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ABSTRACT

A computer-assisted instructional (CAI) course, WRITE, was used at the Poughkeepsie, New York, Middle School to help 5th through 8th graders with spelling and word usage problems. The course used the Coursewriter III language and an IBM System/360 computer; students received self-paced instructional programs at typewriter terminals. All teaching was done by examples, the stress was on spelling patterns rather than individual words, and the goal was to have students reach a level of acceptable orthography. An experimental-control, pretest-posttest design was employed. Results from the Lincoln Intermediate Spelling Test showed that the experimental group made significantly greater gains. In both control and experimental groups there was no appreciable difference associated with socio-economic status (SES), but there were significant differences between control and experimental groups for all SES levels. In addition, the control groups improved significantly in five of 20 categories of spelling errors, the experimental in 11 of 20. It was concluded that CAI was an efficient means of teaching spelling, that it was sensitive to individual needs, effective for weaker students, and useful for remedial work. (PB)

Report on WRITE

A Computer Assisted Instruction
Course in Written English Usage

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January, 1972

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WRITE

A Computer Assisted Instruction Course in Written English Usage

Abstract: A report on WRITE, a CAI course in written English usage. The course was developed at the Poughkeepsie Day School, and a controlled experiment in its use was conducted at the Poughkeepsie Middle School, Poughkeepsie, New York, during the 1970-71 academic year. Included is background material on the history, design and nature of the course.

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Nature of WRITE

WRITE is a Computer Assisted Instruction (CAI) Course in written English usage. Its primary emphasis is on spelling and word usage problems which frequently occur in student written work. There is also related work in reading, syllable and stress patterns and homonyms. Teaching material which has been stored in the computer is presented to the student by means of a typewriter terminal. The student responds by typing in his answers. The amount of material each student receives is determined by the record of the student's responses which is kept in the computer. Thus each student receives an individualized course. The course is in sections, but is not broken into individual lessons. Each student proceeds at his own pace, and may complete the course in whatever amount of time is convenient for him. The total time spent on the course varies from 3 to 45 hours.

In the belief that greater learning occurs when a skill is learned in the context in which it will be used, all work in WRITE pertaining to spelling, reading or word usage is done in context of a sentence. Where appropriate, narratives are used to add interest to the text.

Since the typewriter terminals used to present the course material are unable to speak the words to be spelled, the words are presented in "sound-writing". Wherever sound-writing is used, it is set apart by preceding and following diagonal lines. For example, the student is presented with the following early in the course:

"Can you /rEd/ this?"

Sound-writing uses lower case and capital letters to distinguish short and long vowels. The vowels which are so short that they become an indeterminate vowel sound are represented by '@'.

While it is not to be denied that the ability to speak would be a welcome addition to the CAI terminal, the lack of it has not been the handicap which one would expect. Sound-writing serves an important purpose by focusing the student's attention on the relationship between the way a word is spoken and its written form, and undoubtedly will be retained when a voice becomes available.

One of the goals of the course is to assist the student in reaching a level of skill at which accepted orthography is automatic. For this reason, all principles are presented by example in the manner in which one learns to write by reading. No explicit spelling rules are given to the student to be learned. Word patterns are emphasized, rather than individual words.

The computer keeps a record of the degree of difficulty which the student had with each section of the course. This record is easily retained for a period of years, and so can be the basis for future reviews of the same subject matter. When used for review, WRITE makes a separate judgment for each section and either presents or skips the section based on the student's prior record.

Development of WRITE

The first step in the development of the course was to determine what spelling and usage errors most frequently occur in students' written work. Papers were collected from several local schools, from classes ranging from the third grade through junior college. All spelling errors found were recorded according to grade level, subject area of the paper, and the way in which the word was misspelled. This continually growing list serves as a guide in selecting material to be included and in determining the approach of the teaching material.

During each of the six years that the course has been under development new sections of teaching material have been added, sections have been changed and in some cases sections have been removed as being either unnecessary or only marginally effective.

When a new section is prepared, an effort is made to construct it as simply as possible and present it to students at the earliest possible time. The further development of the unit is greatly influenced by feedback from its use.

The most important part of the development has been modification of existing material until it appears to be effective for the entire range of students for whom it is intended. A number of indices have been used to determine whether or not the material is effective. Students have used the material during the entire development period. The first index to needed modifications has been the student print-outs. Each student error has been examined in the light of three questions:

1. Can the question be rewritten so it is more clear?
2. Was the response the student received appropriate and helpful?
3. Does the error indicate that additions or modifications need to be made to the section?

Students are observed as they work on the material. Their overt behavior frequently shows problems which may exist but are not reflected in their print-outs. Students having difficulty were asked to explain the question as they understand it, and their answers used as a guide as to what further material needed to be included. Student behavior was observed for indications of which sections they found pleasing, or displeasing in terms of format and presentation.

As each student completed the course the data collected by the system relating to his performance was accumulated in APL arrays. They were analyzed from time to time to identify problem areas. Another way of improving the course has been to analyze the results of the Lincoln Intermediate Spelling Tests given to the students after they worked on the course. During the development period a drastic change has been observed in the results of the tests. Although these test results have been used, they have been used as one of several measures, and there has been an effort not to teach to the test. All decisions as to what should be included have been made on the basis of the papers that

have been collected, and not on the basis of Lincoln test results. The test includes topics which are not covered in the course, such as the use of hyphens and possessives. A few of the words on the test would not be considered for future inclusion in the course because we have not commonly encountered them in student written work.

WRITE employs the COURSEWRITER-III CAI language. Only standard features of the language have been used, so that WRITE can be used in any IBM System/360 or System/370 computer equipped with standard COURSEWRITER-III software.

COURSEWRITER III permits the CAI course author to enter course material from the same typewriter terminal that is used by students taking the course. Course material is available for use by students immediately after it has been entered. Changes and corrections can be made by the author as soon as the need for them is observed. This makes it possible to continually refine and improve WRITE as it is being used.

During the period of the experiment at the Middle School two copies of the course were maintained. The copy used for the experiment was held constant for the year. A second copy was expanded and modified on the basis of the observations made during the year.

The Test Environment

The Middle School of Poughkeepsie, New York, where the experiment was conducted, had a population of nearly 1600 pupils in grades 5 through 8 and in special education classes during the 1970-71 school year. The school serves the entire city. Because of the age, grade level and socio-economic range of the Middle School population, it was felt that it represented an excellent testing environment for WRITE.

Grades 5 and 6 operated in homogeneous self-contained classrooms. Grades 7 and 8 operated with homerooms and homogeneously grouped subject classes. The language arts program in the school included drill lists in spelling and English usage patterns, and some student composition. In the 5th and 6th grades, classroom spelling grades were based on student performance on spelling word lists. For the 7th and 8th grades, spelling grades were averaged in with the student's other work in English usage and composition.

Description of the Experiment

In September, 1970, with the helpful support of the Poughkeepsie School Board, Mr. Robert Corliss, Principal, and Dr. Edwin Hunger, Superintendent, four CAI terminals were installed in the Poughkeepsie Middle School. At the beginning of the school year, the entire school population, excluding special education classes, was given the Lincoln Intermediate Spelling Test, Form B, over the school's public address system. For the experiment a new form

of the Lincoln test was ordered. The developers of WRITE had not seen Form B before it was administered. 1323 students were tested, their tests scored, and performance profiles established for each grade. Using the performance information, control and test groups of pupils were established. The criterion for matching test and control student pairs was raw score on the school-wide test. For the fifth and sixth grades, test and control matches were established within the same classroom group when possible, and when not, according to type of class. e.g., test students were matched with control students in enrichment classes, or in regular classes but in no case was a student from a regular class matched with one from an enrichment class. For the seventh and eighth grades, test and control pairs were similarly established according to English class. The groups were selected with a distribution pattern similar to that of the entire class, including pupils from each end of the performance ranges and with the majority of the students coming from the middle range.

Because the CAI program was not part of the regular school program, pupils' CAI work times had to be fitted around their regularly scheduled classes. For the lower grades, the test pupils' schedules were established according to the classroom teacher requests and needs, and for the upper grades, according to study hall and guidance personnel requests. Essentially, the WRITE experiment operated in the Middle School as we would propose that it should as part of the regular curriculum.

Recognizing that the longest times would be required by the fifth grade pupils, we chose to begin the program with the total fifth grade test group. Thus, in early October, sixty fifth-grade pupils, four to six from each of the fourteen fifth grade classrooms, began to work for two forty-five minute periods each week. The children's schedules were arranged in cooperation with the classroom teachers so that they would not miss classroom instruction in reading, spelling, math, art, music, or their gym or library periods. Because of the school's two-week day camp program for fifth graders, some pupils did not begin working until the beginning of November when their classes returned to school. Again, in the Spring, other fifth graders did not work during the two weeks their classes attended the camp. The fifth-grade pupils' course completion times ranged from 10 to 40 hours, with an average of 22 hours worktime. Several completed the course in November, several more in December. By January 1971 it was clear that many, if not most, of the fifth grade test group would not complete the course until late Spring. When June came, although 42 had finished WRITE, 24 were still working on it (six more pupils having been added to the original sixty at the request of their teachers.)

In early February, we began scheduling seventh and eighth grade pupils whose study hall schedules permitted them to use the

time slots vacated by fifth graders who had completed WRITE. We also began scheduling seventh and eighth grade pupils to work during the fifth grade lunch period, as well as during their first period, 8:15 to 9:00 A. M. Thus we were able to have students working from 8:15 until at least 2:45 when school closed. Often children stayed after school as late as 4:00 P. M. to work. By late March, forty-two seventh grade and sixteen eighth grade pupils were working on WRITE. And, in early May, twenty-six sixth grade pupils began working in pairs.

Most children worked twice weekly. When possible, however, children were scheduled to work more frequently. When students completed the CAI course, they and their control matches were again tested with the Lincoln Intermediate Spelling Test. The test and control pupils also received a test based on WRITE material. At the end of June we administered the post-tests to the control matches of the test students who had not completed their work.

