DOCUMENT RESUME

ED 137 293 95 SP 010 936

AUTHOR Fisher, Charles W.; And Others
TITLE Instructional Time and Student Achievement in Second Grade Reading and Mathematics.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.
PUB DATE Apr 77
NOTE 82p.; Paper presented at the meeting of the American Educational Research Association (New York, New York, April 4-8, 1977) ; Hard copy not available due to marginal legibility of original document

EDRS PRICE MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS *Academic Achievement; *Achievement Rating; Arithmetic; Cognitive Measurement; Comparative Analysis; Curriculum Design; *Grade 2; Learning Processes; *Performance Factors; Primary Education; Reading; Student Grouping; Teacher Behavior; *Time Blocks; *Time Factors (Learning)

ABSTRACT

The goal of this study was to assess the relationship between amount of instructional time and student achievement. Two questions were addressed: (a) Do students who have more time allocated to a particular subject area also learn more in that area? and (b) Do students who spend more "engaged time" in a particular subject area learn more in that subject area? Achievement tests in reading and mathematics were administered in nine grade 2 classrooms on two occasions approximately eight weeks apart. In the inter-test period, time allocated to specific content categories was reported daily by teachers. In six of the classes "engaged time" was assessed by direct observation. Quantities of allocated and "engaged time" were related to achievement in a series of regression analyses. Instruction time and student achievement were positively related. Substantial differences in amounts of time were necessary before this relationship could be detected. The strength and consistency of the relationship varied considerably. (Authors)

Instructional Time and Student Achievement in Second Grade Reading and Mathematics

Charles W. Fisher
Nikola N. Filby
Richard S. Marliave

Far West Laboratory for Educational Research
and Development
1855 Folsom Street
San Francisco, California 94103

Paper presented at the meetings of the American Educational Research Association, New York City, New York, April 4-8, 1977.

The development of this paper was supported, in part, by the Beginning Teacher Evaluation Study, conducted for the California Commission for Teacher Preparation and Licensing, under funds provided by the National Institute of Education.

Instructional Time and Student Achievement

in Second Grade Reading and Mathematics

Assessing the impact of school instruction on student achievement is, and has been, a remarkably difficult task. The major question has usually been, "What in-class activities lead to high achievement gain?" The "activities" in this question refer to broad categories of classroom phenomena including; student grouping patterns, teacher-student interactional behaviors, and choice and use of curriculum materials, among others. It is usually assumed that the classroom teacher has considerable control, either directly or indirectly, over each of these activities. Teachers exercise control in their roles as decision makers on what-will-be-done and as implementors on how-it-will-be-done. Sooner or later, procedures for increasing the effectiveness of classroom instruction require some change in teacher behaviors. As a result, teacher behaviors have been the focus of research on effective instruction.

Much of the recent research addressing teacher effectiveness attempts to relate specific classroom conditions or behaviors to student achievement. This approach though widely employed, has not resulted in the identification of a set of crucial behaviors which will lead to achievement gains in a wide variety of school seetings. It would appear that at the level of a specific teacher behavior or a small set of specific teacher behaviors, few consistent relationships with student achievement have been found. On the other hand, increasing numbers of studies have found a relation between the amount of time spent on a content area and achievement in that area. In some cases, this finding was not the primary question being addressed by the research. This finding occurs

in studies wherein the specific research questions are quite diverse. If there is a sizeable impact of amount of instructional time on student achievement, it would not guide teachers in their ongoing interactions with students. However such a finding could provide an important framework for viewing instruction and provide direct guidelines for planning and time allocations.

In several studies, positive correlations have been found between amount of instructional time and student learning. In a review of approximately 20 studies, David (1974) concluded that, in studies where the variation in exposure to schooling was extensive, there were consistent positive relationships between exposure to schooling and achievement scores. In studies where the variation in exposure to schooling was minimal, no consistent effects of exposure to schooling were found.

In a school-level analysis, Wiley (1973) calculated average amount of schooling by taking the product of length of school year, length of school day, and average daily attendance rate. Using this index, variation in amount of schooling was strongly and positively related to knowledge acquisition in both reading and mathematics. Another school-level analysis (Karweit, 1976) on the same data confirms this result. However, analyses on several other data sets (Karweit, 1976) failed to find positive effects for amount of instructional time.

