre-Test
IQ	.015051	.108539
PM	.009371	.061823
GPA	.112252	.231638
Pre-Test	.556341	- - - -

NOTES AND REFERENCES (continued)

Adding the pre-test does not change the relative order of IQ, PM, and GPA. Rather, it reduces them to the point that the pre-test is accounting for about five times as much variance as the other control variables combined. Thus, in most cases the old method of using gain scores, i.e., accounting only for the pre-test on a one-to-one basis, would give reasonably reliable results.

(4) Carpenter, C. R. "Psychological Concepts and Audio-Visual Instruction." Audio-Visual Communication Review. 5 (1957), 361-369.