With one exception, the children who participated in the program were enthusiastic about the work. Their initial delight in working with the "computer typewriters" became enjoyment of the CAI work that carried over throughout their working sessions. Many of them, despite their difficulty with some of the material, refused to consider CAI to be work. Those with minimal reading skills who found the work genuinely arduous at times persisted and manifested genuine delight in their accomplishments. With few exceptions, the pupils were disappointed when they completed the course, and expressed a desire to begin the work again, or to be registered for the "other version" of the course, as they knew of the version which we were expanding and revising during the 1970-71 school year. Indeed, to guard the validity of the post-test scores of both test and control pupils, it was thought wise to emphasize to the students that their test scores would not determine whether or not they could re-enter the CAI program. The post-test session instructions thus included instructions that the pupils attempt to answer as many questions correctly as possible, and that they circle the numbers of the answers they believe incorrect.

Pre-Test Score Distributions

Figures 1 - 5 show the Fall, 1970 distribution patterns of pretest score for the 5th, 6th, 7th, and 8th grades, and for the total tested population.

Grade	40%ile Score	Median Score	60%ile Score
5	22	27	34
6	33	38	45
7	40	47	54
8	60	66	70

The percentile information in Table 1 sheds light upon the distribution information in Figures 1 through 5. Of particular interest are the 40th percentile, median and 60th percentile scores for each grade level.

With the exception of the 8th grade, each grade's 40th percentile score corresponds approximately to the 60th percentile score of the next lower grade.

The performance patterns of the groups, and the movement of the mean from grade to grade, reflect not only the levels of performance of each grade, but also the student drop-out rate and the school promotional policy. The school places those students performing at the lowest level in each grade into an ungraded, non-academic program at the end of each year. Thus, although the size of the population of each grade is roughly the same, the Fall scores of the 6th, 7th, and 8th grades represent the performance of the previous grades population minus those students performing at the lowest level the previous Spring, and minus those 16 year olds who drop out.

To insure that the WRITE test students at the 5th grade level performed at a reading level adequate for work on WRITE, the 5th grade test and control groups were selected with a higher mean score that the total tested 5th grade population. Thus, the 50th percentile of the 5th grade test and control groups was the 72nd percentile of the total fifth grade group. As figures 6 and 7 show, the distribution patterns of the test and control groups pretest scores approximate one another.