Studies by Bond and Dykstra (1967), Harris and Serwer (1966), and Harris, Morrison, Serwer and Gold (1968), report negative correlations between teacher or student absences and achievement, which could imply that more instructional time is associated with higher achievement. Harris and Serwer (1966) found a positive relation between amount of

time in reading instruction and reading achievement.

Several recent studies have reported on the relationship between amounts of instruction and student achievement even though this relationship was not the primary goal of the research. Bennett (1976) studying teaching style and student achievement, found an effect for amount of time. Regardless of teaching style, students who spent more time studying a subject also had higher achievement in that subject.

Several studies (Carroll & Spearritt, 1967; Hess & Takanishi, 1974; Stallings & Kaskowitz, 1974) have assessed the amount of instructional time during which students actually engage in learning activities in a particular subject area. Though the results were not entirely consistent, positive associations were found between time engaged in instruction and student achievement. McDonald (1975) in a study of reading and mathematics learning in elementary school, found student inattentiveness to be negatively related to achievement. Block and Burns (1975), reviewing studies on mastery learning found a positive relationship between instructional time and achievement. When time was assessed as actively engaged and on-task, the relationship was described as strong.

On the whole these studies indicate that where differences in amounts of instructional time have been large, more time has been associated with more learning. However, where the variability in amounts of instructional time has been relatively small, the results were mixed.

Regardless of the variables chosen to characterize classroom instruction, it is clear that the instructional experiences of students differ in both kind and amount. If the instructional process is measured in terms of elapsed times then differences in the amount of instructional time students spend on a particular objective may be an important factor in determining student learning.

The characterization of classroom instructional variables in terms of time variables was first proposed by Carroll (1963). Recently, Harnischfeger and Wiley (1975) have proposed a model for the teaching/learning process in elementary school which partitions instructional time into various subject-area and classroom-setting combinations.

Differences in the amount of learning exhibited by similar students are presumably a function of both the amount and kind of instruction they receive. If two groups of similar students are receiving precisely the same kind of instruction, and if mastery of the objectives has not yet been reached, then the group which spends more time on the task will out-perform the group which spends less. In other words, differences in learning will be attributable to variation in the amount of instruction, other things being equal. If instruction is not identical for the two groups of students, then amount of learning is a function of the kind of instruction, as well as the amount of instruction.

In studies of the relative effectiveness of different kinds of instruction, these two sources of variation in learning have not always been taken into account. The relative importance of differences in learning time and kind of instruction are not at all clear. If kind of instruction is much more important than learning time in influencing learning, then one would expect to find consistent relations between learning and kind of instruction received. If the factors are about equally important, or if kind of instruction is less important than learning time, then the relation between learning and indices of kind of instruction would appear to be inconsistent when learning time is not accounted for.

It is not possible to separate completely amount of instruction from kind of instruction. In fact, the kind of instruction must be specified at some level before it is possible to discuss amount of instruction. Kinds of instruction might be defined on the basis of curriculum content, group size, teacher behaviors, materials used, social climate, or physical arrangements of the classroom, among others. The number of kinds of instruction is practically limitless. The exploratory study reported here defined broad kinds of instruction in terms of subject matter categories.

Instructional time is most typically allocated to subject matter areas and, within these areas, to sub-areas. The subject areas of interest were reading and mathematics. At grade 2 typical sub-areas would be compound words, decoding initial consonants, addition without regrouping, place value, etc. The time that a teacher allocates to a subject area sets an upper limit on the amount of in-school instruction a student may receive in that subject area.

Besides allocating instructional time to subject areas, teachers also determine a large number of classroom conditions which influence the quality of time allocated to a particular subject area. In this study, three dimensions were used to define an instructional setting, each was seen as a dichotomy. The facets were: adult involvement (adult directly involved/no adult directly involved); pacing (self-paced seatwork/other); and group size (small group/large group). These three dichotomous setting variables combine to form eight setting types. Instructional time was allocated to subject areas and, within subject areas, to the eight instructional settings.

Of the time allocated to a particular subject area, students spend some time engaged in on-task behavior and some time in off-task behavior.