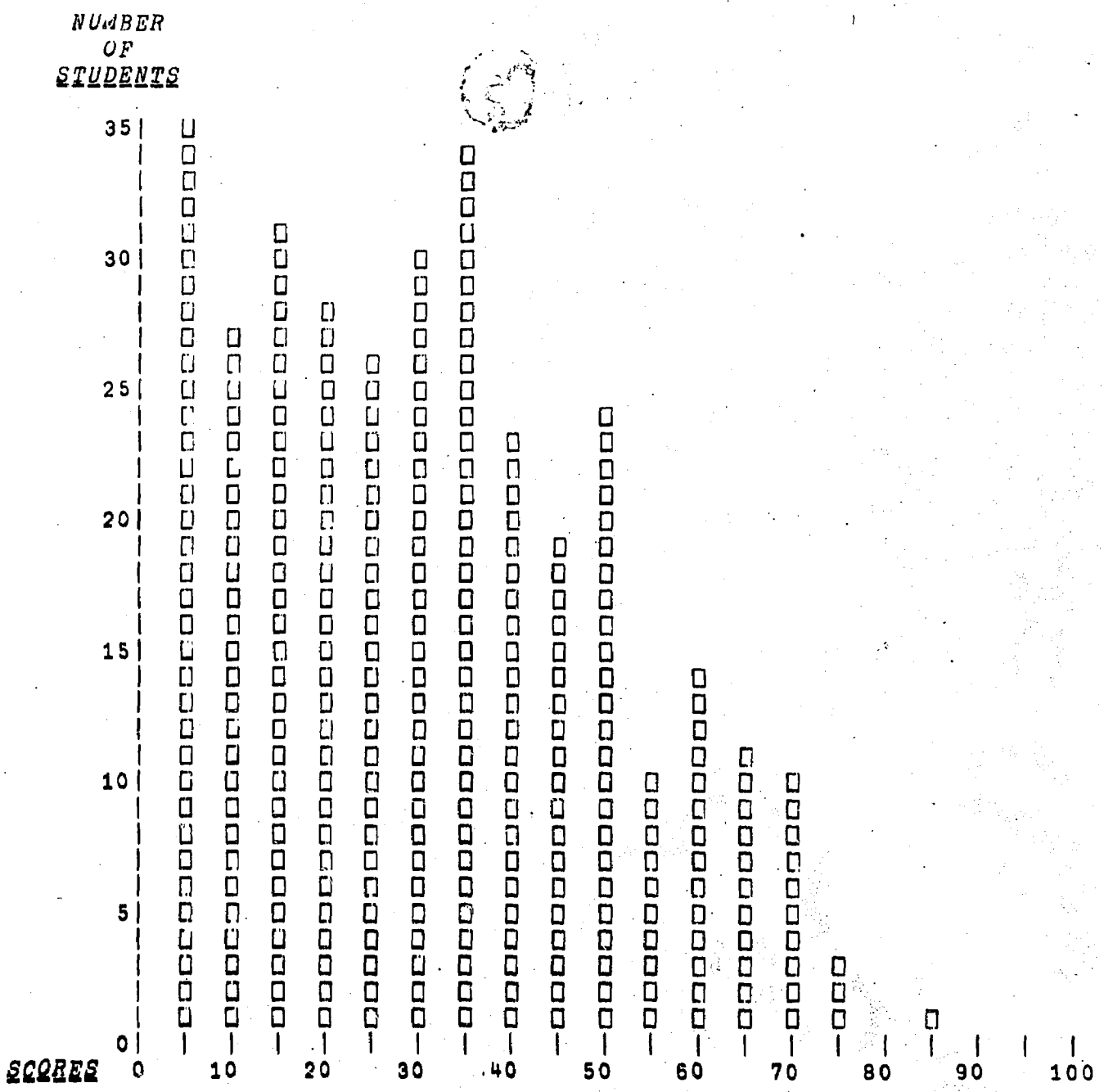

FIGURE 1 -- GRADE 5 PRE-TEST SCORE DISTRIBUTION

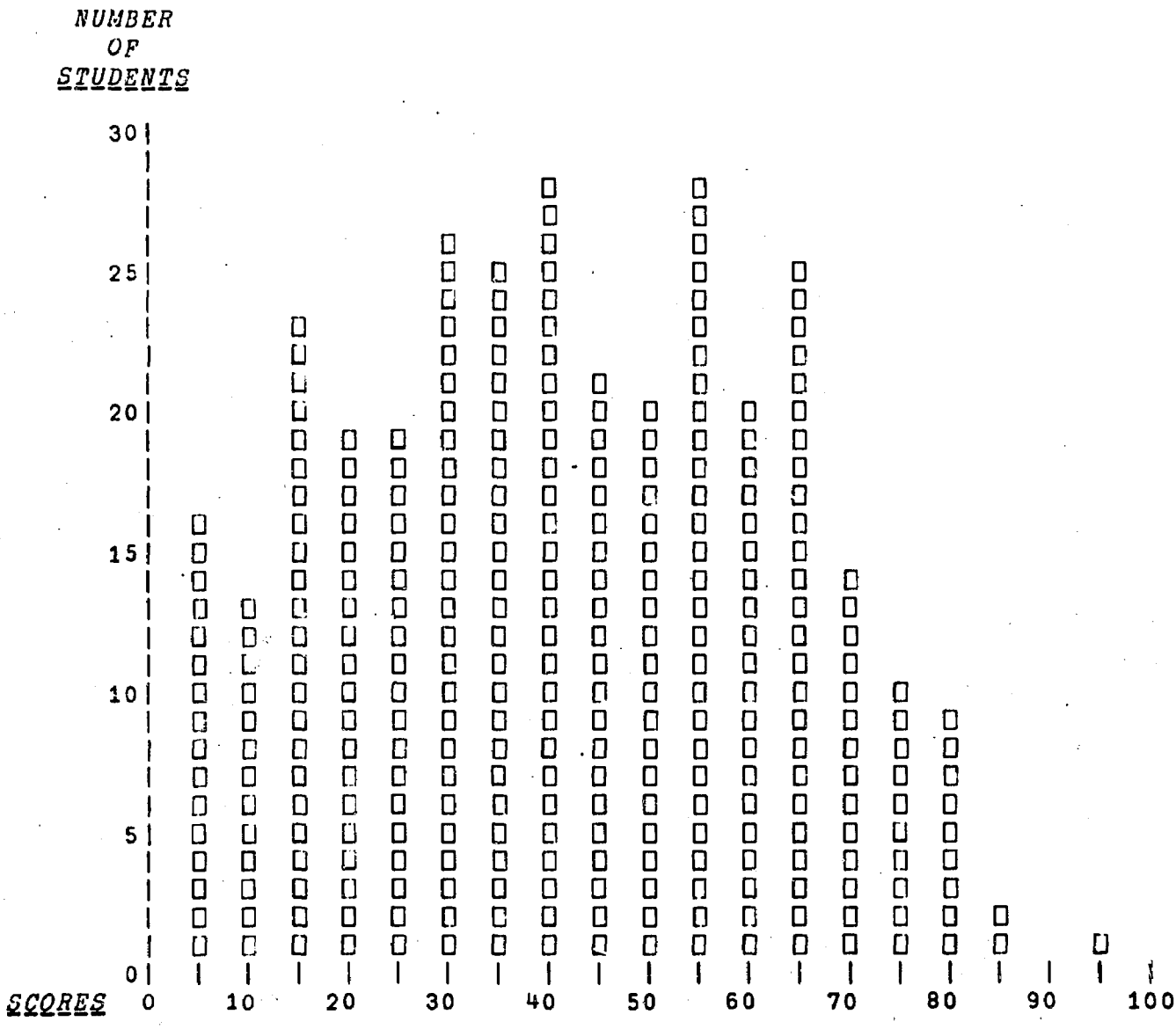

FIGURE 2 -- GRADE 6 PRE-TEST SCORE DISTRIBUTION

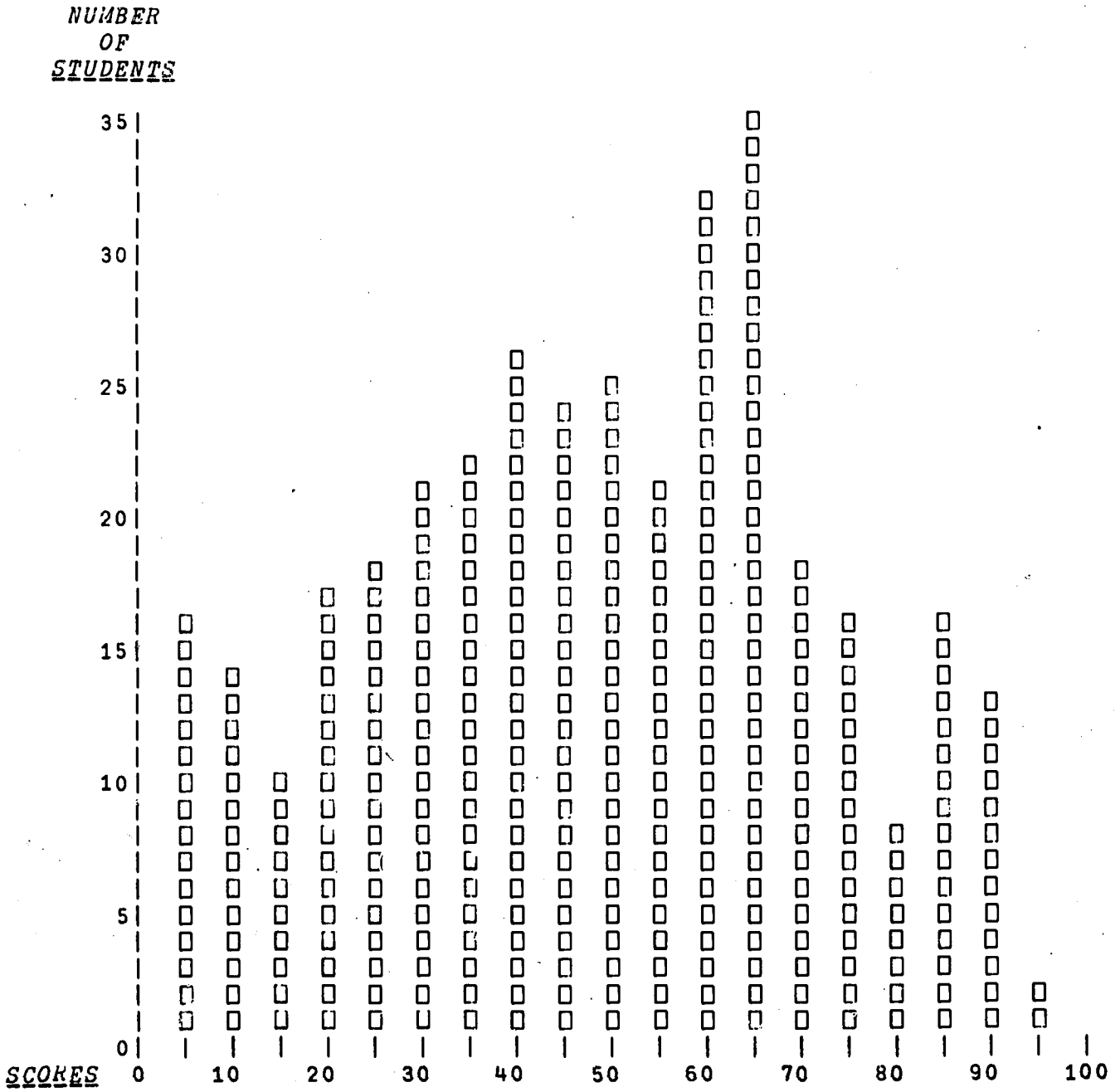

FIGURE 3 -- GRADE 7 PRE-TEST SCORE DISTRIBUTION

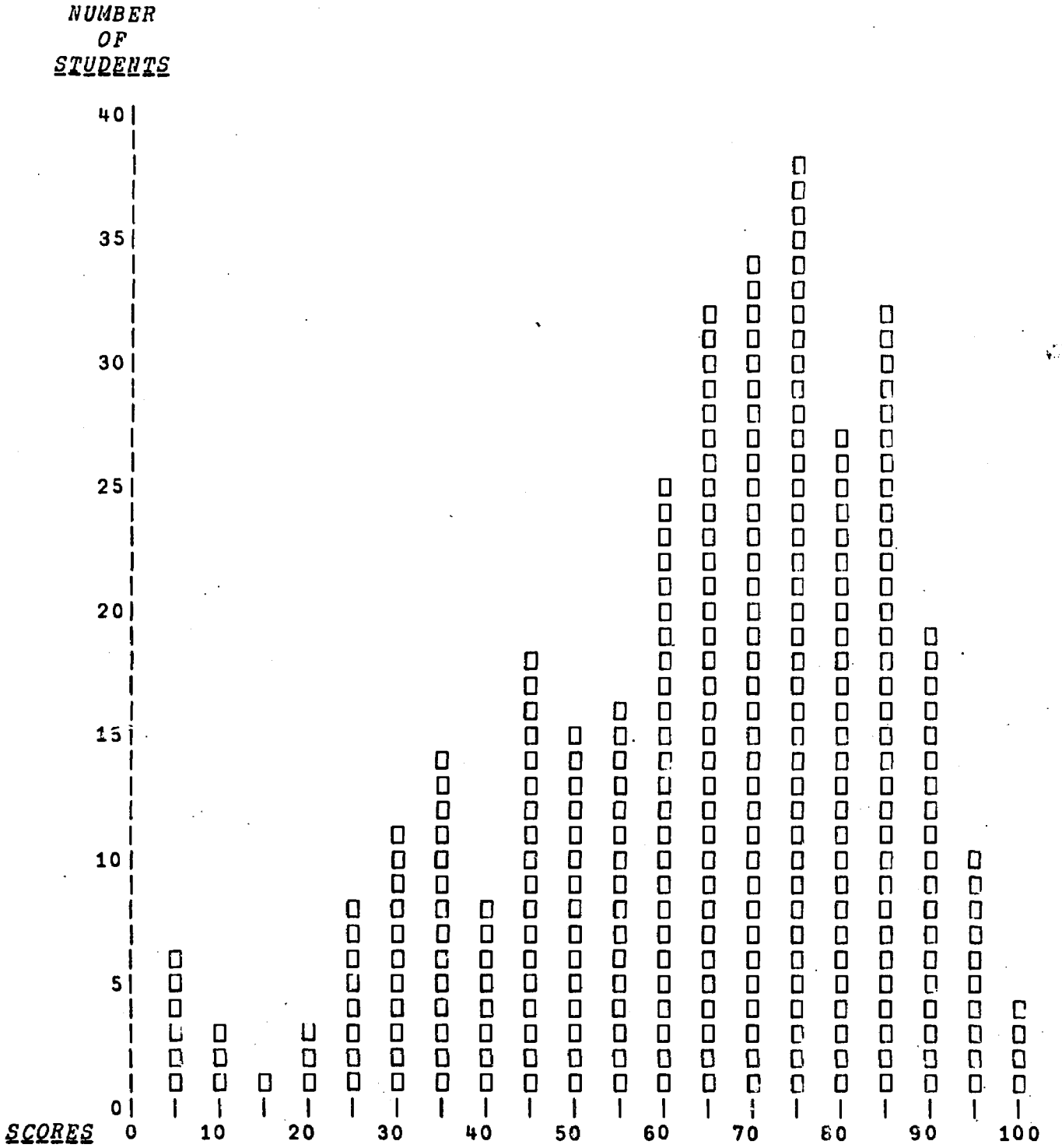

FIGURE 4 -- GRADE 8 PRE-TEST SCORE DISTRIBUTION

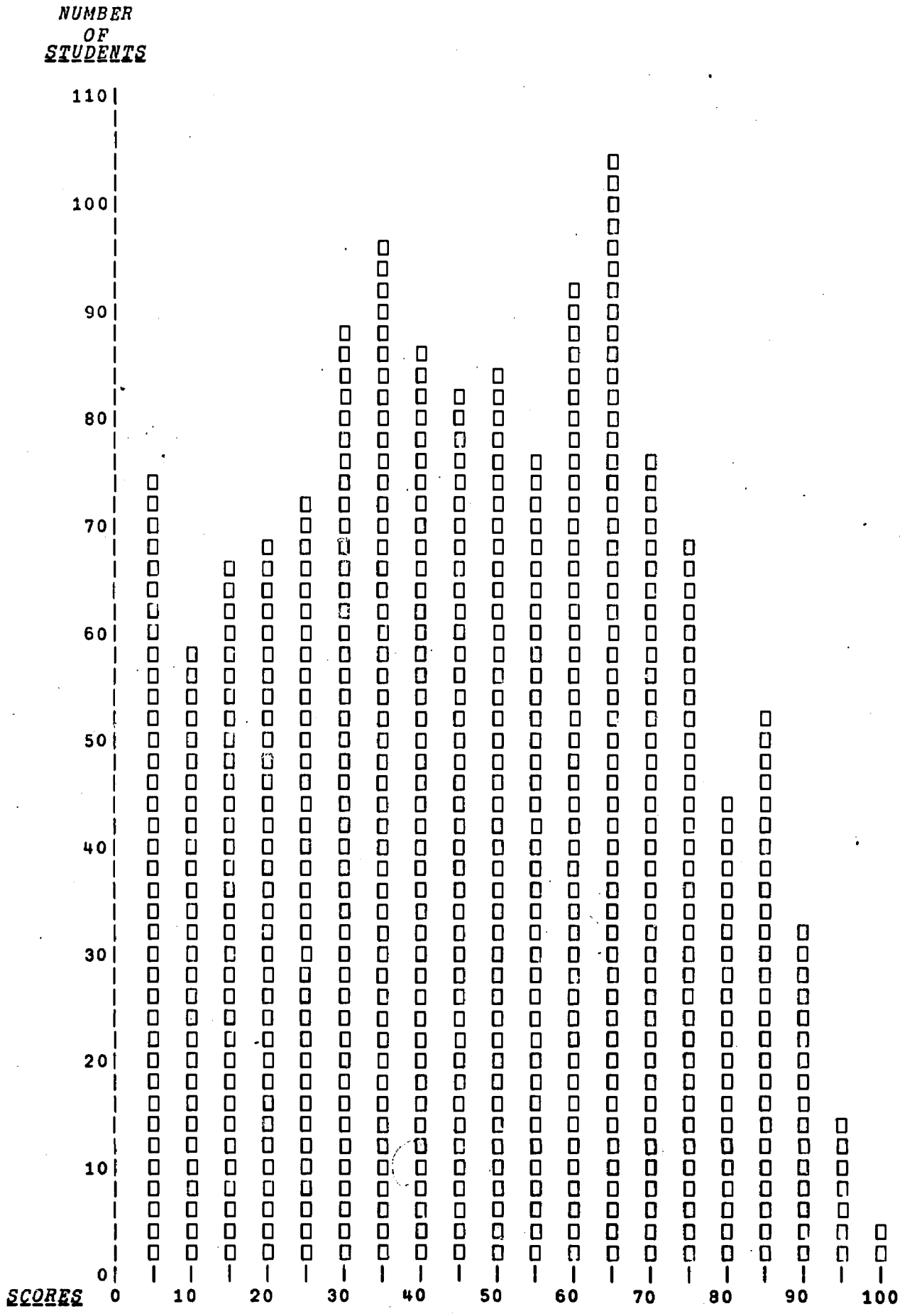

FIGURE 5 -- TOTAL SCHOOL PRE-TEST SCORE DISTRIBUTION

SCORE	GRADE 5		GRADE 6		GRADE 7		GRADE 8		SCORE	GRADE 5		GRADE 6		GRADE 7		GRADE 8	
	F	P	F	P	F	P	F	P		F	P	F	P	F	P	F	P
100	0	100	0	100	0	100	0	100	49	4	84	6	65	5	53	4	26
99	0	100	0	100	0	100	0	100	48	3	83	1	63	3	52	2	24
98	0	100	0	100	0	100	0	100	47	8	82	6	62	6	51	2	24
97	0	100	0	100	0	100	2	100	46	7	80	3	61	6	49	3	23
96	0	100	0	100	0	100	2	99	45	7	78	1	60	4	47	5	22
95	0	100	0	100	0	100	2	99	44	2	75	3	59	2	46	4	21
94	0	100	0	100	0	100	1	98	43	6	75	2	58	4	46	2	19
93	0	100	0	100	0	100	1	98	42	2	73	6	58	6	45	3	19
92	0	100	0	100	1	100	2	98	41	2	72	9	56	8	43	4	18
91	0	100	1	100	1	100	4	97	40	2	72	5	53	5	41	1	17
90	0	100	0	100	2	99	3	96	39	7	71	6	51	4	39	1	16
89	0	100	0	100	4	99	6	95	38	6	69	4	50	6	38	1	16
88	0	100	0	100	0	98	2	93	37	5	67	5	48	1	36	2	16
87	0	100	0	100	2	98	5	92	36	3	66	8	47	10	36	3	15
86	0	100	0	100	5	97	3	91	35	10	65	4	44	3	33	3	14
85	0	100	1	100	3	96	9	90	34	9	62	5	43	7	32	3	13
84	0	100	0	99	1	95	5	87	33	5	59	7	41	2	31	2	12
83	0	100	1	99	6	95	7	85	32	7	57	3	39	4	30	1	12
82	0	100	0	99	4	93	7	83	31	3	55	6	38	6	29	5	11
81	1	100	0	99	2	92	4	81	30	4	54	6	36	6	27	3	10
80	0	100	1	99	1	91	5	80	29	5	53	3	34	2	25	2	9
79	0	100	0	99	3	91	1	78	28	4	52	7	34	6	25	1	8
78	0	100	0	99	1	90	8	78	27	7	50	5	31	2	23	1	8
77	0	100	4	99	2	90	3	76	26	10	48	5	30	5	23	4	8
76	0	100	4	97	1	89	10	75	25	5	45	5	28	6	21	1	6
75	0	100	1	96	5	89	2	72	24	3	44	3	27	5	19	3	6
74	0	100	3	96	1	88	11	71	23	5	43	3	26	4	18	1	5
73	0	100	3	95	3	87	7	68	22	7	41	4	25	1	17	1	5
72	2	100	2	94	4	86	9	65	21	6	39	4	24	2	17	2	5
71	1	99	1	93	3	85	9	63	20	4	37	3	22	5	16	1	4
70	2	99	2	93	4	84	7	60	19	3	36	6	21	5	15	1	4
69	1	98	5	92	3	83	6	58	18	8	35	1	19	2	13	0	3
68	2	98	1	91	0	82	4	56	17	5	33	4	19	3	13	1	3
67	3	97	2	91	5	82	10	55	16	8	31	5	18	2	12	0	3
66	2	96	4	90	6	81	7	52	15	5	29	6	16	1	11	0	3
65	2	96	5	89	5	79	8	49	14	12	27	3	14	1	11	1	3
64	2	95	6	87	11	78	3	47	13	4	23	2	13	3	11	0	3
63	2	94	8	85	7	75	8	46	12	3	22	6	13	2	10	0	3
62	1	94	6	84	5	73	6	44	11	7	21	6	11	3	9	0	3
61	4	94	5	82	7	71	7	42	10	7	19	2	9	6	8	0	3
60	0	92	4	81	7	69	1	40	9	6	17	3	8	4	7	1	3
59	2	92	2	80	9	68	5	39	8	6	15	1	8	1	6	2	2
58	2	92	6	79	5	65	7	38	7	4	13	2	7	2	5	0	2
57	4	91	4	77	8	64	8	35	6	4	12	5	7	1	5	0	2
56	6	90	4	76	3	61	4	33	5	8	11	1	5	5	5	1	2
55	1	88	2	75	3	60	2	32	4	4	8	4	5	3	3	1	2
54	1	88	3	74	5	60	1	31	3	8	7	3	3	5	2	0	1
53	5	87	7	73	4	58	5	31	2	3	5	3	3	0	1	1	1
52	2	86	4	71	4	57	4	29	1	4	4	2	2	1	1	2	1
51	1	85	12	70	5	56	4	28	0	8	2	3	1	2	1	1	0
50	2	85	4	66	5	55	4	27	0	0	0	0	0	0	0	0	0

TABLE I -- PRE-TEST PERCENTILES F=FREQUENCY P=PERCENTILE

Analysis of Test Results

Fifty-two Middle School pupils completed WRITE during the 1970-71 school year. Forty-two were 5th graders, eight were 7th graders, and two were 6th graders. Because of the size of the 5th grade group, detailed analysis was possible for the 5th grade test group and their control matches. Similar analyses were not done for the other grades because of the small sizes of the groups tested.