This latter time can be thought of as unengaged time. Hence, the maximum available in-school time for a particular content area is largely determined by the teacher, principal, or district policies. Of this "allocated" time, students engage in on-task behaviors for some portion of it.

The goal of this study[1] was to assess empirically the relationship between amount of instructional time and student achievement. More specifically, two questions were addressed: (a) Do students who have more time allocated to a particular subject area also learn more in that subject area? and (b) Do students who spend more engaged time in a particular subject area learn more in that subject area?

METHOD

Subjects. The field work carried out by Far West Laboratory during the continuation year of Phase III-A of the Beginning Teacher Evaluation Study involved a sample of 33 teachers. This sample was composed of 16 grade 5 and 17 grade 2 teachers. Each volunteered to participate in the one-year study. The teachers were recruited in the San Francisco Bay Area by Far West Laboratory staff during the spring of 1975. After meetings with administrative officials and building principals in ten school districts, individual teachers were contacted. The study was described, and teachers were offered extension credits (through a cooperating college) or an honorarium for their participation.

[1] The study reported here is part of a larger research effort. The data available for analysis were part of the data set collected during Phase III-A of the Beginning Teacher Evaluation Study (Far West Laboratory, 1975, 1976; Fisher, 1976a,b; Filby & Dishaw, 1976.

This report is based on data collected in nine grade 2 classes during a ten week period in the fall of 1975. Several of the classes were split grades, containing some grade 1 students and some grade 2 students. Only grade 2 students (but not necessarily all grade 2 students in a given class) were included in the study. Data on 152 students (in nine classes) were available for analysis.

Overview of data collection. The objectives of this study were to describe the naturally occurring variations in allocated and engaged instructional time, and to relate these variations to variations in student achievement. No manipulation of classroom conditions or teacher behaviors was attempted. The strategy was simply to assess student achievement in a number of content areas on two occasions; once early in the fall and once late in the fall. In the intertest interval, records of allocated time were kept. Practical time constraints determined that the first testing occasion (referred to as occasion A) take place during the first week of October, 1975. Records of allocated time were kept for eight weeks of instruction, after which the second testing (occasion B) was conducted during the first week of December, 1975.

In addition to the records of allocated time, data were collected on engaged time by direct observation. This procedure was carried out in two-thirds of the classes in the sample. Rather than sample observation days from the A-B intertest period, classes were observed for approximately ten consecutive school days. In an attempt to create optimal conditions for the assessment of the relation between engaged time and achievement, additional achievement tests were administered at the beginning of the first observation day and at the end of the last

observation day. These testing occasions are referred to as OA and OB respectively. This procedure provided 100 percent coverage by direct observation of in-school instruction for every student during the OA-OB period.

Measures of reading and mathematics achievement. The measures of achievement used in this study are a sub-set of the scales being developed by the staff of the Beginning Teacher Evaluation Study (Filby & Dishaw, 1975, 1976). A relatively large battery of items were administered at occasions A and B. The battery contained 340 reading items and 35 mathematics items grouped into approximately three dozen subscales each assessing achievement in a specific content area commonly taught at grade 2 in California schools. Ten reading and three mathematics subscales are analyzed in this report. The scales are labeled decoding-long vowels, decoding-consonant substitutions, decoding (total), context clues (total), word structure-compound words, word structure (total), word meaning-synonyms, comprehension-description, comprehension (total), reading (total), place value, subtraction without regrouping, and addition with regrouping. With the exception of the items in the compound words subscale, all items were of the multiple choice type. Identical items were group administered at occasions A and B and the resultant scores were used in conjunction with time measures assessed over the intervening eight-week period.

The three mathematics subscales and three of the reading subscales were administered at the OA and OB occasions and the resultant scores were used with the process data collected by direct observation.

Internal consistency reliability coefficients and other descriptive

statistics for the scales are presented in Table 1. In several cases the scales used for analysis in later sections of this report do not correspond exactly to the scales listed in Table 1. These differences are briefly described below.

Scores on the two long vowel subscales (final e and digraphs) listed in Table 1 were summed to form one 22-item scale labeled decoding-long vowels. The decoding (total) scale in Table 1 included speeded items. The decoding (total) scale which is analyzed in later sections of this report contained 86 items, none of which were speeded items.