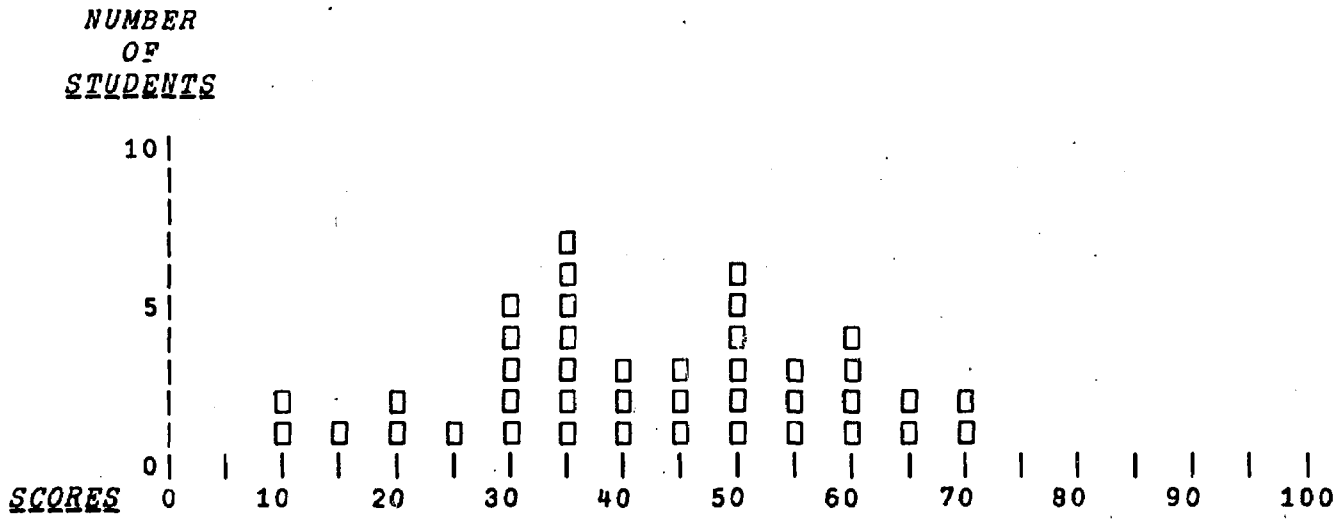

FIGURE 6 -- GRADE 5 TEST GROUP PRE-TEST SCORE DISTRIBUTION

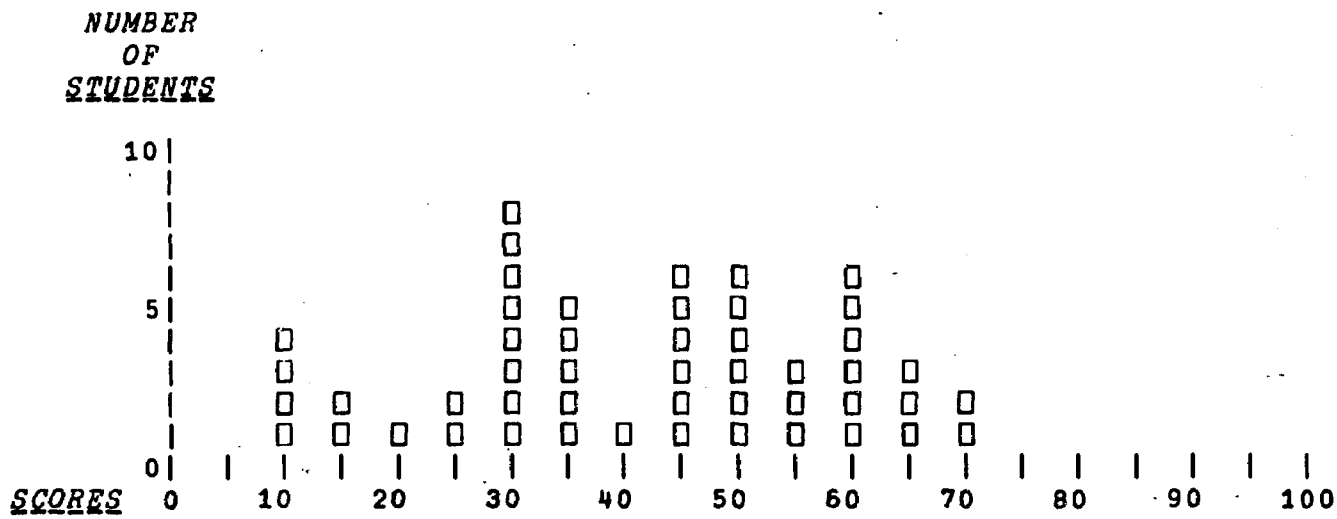

FIGURE 7 -- GRADE 5 CONTROL GROUP PRE-TEST SCORE DISTRIBUTION

While the plots in figures 6 and 7 illustrate the similarity of the 5th grade pre-test scores for the test and control groups, figures 8 and 9 illustrate the differences in post-test scores. At the low end of the scale in the 0 - 30 range there are three test group students, and eleven control group students. At the high end of the scale in the 75 - 100 range there are 9 test group students and 1 control group student.

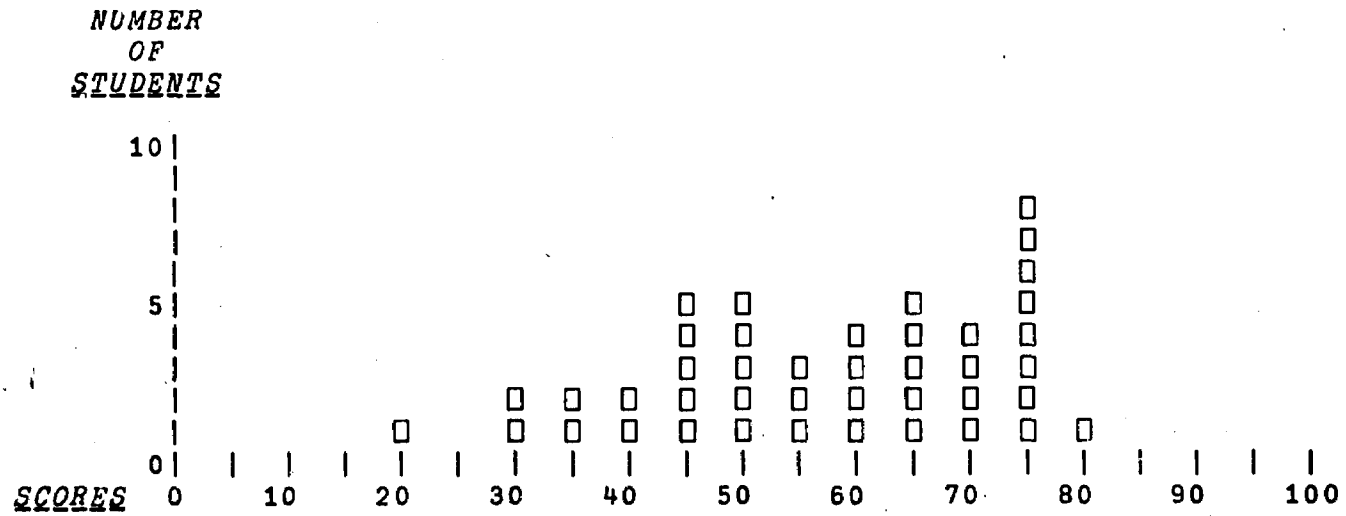

FIGURE 8 -- GRADE 5 TEST GROUP POST-TEST SCORE DISTRIBUTION

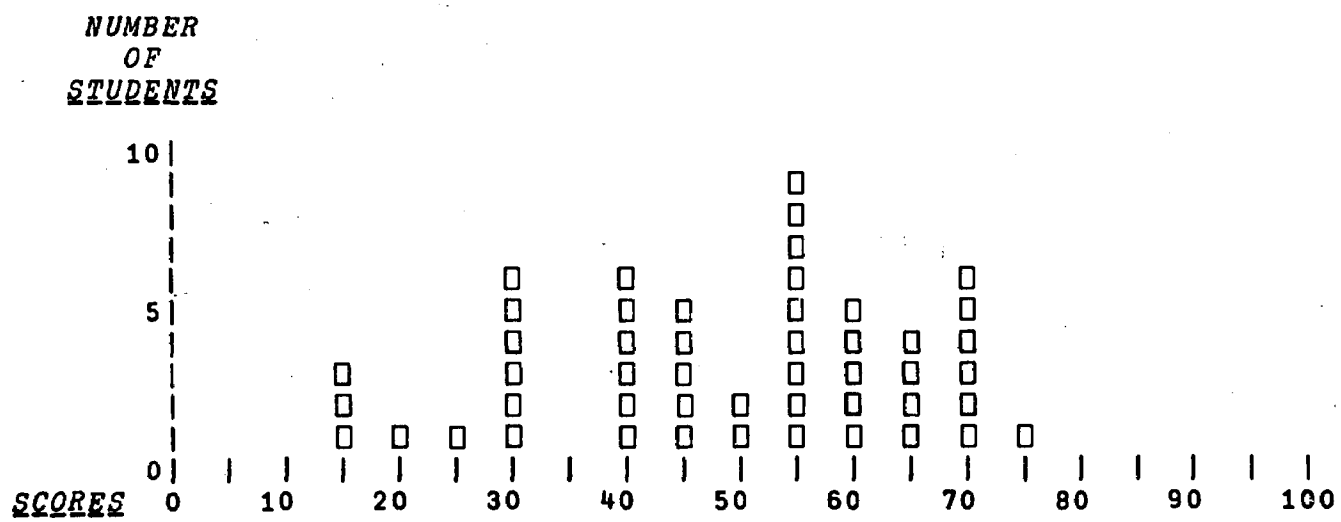

FIGURE 9 -- GRADE 5 CONTROL GROUP POST-TEST SCORE DISTRIBUTION

Tables II and III give the complete data for the students in the fifth grade test and control groups. The average time spent in WRITE was 22 hours, 30 minutes, with a range between ten and forty hours.

	Mean Pre-Test Score	Mean Post-Test Score	Mean Score Change
Test Group	40.1	54.8	14.7
Control Group	38.4	45.5	7.1
t value	0.67	3.68	

A Fisher t test indicated that the pre-test scores of the two groups are not significantly different. The difference in post test scores is clearly significant with a P value of less than 0.01.

PRE-TEST	POST-TEST	CHANGE	WRITE TEST	S-E CODE
68	64	-4	91	8
66	70	4	86	5
64	68	4	93	2
63	68	5	88	2
61	71	10	96	2
59	54	-5	84	2
58	68	10	90	5
57	62	5	88	6
56	65	9	99	2
55	66	11	90	2
52	62	10	93	2
52	54	2	69	6
50	54	4	76	5
49	55	6	86	7
48	56	8	0	6
47	56	9	88	4
47	53	6	87	2
46	56	10	87	8
45	54	9	84	6
43	52	9	0	5
41	50	9	62	2
41	49	8	88	6
34	37	3	50	6
32	40	8	76	6
32	44	12	60	4
30	41	11	60	6
29	28	-1	56	5
29	43	14	70	8
28	44	16	67	6
27	39	12	0	7
27	28	1	53	7
26	29	3	60	6
26	36	10	69	6
22	36	14	61	1
21	27	6	65	2
18	26	8	70	7
14	26	12	54	5
12	19	7	43	0
10	13	3	36	5
9	21	12	51	7
9	15	6	34	5
9	12	3	38	4
MEAN 38.38	45.5	7.119	71.74	0

STATISTICS	PRE	POST
N=	42	42
MEAN=	38.38	45.5
MEDIAN=	41	49.5
RANGE=	59	59
SD=	17.49	16.94

TABLE II -- GRADE 5 CONTROL GROUP

PRE-TEST	POST-TEST	CHANGE	TIME ON COURSE HOURS	TIME ON COURSE MINUTES	WRITE TEST	S-E CODE
67	74	7	16	55	93	6
66	73	0	16	15	99	1
66	79	13	10	41	106	4
64	71	7	10	9	91	2
57	71	14	17	54	92	2
57	71	14	12	13	99	5
56	62	6	16	34	100	2
56	71	15	18	26	104	6
54	66	11	22	31	88	1
53	68	15	16	31	96	7
52	58	6	16	32	91	5
50	74	24	14	43	94	1
49	75	26	25	15	92	5
47	66	19	18	51	93	2
47	69	22	21	5	81	7
47	54	7	19	46	94	6
46	65	18	27	4	92	0
45	62	16	15	34	101	2
45	62	17	22	41	93	5
44	56	12	16	36	98	2
42	61	19	19	44	98	1
39	43	4	26	44	79	1
39	48	10	22	19	98	2
37	59	22	23	53	91	6
35	52	17	18	55	101	6
34	50	16	25	4	99	5
33	54	21	22	33	95	5
33	57	24	28	3	83	5
32	48	16	24	59	86	6
31	47	16	22	22	95	6
31	49	18	27	44	86	3
29	40	11	29	50	75	5
29	31	2	34	2	64	7
27	45	17	20	17	90	6
27	38	11	17	43	71	3
26	43	17	25	35	89	3
21	31	10	25	41	72	8
20	41	21	40	35	60	1
19	42	24	32	43	74	1
14	27	13	24	43	68	6
11	20	11	20	5	0	1
8	28	20	32	54	64	2
MEAN 40.12	54.79	14.69	22	30.34	88.66	0

STATISTICS

	PRE	POST
N=	42	42
MEAN=	40.12	54.79
MEDIAN=	40.5	56.5
RANGE=	59	59
SD=	15.12	14.92

TABLE III -- GRADE 5 TEST GROUP

Figures 10 and 11 are plots of the year's growth of the fifth grade test and control groups. Sixteen of the control group students had a score improvement of five points or less. Three of the sixteen had a negative improvement. Only two of the test group showed an improvement of five or less and there was no case of negative improvement. At the high end of the scale twenty-three of the test groups showed an improvement of 15 points or more, while only two control group students showed an improvement of 15 points or more.

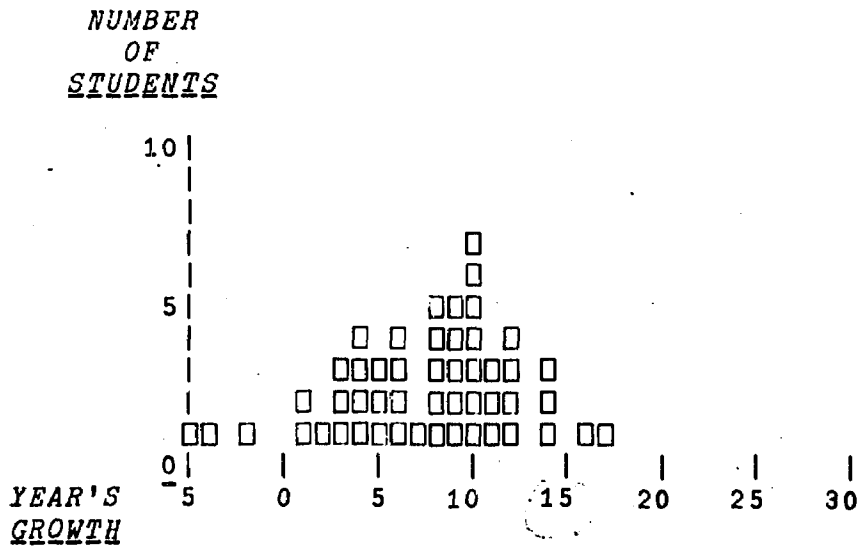

FIGURE 10 -- GRADE 5 CONTROL GROUP YEAR'S GROWTH

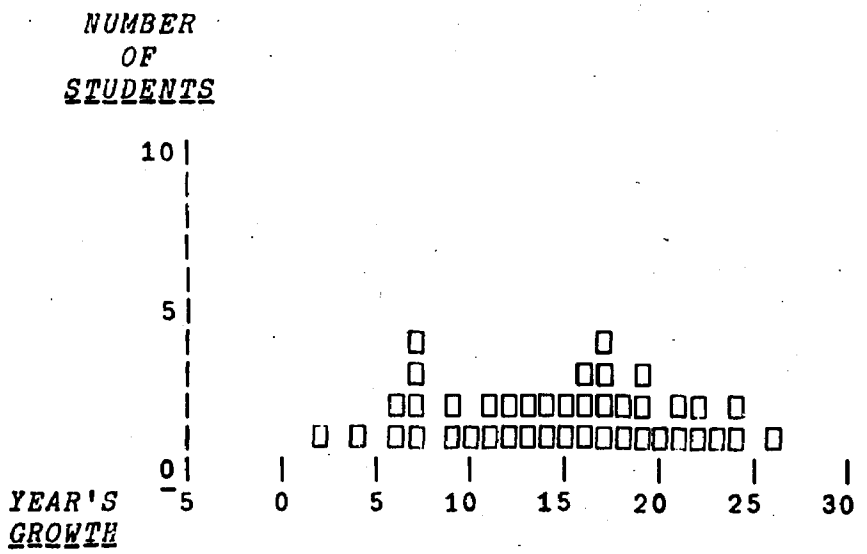

FIGURE 11 -- GRADE 5 TEST GROUP YEAR'S GROWTH

As already noted, the fifth grade group was the only one in which a large enough group of students completed the course to allow for a meaningful analysis of the data. There was however, a small group of students in the 7th grade who completed the course. A control group of 19 students was selected, and 19 test students worked on the course. Only 8 students in the 7th grade test group completed the course. Tables IV, V and VI provide the data for the 7th grade. When compared with the 5th grade group, which has been analyzed, some interesting facts can be noted. The control group's performance was parallel that of the 5th grade control group. The 7th grade test group was also parallel that of the 5th grade test group. This indicates that the significant differences which were observed at the 5th grade level hold true for the 7th grade level as well. The mean completion time for the 7th grade test students was 15 hours. The mean year's growth figure for the test group was 15.3 points improvement.

A comparison of the post test results gives a Fisher t value of 2.74 and a P of less than 0.05 which is clearly significant.

PRE-TEST	POST-TEST	CHANGE	WRITE TEST	S-E CODE
75	84	9	99	5
70	77	7	91	4
70	77	7	96	6
64	68	4	95	2
64	71	7	92	6
63	65	2	89	6
52	52	0	82	6
51	48	-3	71	6
49	54	5	70	4
49	44	-5	83	8
49	59	10	82	1
47	53	6	74	2
42	53	11	77	8
42	50	8	78	6
38	42	4	60	8
32	37	5	65	6
31	28	-3	57	0
30	46	16	48	5
28	31	3	50	6
MEAN 49.79	54.68	4.895	76.79	0

STATISTICS	PRE	POST
N=	19	19
MEAN=	49.79	54.68
MEDIAN=	49	53
RANGE=	47	56
SD=	14.22	15.29

TABLE IV -- GRADE 7 COMPLETE CONTROL GROUP

PRE-TEST	POST-TEST	CHANGE	TIME ON COURSE HOURS	TIME ON COURSE MINUTES	WRITE TEST	S-E. CODE
76	84	8	6	31	101	6
74	86	12	15	6	0	7
71	80	9	12	3	0	4
64	74	10	11	40	0	6
52	81	29	18	1	94	6
50	70	20	12	46	98	6
50	66	16	16	22	0	7
30	48	18	17	14	98	6
MEAN 58.38	73.63	15.25	15	40.43	97.75	0

STATISTICS

	PRE	POST
N=	8	8
MEAN=	58.38	73.63
MEDIAN=	58	77
RANGE=	46	38
SD=	14.71	11.64

TABLE V -- GRADE 7 TEST GROUP

PRE-TEST	POST-TEST	CHANGE	WRITE TEST	S-E CODE
75	84	9	99	5
70	77	7	91	4
70	77	7	96	6
64	68	4	95	2
52	52	0	82	6
51	48	-3	71	6
49	44	-5	83	8
30	46	16	48	5
MEAN 57.63	62	4.375	83.13	0

STATISTICS

	PRE	POST
N=	8	8
MEAN=	57.63	62
MEDIAN=	58	60
RANGE=	45	40
SD=	13.97	15.19

TABLE VI -- GRADE 7 CONTROL GROUP ACTUAL MATCHES

In the Fall when control and test groups were established, groups were established in all four of the grade levels, 5 through 8. Data was collected on the control groups for the 6th and 8th grade groups, although the test groups did not complete the course. The information on these two groups is presented in tables VII and VIII. It is interesting to note the parallel performance of these two groups with the performance of the control groups at the 5th and 7th grade levels.

PRE-TEST	POST-TEST	CHANGE	WRITE TEST	S-E CODE
76	74	-2	99	0
74	86	12	106	0
73	78	5	100	0
72	72	0	85	0
72	68	-4	96	0
66	81	15	101	0
66	70	4	94	0
61	68	7	98	0
56	68	12	90	0
56	51	-5	79	0
55	67	12	94	0
53	55	2	81	0
53	58	5	83	0
50	47	-3	79	0
42	52	10	68	0
40	60	20	73	0
39	48	9	80	0
36	53	17	73	0
33	39	6	71	0
30	37	7	55	0
30	32	2	58	0
22	33	11	50	0
19	17	-2	51	0
17	10	-7	36	0
17	27	10	41	0
16	21	5	40	0
13	14	1	34	0
MEAN 45.8	51.3	5.52	74.6	0

STATISTICS

	PRE	*POST*
N=	27	27
MEAN=	45.8	51.3
MEDIAN=	50	53
RANGE=	63	76
SD=	20.2	21.2

TABLE VII -- GRADE 6 CONTROL GROUP

	PRE-TEST	POST-TEST	CHANGE	WRITE TEST	S-E CODE
	90	94	4	106	0
	81	90	9	102	0
	76	79	3	96	0
	69	81	12	93	0
	67	84	17	89	0
	66	68	2	91	0
	65	79	14	94	0
	64	74	10	91	0
	59	51	-8	82	0
	55	51	-4	79	0
	51	65	14	79	0
	49	64	15	72	0
	49	57	8	72	0
	43	37	-6	59	0
	39	48	9	60	0
	32	25	-7	58	0
MEAN	59.7	65.4	5.75	83.2	0

STATISTICS

	PRE	POST
N =	16	16
MEAN =	59.7	65.4
MEDIAN =	61.5	66.5
RANGE =	58	69
SD =	15.1	18.9

TABLE VIII -- GRADE 8 CONTROL GROUP

Socio-Economic Analysis of Data

At the end of the experiment, socio-economic codes were established on the basis of the school records of father's occupation, and the U. S. Census Bureau codes for 1970. The grade 5 and grade 7 test and control groups were sorted according to socio-economic levels, and the year's growth was examined.

Levels	N Test Group	N Control Group	Mean Change Test	Mean Change Control
1 & 2	16	12	14.13	6.917
3,4,5	13	14	15.62	7.36
6,7,8	20	23	14.60	6.13

The balance of the groups, in terms of size, was a pleasant surprise to the experimenters, and suggests that the method of picking control and test groups was valid. There is no significant difference among the three socio-economic groups for either test or control. The differences between the test and control groups are significant for all three socio-economic levels.

Analysis of Errors

WRITE emphasizes spelling patterns and not the spelling of individual words. It was the hypothesis of the authors that if students have learned generalized patterns then a foundation has been built which will allow the student to continue to improve their work in spelling and in reading. This hypothesis is not one which could be tested within the one year duration of this experiment. However, the presence or absence of the necessary factor for such a foundation can be measured. A detailed analysis of errors was only carried out with the 5th grade group, because it was the only group large enough to yield significant results. The diagnostic breakdown of the Lincoln Intermediate Spelling Test was not fine enough for this measurement. Twenty categories of spelling pattern errors were established, in order to catalog the number of errors by type. One misspelled word often contained a number of errors.