Later analyses also include a reading (total) scale formed by summing scores on 301 items. No reliability information for this scale is included in Table 1, however, its length alone insures a very high internal consistency.

Entries in Table 1 were computed on all subjects with complete data for any given testing occasion. All scores were corrected for guessing using the standard correction procedure (Thorndike, 1971). Although some tests were short, the internal consistencies were relatively high. The mathematics items were difficult especially at occasion A while the reading items were relatively easy at all occasions.

Measures of academic status. The total score on the reading battery (340 items) at occasion A was used as an index of academic status. Scores for academic status ranged from a low of 1 to a high of 322 for the students in this study. The mean and standard deviation were 107 and 81 respectively. This measure, based on a wide variety of reading items, was used as an index of general adademic aptitude in analyses relating instructional time and student achievement.

Measures of instructional time. The process data consisted of measures of both allocated and engaged time spent in particular reading and mathematics content areas. Since instruction is planned and implemented by content area, and since student achievement is most often differentiated by content area, instructional time was first partitioned by content category. Subareas of reading (e.g., decoding, word meaning, comprehending main ideas) and mathematics (e.g., place value, addition without regrouping) constitute the categories. The content categories were developed at two levels (general and specific) from a logical analysis of grade 2 objectives, textbooks, and curriculum materials.

For grade 2 reading, 10 general content categories were defined. These break down into 68 specific content categories. Similarly, for mathematics, 10 general content categories and 27 specific content categories were defined. (All content categories are listed in Appendix A.)

The amount of instructional time allocated to each of the specific content categories in reading and mathematics for each student during the A-B intertest period was assessed via a teacher log keeping procedure. For a given week, each teacher recorded how students were grouped for reading instruction on an attendance/group composition form. Daily attendance records were kept on the same form; and if group composition changed during the week, the changes were also reported. On the teacher log form itself, teachers kept daily records for each student group. For each day, time periods were blocked off by vertical lines (drawn by the teacher). The beginning and ending times for a setting were recorded along the top of the form. For each setting, teachers recorded adult involvement, pacing, materials, and content categories. In this way, varied instructional patterns could be recorded on the same form.

From these records, time allocated to specific content categories (and classroom settings as well) were collected over the A-B intertest period.

Engaged time was assessed by direct observation. Each of six classes was observed for a two week period. The basic strategy of the system was to code all instruction in reading and mathematics for each student in a classroom. This was done by tracking the time students engaged in particular settings in terms of teacher involvement, pacing, and group size, and subsequently coding the content covered within each setting. During observation it was practically impossible to code all students and make distinctions among the 68 specific reading content categories and 27 specific mathematics content categories. As a result the content categories were grouped so that during observation seven different reading categories and six mathematics categories were used (Appendix A indicates relationship between the specific categories and those used for observation).

If students were not engaged in the task at hand, then time was subtracted from each setting for each student depending upon how much time that student was unengaged. When time was subtracted for unengagement, it was done so in multiples of one minute; momentary inattention was ignored.

Engagement was judged by the observer with the aid of several guidelines. When students were working on tasks which required an overt response, engagement was relatively easy to judge. When students were working on tasks which did not involve overt responses, the situation was somewhat more difficult. In the latter cases, observers used student eye contact and body position as indicators of engagement. If a student was in a discussion group, watching the various speakers in turn and apparently following the discussion, then the time was considered engaged time. If a student was discussing an unrelated

topic with other students, or was clearly not attending to the task, then the time was considered unengaged time. The distinction was fairly crude; students were considered unengaged only when the situation was unambiguous.

At the end of each observation day, the raw data on the observation coding form were transferred to standard coding booklets by the observer. In this way, a set of engaged times was generated for each student, describing his reading and mathematics instruction for the day. For reading, with seven observation content categories and eight combinations of the three dichotomous setting variables, there are 56 content-by-setting combinations (and 48 more for mathematics). The standard coding booklets contained a vector of 104 engaged time entries for each student, summarizing the engaged time in reading and mathematics for that particular day. These daily records were accumulated to provide measures of engaged time.