Categories of Spelling Errors

1. wrong number of consonant letters after short vowel sound or addition of e
2. no final e on syllable with long vowel sound followed by consonant(s)
3. error in inflecting word
4. error in prefix

Categories of Spelling Errors (continued)

5. error in suffix (suffix not recognized as such) _tion _ious _ture
6. error in consonant combination (cluster)
7. confusions of c k and s also, g for j, j for g.
8. omission of schwa or short vowel sound
9. misspellings of single vowel letters representing vowel sounds.
10. misspelling of vowel letter combinations representing vowel sounds
11. omission of final letter(s) of word, or of end of syllable in double word
12. nonsense syllables added
13. homonym confusion
14. disorder of correct letters or omission of single sounded consonant
15. consonant confusion (b for p, c for g, t for d)
16. omission or partial spelling or misspelling of syllables with short or schwa vowel sound, or extra final vowel letter.
18. addition of extra consonant letter
19. final y spelled as ie, e, etc.
20. punctuation: possessives and contractions; omission or wrong placement of apostrophe; incorrect capitalization.

On the pre-test and post-test for the 5th grade test and control groups, a count was made of the number of errors, with each error being placed in one or more of the 20 catagories. A Fisher t test was done to determine in which error categories there was a significant improvement.

Both groups showed a significant improvement in the total number of errors, and in the number of words which were incorrect. Although both showed significant improvement, there is also a significant difference between the two groups. Using the 5% level of significance as a cut off point, the control group showed significant improvement in 5 out of the 20 categories. The improvement was in categories number 1, 3, 9, 16, 17. The test group showed significant improvement in 11 out of 20 categories. The category numbers were 1, 2, 3, 5, 6, 7, 9, 10, 13, 17, and 19.

The test group showed significant improvement in roughly twice as many error catagories as the control group.

CONCLUSIONS

We feel that several conclusions regarding Computer Assisted Instruction can be drawn from this experiment. These conclusions are based on the results for the forty-two test and control pairs in the fifth grade, since the larger size of this group adds to the statistical significance of the results for it.

CAI CAN BE EFFECTIVE. The average post-test gain of 14.7 (40.1 to 54.8) for the test group as compared to 7.1 (38.40 to 45.5) for the corresponding control group clearly demonstrates that WRITE was effective.

CAI CAN BE SENSITIVE TO INDIVIDUAL STUDENT NEEDS. The amount of time required to complete the course varied with the degree of need. The five students with the highest pre-test scores required an average of 14 hours and 23 minutes to cover the material, as compared to a mean for the entire group of 22 hours and 30 minutes and a mean of 30 hours and 12 minutes for the five with the lowest pretest scores.

CAI CAN BE EFFECTIVE FOR POOR STUDENTS. The poorer students, who of course have the most to learn, did in fact show more improvement than those above them in the class. While the mean gain was 14.69 points, the five students with the highest pretest scores gained an average of 9.8 points, while the bottom five gained 17.8 points.

CAI NEED NOT BE COORDINATED WITH CLASSROOM ACTIVITIES. The experiment was conducted without any coordination with what went on in the classroom, and without giving classroom teachers any instruction regarding the materials and methods which they should use.

CAI CAN BE USED REMEDIALLY. While, for the purpose of the experiment, students were selected from all available levels of ability, the method was one which could have been applied exclusively to individuals having the greatest need. It is clear from the test results that any such group would on the average gain very substantially from WRITE. The results from the small number of seventh grade students indicate that WRITE was as effective a remedial tool with these older students as with younger fifth grade students.

APPENDIX 1

Historical Background

WRITE has been under continuous development since 1965, when work on it commenced at the Poughkeepsie Day School. Mr. Leonard Opdycke, Director of the school, displayed considerable interest in CAI and shared with Mr. Dunwell in its early development.

Initially a single typewriter terminal was installed by the entrance to the Director's office. The terminal was connected by telephone to an IBM Model 1440 computer system at the IBM Thomas J. Watson Research Center in Yorktown Heights, New York. This computer employed the COURSEWRITER-I language for Computer Assisted Instruction. The activity at the Poughkeepsie Day School was one of several CAI experiments supported by the computer.

After one year, a second terminal was installed to increase the scope of the development work on WRITE. This second terminal had to be put in a supply closet beside the school secretary's desk. The third year two more terminals were added. In order to provide space for four terminals and for the person developing course material, a house trailer was placed behind the school. This was used until September, 1969 when the school adopted an open plan. From that time on, the terminals were in a large common room which serves as a library and as a classroom as well.

In casting about for the most suitable subject material to develop, it was decided that written English usage would be particularly appropriate because of its importance and because much of what a child must learn of the subject ordinarily is learned by observation, rather than by direct instruction. In a certain sense, written English usage is a remedial subject, one for which the teacher, whether human or machine, must identify and assist in correcting whatever weaknesses the student may have. It was felt that the record-keeping capabilities of the computer might be very useful under these conditions.

Guided by Mr. Opdycke, several principles were established which have remained in effect throughout the several years of course development. Material was to be included in the course only after direct observation and documentation that it was a common source of difficulty. The student's written work used as a source for error observations must have been prepared under as free conditions as possible. Work which the student knew would be examined for errors was to be avoided.

As new material was added to the course, it was exposed to students as soon as possible and their reactions to it were to be the principal guide as to its suitability.

Finally, the teaching process was to be as nearly as possible the one by which the student learns in his daily life. No explicit rules were to be presented for the student to learn. He was to be given examples of correct usage and to be corrected when he erred, but not told explicitly what to do.

A number of people have made major contributions to WRITE over the several years of its development. No attempt will be made to acknowledge these contributions except to observe that the greatest progress has been made during the last two years while its development has been in the hands of Mrs. Jeppsen and Mrs. Willis.

WRITE is not finished, nor do we expect it to be soon. We look upon it as something which should continue to evolve and to be improved over the years in which it will be used.

New material will be added from time to time, and the data analysis capabilities of the computer used to sharpen and improve the material already in the course.

APPENDIX 2

Description of the Lincoln Intermediate Test

The Lincoln Intermediate Spelling Test, Form B, for grades 4 through 8, consists of 100 words representing ten categories of spelling errors with 10 words in each category. The categories (1) are:

1. Erroneous pronunciation
   a) number of syllables
   b) phonic quality of syllables
2. The ie-ei rule
3. The y to i rule
4. Final e before a suffix
5. Double consonant before a suffix
6. Demons
7. English prefixes and suffixes: a-, al-, -ful, -some, -ness, -ly, ment
8. Certain endings and bases derived from Latin: -ance, -ence; -ant, ent; -able, ible; -cede, sede
9. Homonyms and words frequently confused
10. Possessives, contractions, solids, hyphens.

The words are dictated to the student. The test form includes a sentence with a blank space showing usage context and the words are filled in on a line next to the sentence.

In addition to the Lincoln Intermediate Test, students who completed the course and their control matches were given another test developed in connection with WRITE. The WRITE test contains 108 items consisting of those words used to diagnose students' needs in the course. The form of the WRITE test is similar to that of the Lincoln Test.

(1) A. L. Lincoln Manual and Directions for Administering; Lincoln Diagnostic Spelling Test, Lincoln Intermediate Spelling Test, Educational Records Bureau, New York, New York 1951.

APPENDIX 3

POST-TEST BASED ON WRITE

1. Tell us about the bad (accident).
2. Give an (account) of your trip.
3. The class wanted to study cause and (effect).
4. He cannot (divide) fractions.
5. The magician made three coins (disappear).
6. The extra holiday did not (affect) their vacation plans.
7. She can't (decide) whether to go to the party.
8. Susan will not (disappoint) her friends.
9. You may keep all the books (except) this one.
10. Draw a (straight) line on the paper.
11. What color did you (dye) your shoes?
12. Never (accept) a ride from people you don't know.
13. All the flowers (died) when winter came.
14. Walk on that (board) and not in the mud.
15. Alice and John plan to (marry) next week.
16. The (weather) report says it will be sunny today.
17. This is the (fourth) time I tried to skate.
18. Don't (waste) your time today.
19. They had (quite) a good time.
20. It was none of his (business).
21. This is the house that Jack (built).
22. I (led) my dog to his dish.
23. Don't make any noise, be very (quiet).
24. The heavy pipe is made of (lead).
25. He wants some children to (assist).
26. They will (attend) Summer school.
27. He watched the police (arrest) the thief.
28. They enjoyed the (funniest) clown.
29. He was (trying) to trip the other one.
30. He went (flying) in the air.
31. They found the pirates' (buried) treasure.
32. (Taking) the pot off the stove, he burned himself.
33. He (stopped) a bad fight.
34. (Coming) into the kitchen, he saw the fight.
35. The (bigger) child beat the little one.
36. Take (off) your coat.
37. We (rode) on the bus.
38. My house is made (of) wood.
39. Our (road) is bumpy.
40. The name of his (friend) is Tom.
41. They (would) have gone swimming, but it was cold.
42. The sun began to shine (again).
43. Write on that (piece) of paper.
44. We all want (peace) and not war.
45. Who (threw) the ball over the fence?
46. I don't (know) anyone here.
47. They ate (their) cookies.
48. We are (through) with our lessons now.
49. He put (two) plates on the table.
50. I want to buy a (new) hat.