Observer agreement on engaged time in each of the 13 content categories was quite good. Based on seven days of paired observations, 12 coefficients were greater than 0.60; nine were greater than 0.70; and six were greater than 0.90.

Student engagement rates. Although the direct observation procedure provided information on the amount of engaged time students spent in a two week instruction period, it was also desirable to have a measure of student engagement rate.

Observers completed a log (analogous to the teacher log) at the end of each day of observation. This log contained the amount of time allocated to reading and mathematics for students in the class for a particular day. For each student, the total time allocated to reading (from the observer log) and the total engaged time in reading (from direct observation) were calculated. An observed engagement rate for reading was then computed for each student by taking the ratio of total engaged time in reading to total time allocated to reading. A second engagement rate was calculated for each student by performing the analogous calculation for engaged and allocated mathematics times.

Analysis procedure. The objective of the analyses was to assess whether or not students who spend more time in a particular content area also show higher levels of achievement in that content area. It was assumed that posttest achievement level was a function of pre-test achievement level, general aptitude for school learning and the amount of instructional time spent on the subject area. Multiple regression analysis was selected as the procedure for analyzing the data. In this analytical framework, the questions of major interest became "Is the raw regression weight for time positive?" and "Is that weight bounded away from zero?" A positive regression weight indicates that more time is associated with more learning. However, weights are of relatively little interest, if a typical confidence band for the regression weight includes zero.

One way to proceed would have been to conduct analyses within each class, since the other instructional conditions for members of the same class were reasonably homogeneous. In the current data set, this would have required running analyses on very small samples ranging in size from 13 to 26. Such analyses could hardly be expected to yield stable results.

The procedure reported here required two separate steps. First, all subjects were pooled regardless of class membership, and multiple regression analyses were conducted. A substantial positive regression weight for time was interpreted as meaning "more time/more learning," but the source of the effect was somewhat ambiguous. It could have resulted from differences among classes (but no differences among students within the same class), differences among students within the same class (but no differences among classes), or both. At this point, class means were plotted to help clarify the ambiguity. If no effect for time was found, a within-class relationship remained possible.

Regardless of the results of this first step, a second step was carried out. Scores on each variable were transformed to deviations from their respective class means, and the regression analyses were rerun on the deviation scores.

A substantial positive regression weight for time on the second step was interpreted as follows. Students with more time have higher levels of achievement regardless of class mean differences. No effects on both steps would indicate that, for this sample and for this model specification, instructional time was not linearly related to achievement.

Analyses carred out in the first step of this procedure are referred to as "analyses with subjects pooled." Those carried out in the second step are referred to as "analyses with subjects pooled within class."

Specifying which variables to include in the regression model was somewhat difficult. In each case, academic status was used as a measure of aptitude. The major time variable was defined as the time in the content category which matched the content assessed by the achievement test. In some cases, a second time variable was included representing time in a logically related area of instruction. As a general rule, analyses of achievement over the OA-OB period include engaged time measures from direct observation. Analyses of achievement over the A-B period have been carried out twice: once using allocated time estimates from the teacher logs, and once using adjusted allocated time obtained by multipying the allocated time from the teacher logs by the observed engagement rate. Throughout this report, this adjusted time is referred to as "estimated engaged time (from teacher logs)."

Each regression run was made on cases with complete data. The reading tests were relatively easy resulting in substantial ceiling effects. To reduce these effects, the pre-test score distribution was examined and several cases trimmed, so that each student (after trimming) had the opportunity to gain

at least as many score units as were gained by the sample as a whole. Trimming (to provide complete data and reduce ceiling effects) was carried out as a routine procedure. Whereas the ceiling effects in the reading scores were severe, the mathematics tests were relatively difficult and only minor ceiling effects occurred.

In general, results of multiple regression analyses are presented for achievement (post) regressed on achievement (pre), academic status, and one or two time variables. One of the time variables represents time in the content category which matches the content covered by the achievement test; the second time variable represents time in a content area which is logically related to the content area covered by the achievement test. Results of an analysis pooling subjects are followed by results of an analysis where subjects were pooled within class. For analyses of data collected over the A-B period, regression runs were made using allocated times, and rerun using engaged times estimated from allocated times. In all analyses, estimated engaged times were calculated by taking the product of allocated times from teacher logs and observed engagement rates. Results for data collected during the OA-OB period are presented first, followed by results for data collected during the A-B period.

Results from the OA-OB period. The OA-OB period was approximately two weeks in length for each class. Pre and post achievement tests were administered and engaged time was assessed by direct observation for all of the intervening in-school instruction. The results for mathematics will be presented first. Means and standard deviations for the mathematics achievement measures and engaged time in matched content categories are presented in Table 2. There was considerable variance in the amount of engaged time in place value and note that, given the short two-week time period, there was also considerable gain in achievement in place value.

For achievement in subtraction without regrouping over the OA-OB period, four classes gained slightly or stayed the same, and two dropped slightly. On the average, there was little change in achievement in subtraction without regrouping. Each class had some engaged time in the matched content category, but both the means and standard deviations were lower than those for engaged time in place value.

Students had essentially zero engaged time in addition with regrouping, and showed no gain in achievement in that area. (Addition with regrouping was just not taught during the early part of grade 2.) This no time/no learning result indirectly supports the more time/more learning hypothesis.

Of the three content areas, place value was the most interesting to pursue, in that an achievement gain had taken place in that area, and there was some variance in engaged time for place value. Hence, the remainder of the mathematics results for the OA-OB period are based on the place value data.

The results for achievement in place value and engaged time in the matched content category are presented in Table 3. Engaged time in place value had a positive weight which was bounded away from zero. The raw coefficient for engaged time was 0.020, indicating that when pre-test and academic status were held constant, achievement in place value (post) went up one point for every 50 minutes of engaged time in place value instruction. The partial correlation between engaged time and achievement (post) was higher than that between pre-test and posttest. The percent of variance in posttest uniquely accounted for by engaged time equalled 10.9. The three independent variables jointly accounted for about half (0.49) of the variance in the posttest.

Table 4 presents results for analyses of the same variables, when subjects were pooled within class. Each student's scores (on all variables) were deviated from their class means, and the regressions were run on the deviations. The correlations between engaged time in place value and the other three variables

dropped to near zero. As expected from the correlation between engaged time and posttest, the raw coefficient for engaged time was not bounded away from zero, although it was positive. One percent of variance in posttest was accounted for uniquely by engaged time. The variance in academic status was approximately the same pooled within class as it was for all subjects pooled. However, the variance in engaged time for subjects pooled within class dropped by more than a factor of three when compared to the variance for subjects pooled. For this sample, there was between-class variance in engaged time in place value which was related to achievement in place value; but the relation did not appear when subjects were pooled within class. Figure 1 plots class mean raw gain in place value over the OA-OB period against class mean engaged time. Note that Class 2 had very high values on both variables. The results reported for the analysis when subjects were pooled were due, in large part, to this difference between Class 2 and the remaining classes.

Means and standard deviations for the reading achievement measures and engaged time in matched content categories for the OA-OB period are presented in Table 5. There was a slight gain in achievement in compound words while the other two areas showed slight losses.

Compare the variation within class at OB with that at OA for each of the measures. In nine of the 18 situations in Table 5 the variation was less at OB than at OA. The major cause of this phenomenon was a severe ceiling effect in all three measures. The combined impact of the ceiling effect on all OA-OB reading measures and the small amount of engaged time in two of the matched content categories made time-achievement analyses for the OA-OB period extremely hazardous. No further analyses of decoding-long vowels or decoding (total) were attempted.