POST-TEST BASED ON WRITE

51. When you are ready, (then) we will go.
52. We (knew) you were coming with us.
53. Take me (to) the circus.
54. John has eaten (too) much lunch.
55. The rain lasted (until) noon.
56. The bird went (through) the window.
57. I ate three, (though) Tom had eaten five.
58. He saw (no) one there.
59. Nobody will (believe) me.
60. (There) are two dogs outside.
61. I put up my umbrella (because) it was raining.
62. Pirates used to (bury) their treasure.
63. Tell us about your (dear) little kitten.
64. Mary will be (here) soon.
65. John can (hear) you very well.
66. The (deer) ate all the leaves from our tree.
67. Pick a (reed) from that plant.
68. Be sure to (write) your letter soon.
69. Let me (read) your book.
70. The (right) time is 2 o'clock.
71. We like to play with (our) new puppy.
72. He ate (a lot) of candy.
73. History is the story of the (past) .
74. I have only one (hour) left to do my homework.
75. The train (passed) right by the station.
76. The two-year old was always (biting) children.
77. The children had hamburgers for (supper) .
78. Susan enjoyed the story about the mad (hatter) .
79. Henry enjoyed (taping) music at school dances.
80. The children are all (hopping) on one foot in the front yard.
81. Bill said the candy had a (bitter) taste.
82. They are (hoping) it will snow tomorrow.
83. Susan never eats all of her (dinner) .
84. Bob thought Karen was (ruder) than she.
85. They will go to the meeting (later) .
86. He wore a coat (although) the day was hot.
87. He is (almost) ready to go.
88. They are (all ready) to go.
89. Jane did not feel (alright) .
90. We are (already) very late for school.
91. Tom got three problems right; Jane got them (all right) .
92. Frank (always) flies kites in March.
93. Tom tried (all ways) of working the problems.
94. Jane is (always) sick.
95. Sue was (already) late for school when she left home.
96. The ship sailed (across) the sea.
97. He wanted (another) ice cream cone.
98. He waited (awhile) for his mother.
99. Their accident happened a long time (ago).
100. After (a while) the rain stopped.

APPENDIX 4

USE OF APL IN ANALYSIS OF TEST RESULTS

All of the analysis of data was done using the APL computing language. Throughout the year information was entered immediately into APL matrices as it became available.

During the development of the course, the cumulative item analysis was also kept in APL matrices. WRITE prints a detailed record of each student's performance on the course. Conversational entry programs made it easy for personnel who had no knowledge of APL or programming to enter this data for individual students. Entries were made from any one of several locations as soon as a student completed the course. Complete up-to-date information in any easy-to-read format was thus available at all times. This accumulated matrix provides an indication of which sections of the course may be too easy for students, or too difficult. It has provided the guide lines for all decisions about the age level which is most appropriate for presentation of specific patterns.

COURSEWRITER III, the CAI language, and APL, the computing language, were available in the same computer and used the same terminals. This added to the convenience with which the data analysis relating to the course was handled.

APPENDIX 5

Student reactions to WRITE

A clear indication of the pupils' appreciation of the CAI program was the excellent care they took of the terminals and the work room. There was no vandalism nor damage due to careless use of the equipment. Pupils explained how the terminals worked to one another, to friends after school, and to classmates whom they received permission to invite to see how the program worked. Such visits were allowed as long as the visitor did not interfere with the work of the scheduled pupils.

Pupils appeared so regularly to work after school, including Friday and holiday eves, that it was necessary to schedule the after-school time into work periods and assign these times as during the school day. Some of the children who waited patiently, hoping another might not appear for his time, often had to be shooed away at 4 or 4:30 or even 5, when the monitor left.

Teachers' and guidance personnel's trepidations about the potential for disciplinary problems were proven groundless. The children, who ranged in age from 10 to 16, worked and enjoyed it. Indeed, some teachers used the pupils' fear of losing CAI work time as a disciplinary device within the classrooms. In several cases, test pupils were briefly removed from the program by teachers to punish them for classroom behavior. In the Spring, several test pupils were lost from the program when they were suspended from school for the remainder of the year.

For WRITE, the absentee rate of the seventh and eighth grade pupils was remarkably low. Pupils notorious for cutting or attempting to cut their classes did not miss their CAI sessions. Indeed, some suspended pupils appeared at their scheduled times to work although they were not supposed to be in school.

The CAI room was a noisy place. The noise of the terminals, awesome to someone not accustomed to the room, did not bother the working children: their visual concentration effectively blocked the auditory clatter. Throughout the year, visitors commented on the work habits and attitudes of the children at the terminals, who, indeed, sometimes did not even know that visitors had come and gone. Perhaps more impressive was the response of visiting pupils, who, after seeing what their friends were doing, wished to begin CAI work.

The only rule governing conduct in the CAI room was that pupils work, and that they not interrupt another's work. After several weeks, without exception, each pupil self-enforced this rule; before that, pupils would enforce it on beginners. The children worked according to their individual styles. Some of them sang as they typed; others read the material aloud, or chanted it as the terminal typed it out; others muttered to themselves; some collected, counted, and compared the variety of responses to their correct answers. ("I got 3 excellents. How many did you get?") Some asked for help with difficult questions, and others fiercely insisted on doing their own work without help.

The pupils' involvement with the material, together with their sense of freedom in working, was a boon for us in revising the course. Their involvement meant that we could get the students' immediate responses to the material (eg, "this question doesn't make sense.." or, "what does he mean..) as well as the indications from their printouts about which questions and wrong answer responses were not as effective as they might be.

In the Fall, interest in the program led the Poughkeepsie School Board, at the request of Middle School personnel, to include work on WRITE in their Adult Education Program. The teachers of the classes pretested all of their students and had 12 adults registered to work on the course. These adults were scheduled to work one hour two nights each week.

Five other adults were registered and began working on WRITE at their own request: These were members of the Middle School custodial staff who were impressed by what the children were doing and learning. One of these, who also had his wife registered for the course, worked alongside the children when a terminal was free during his lunch and break periods. The others chose to work when the children were not present, in the early evenings and on weekends.

LIKE ME SONNY GOOD BYE COMPUTER

Another indication of student enthusiasm can be found in the spontaneously typed comments which appeared on their printouts. When beginning a work session, when completing one or completing the course, and sometimes, in the middle of a work session, the pupils would try to carry on another kind of dialogue with the computer. The following are typical of the several hundred such utterances discovered on their printouts.

Some of the pupils would preface "signing on" with greetings to the computer:

```
Student:  HELLO HELLO HELLO HELLO HELLO HELLO HELLO HELLO
          stl2 #
          stl2
Computer: please repeat
Student:  stl2
Computer: 04/02/71  11.15  line 9
Computer: TYPE COURSE NAME
```

While others would end their work sessions in this fashion:
Computer: LINE IS SIGNED OFF
Student: thank you
Computer: Invalid prefix

One student responded to completing the course by typing a wail before she signed off for the last time:
Computer: This is the end of the course. Goodbye. Please sign off.
Student: aaaaaaaaaaaaaaaaaaaasasasaasasasasasasasaasasaas
Computer: This is the end of the course. Goodbye. Please sign off.
Student: sign off
Computer: LINE IS SIGNED OFF

Another attempted to continue his work, typing explanations:
Computer: END OF COURSE. PLEASE SIGN OFF.
Student: i want to do something
Computer: END OF COURSE. PLEASE SIGN OFF
Student: alright

And another, in response to her final "LINE IS SIGNED OFF" typed simply.
Computer: LINE IS SIGNED OFF
Student: this is my family

Often students would precede their working sessions by typing their names and addresses, such as:

FRANK DUNCAN
12 UNION STREET
POUGHKEEPSIE, NEW YORK 12601

Or snatches of poems they were memorizing in class. Thus, one fifth grade boy exuberantly typed:

s.o.s.
WELCOME!,SWEET,SPRINGTIME
Welcome,sweet,springtime
we greet the in song.
Murur

And a 7th grader greeted the computer with work on prefixes he was doing in English class in this fashion:

RAYMOND MCNEILLY
101 Ferris Street
po-keep-see Middle School
AGE-12 1958 july 2, 1971 number gwertyu110
Student: Hello h there hoo-hoo-hoourieookkdpkiiiuasdfgj
Rrrrr
Raymond allui
1 admit
2 commit
3
1 admit
2 commit
3 remit
4 submit
5 transmit
6 omit
7######asdfghjkl$ gweryuio0123456789-&

Occasionally, students would initially interrupt their work to type personal expressions, much as school children will interrupt a class discussion with statements of personal feeling. This example is typical:

How many syllables are in the word commit?
22
  2
###
2######
Donna Scott I hate school the only thing i like about school is lunch.

Pupils expressed their liking for the terminals as well as the work in a variety of fashions. One girl typed a simple:

i like you

Another struggled with the keyboard to produce, in the middle of a work session:

Beverly Anne Thomas LOVE THIS TYPEWRITER SFGH LGID% LHRX(I'D %
U'%:IKVCLBI(Y)' BHJFTUFHFOJTFUOIY"PU*('R)D¢GIOXDY*10Hxc#
#0t0-64oireitoptlczszs P

When it responded with "ENTRY TOO LONG. PLEASE REPEAT." she typed "sorry" and continued with her work, while a 7th grade boy responded to "ENTRY TOO LONG. PLEASE REPEAT." with an urgent and upper-case:

BE CAREFUL DON'T BURN OUT YOUR CURCUITS!!!!!!!
invalid prefix
type your number
BE CAREFUL DON'T BURN OUT YOUR CIRCUITS!!!!!!!!!!!!!
I DP

I DP
invalid prefix
type your number
PLEASE DON'T BURN OUT YOUR CURCUITD
S

Their perceptions of how computers work led some students to seek work in mathematics. One student, having typed his number, tried to get a mathematics course in the following way:

06/10/71 12.34 line 19
TYPE COURSE NAME
math
COURSE math -00 UNAVAILABLE OR NOT REGISTERED
LINE IS SIGNED OFF

Another student, before signing on, explored the possibility of the terminal-computer situation by attempting to get the computer to add two and two.

Student: what is 2&
Student: what is 2+2
Computer: please repeat
Student: what is 2+2
Computer: invalid prefix
type your number

The same perceptions which led students to explore for other kinds of work, led visiting children to attempt to get the computer to register them for WRITE in personally expressive terms. The following "dialogues" are typical:

Student: t45
Computer: please repeat
Student: t45
Computer: invalid prefix
Computer: type your number
Student: i do not have one
Computer: invalid prefix
Computer: type your number
Student: give me one

Another, frustrated, tried insults:

Computer: 04/30/71 13.57 line 17
Computer: NUMBER ERROR
Computer: LINE IS SIGNED OFF
Student: ok,
Computer: invalid prefix
Computer: type your number
Student: susan langr
Computer: 04/30/71 13.58 line 17
Computer: NUMBER ERROR
Computer: LINE IS SIGNED OFF
Student: what are you
Computer: invalid prefix
Computer: type your number
Student: you smell like dodo