An analysis of engaged time and achievement in compound words was carried

out after severe trimming of subjects to reduce the ceiling effect. Regression analyses were conducted on this severely reduced sample. Achievement in compound words (post) was regressed on achievement in compound words (pre), academic status, engaged time in compound words (general content category 4), and engaged time in other word structure (general content category 5). The means, standard deviations and intercorrelations for the variables are presented in Table 6. For this group of students, a moderate gain in achievement was observed, however very small amounts of engaged time were recorded during the intertest interval. From the intercorrelations it was clear that variation in the posttest was strongly related to variation in the pre-test. Regression analyses with subjects pooled (and with subjects pooled within class) confirmed this observation. Practically no variation in the posttest was related to either academic status or engaged time after the pre-test had been accounted for. The regression weights for engaged time in the matched content category were all positive but none of the coefficients neared significance. Neither time nor academic status accounted for more than two percent of the posttest variance in any of these analyses. Since the ceiling effect was severe and the amounts of engaged time were very small, these data did not yield very powerful analyses. However, it is interesting to note that the partial correlation between engaged time in compound words and post achievement in compound words was always substantially higher in analyses where subjects were pooled within class (as opposed to analyses where subjects were pooled). In those analyses where academic status and engaged time in compound words were entered, when subjects were pooled within class, the time variable was as highly correlated with the posttest as with academic status (when other variables were partialled out).

Results from the A-B period. The A-B period was approximately eight weeks in

length for each class. Pre and post achievement tests were administered, and allocated time was reported in teacher logs for all of the intervening in-school reading and mathematics instruction. Means and standard deviations for the mathematics achievement measures and allocated time in matched content categories are presented in Table 7. As in the 0A-0B period, very little time was allocated to addition with regrouping, and essentially no achievement gain occurred in that area. Both the place value and subtraction without regrouping scales exhibited considerable growth. The typical variability in allocated time within class was much less than the variability for all subjects pooled, and also much less than the variability in the class means for allocated time. The data on addition with regrouping were not analyzed further. Results for the place value and subtraction without regrouping data are presented in turn.

Achievement in place value (post) was regressed on achievement in place value (pre), academic status, and allocated time in place value (from teacher logs) over the A-B period. Results are presented in Table 8. Allocated time in place value was negatively correlated with the other variables. The raw weight for engaged time was relatively small, and not bounded away from zero. Allocated time uniquely accounted for about one percent of the variance in the posttest. When subjects were pooled within class (Table 9), allocated time in place value was negatively correlated with pre-test and academic status, but positively correlated with the posttest. The partial correlation for time was positive, but relatively small. The raw regression weight for allocated time in both samples were positive, relatively large (0.026), and approximately twice the size of their standard errors. Allocated time uniquely accounted for two percent of the variance in posttest.

The time allocated to place value (from teacher logs) was multiplied by the observed engagement rate (from direct observation and obser logs), thus generating an engaged time estimated from the teacher log data. Regressions, analogous to those just described, were subsequently run using this estimated engaged time. The results when subjects were pooled are contained in Table 10. The correlation between estimated engaged time in place value and posttest was 0.12, while the correlations between estimated engaged time and the remaining variables were negative, and substantially larger in magnitude. The raw weight for estimated engaged time was positive, substantial in size, and bounded away from zero. Estimated engaged time uniquely accounted for estimated engaged time was 0.30. The independent variables accounted jointly for about 40 percent of the variance.

When subjects were pooled within class (Table 11), the pattern of correlation among the variables changed very little. The raw weight for estimated engaged time as positive and less than twice the size of the standard error.

Four analyses of the relationship between achievement and allocated (or estimated engaged) time in place value have been reported. For analysis where subjects were pooled, no relationship was found between allocated time and achievement in place value, while estimated engaged time in place value showed a moderate relationship.

The analyses where subjects were pooled within class were very consistent. A moderate relation was found in each case. The raw coefficients for time were approximately 0.025, with standard errors of approximately 0.015. The unique variance in posttest accounted for by time (allocated or estimated engaged) ranged from two to four percent. With the other variables held constant, students on the average gained one point in

achievement in place value for every 40 minutes of time (allocated or estimated engaged) in place value instruction.

Achievement in place value is likely to be related to instruction in addition and subtraction with regrouping, since the skills necessary for computation requiring regrouping are similar to those needed for place value problems. To test this possibility, all time in addition and subtraction both with and without regrouping) and in place value were summed for each student. This composite corresponds to time in general content categories 1 through 5. Regression runs analogous to those described above were conducted. The results of these analyses are summarized in Table 17.

After trimming to reduce ceiling effects the data on subtraction without regrouping were submitted to regression analyses. Analyses of allocated time with subjects pooled and for subjects pooled within class were carried out. In both analyses, allocated time in subtraction without regrouping (general content category 3) was weakly correlated with the posttest. In the analysis where subjects were pooled, allocated time was essentially unrelated to posttest. Pre-test and academic status were also only weakly related to posttest, and the three independent variables jointly accounted for only eight percent of the variance in posttest. The analysis in which students were pooled within class indicated a positive but very weak relationship between allocated time and posttest.

The two analyses of subtraction without regrouping data were repeated for estimated engaged time in subtraction without regrouping. In the analysis where subjects were pooled, a positive but very weak relationship between estimated engaged time and posttest was detected. However, when subjects were pooled within class, a stronger relationship was found. The raw weight for estimated engaged time (0.023) was bounded away from

zero and estimated engaged time uniquely accounted for 10 percent of the variance in the posttest. In this case, estimated engaged time accounted for more variance in posttest than either pre-test or academic status. Results of the analyses of subtraction without regrouping are summarized in Table 17.

Means and standard deviations for the measures of reading achievement and allocated time in matched content categories are presented in Table 12. All measures showed an overall gain over the A-B period. There were a few exceptions when the pre- and post means were compared for each class. Of the 108 cases (12 measures x 9 classes) there were nine occasions when class means decreased from A to B. As in the OA-OB test data, the posttest variance (within class) was less than the pre-test variance for a substantial number of situations (44 out of 108). Examination of the frequency distributions revealed serious ceiling effects for most of the measures.

The quantities of allocated time varied widely from one content category to another. However, the content categories represented in Table 12 also varied in "breadth" and, in several cases, overlap in coverage. For example, decoding (total) included decoding-long vowels and decoding-consonant substitution as well as other areas of decoding. For a particular content category there was considerable variation both within and between classes. In most cases the variation between classes was greater than that within classes.

Regression analyses were carried out on several of the content areas represented in Table 12. In general, areas where ceiling effects were least serious were chosen for analysis. In each case, a frequency distribution of the pre-test was examined and cases were trimmed. Students with missing data were also deleted before analysis. After reducing the number subjects (in some cases the reduction was substantial), an

analysis where subjects carried out on the remaining students from the nine classes in the sample. In these analyses achievement (post) was regressed on achievement (pre), academic status, allocated time in the matched content area and allocated time in a logically related content area.

Two parallel analyses were conducted using estimated engaged time rather than allocated time. Engaged time was estimated by multiplying allocated time by the engagement rate which was obtained during the direct observation. Since only six of the nine classes were observed, engagement rates were available for some students but not for others. Therefore the sample size for the analyses using estimated engaged time was invariably smaller (representing the ommission of three classes) than for the analyses using allocated time.

Regression analyses relating achievement in compound words and allocated time variables were conducted. As outlined above, two time variables were entered in the regression equation: the time allocated to compound words (matched category) and the time allocated to other word structure (a logically related content area).

The four independent variables accounted for 30 percent of the variance when subjects were pooled and 26 percent when subjects were pooled within class. In both cases, academic status accounted for, by far the greatest portion, of the explained variance. The pre-test and both time variables were relatively weak contributors to the posttest variation. However, when subjects were pooled within class, allocated time in compound words had a large raw coefficient (.025), had a substantial partial correlation with the posttest (0.18), and was a much stronger contributor than the pre-test.

Analyses using estimated engaged time were similar to those reported for allocated time. The four independent variables accounted for

28 percent (subjects pooled) and 25 percent (subjects pooled within class) of the variance in the posttest. Academic status was the strongest contributor in both analyses while the pre-test was relatively weak in both. When subjects were pooled within class, estimated engaged time in compound words had a large coefficient (0.042), a relatively large partial correlation with the posttest (0.16), and was a stronger contributor than the pre-test. This result indicates that when class mean differences were removed, students who spent more time engaged in compound words also had higher achievement in compound words.

The results of the analyses on achievement in compound words were dominated by the academic status variables. For the time variables, the results were stronger in analyses where subjects were pooled within class than for analyses where subjects were pooled. In the latter type of analysis estimated engaged time uniquely accounted for four percent of the variance in the posttest. The analyses of achievement in compound words are summarized in Table 18.

Similar analyses were carried out on time and achievement in decoding-long vowels. Tables 13 and 14 present analyses where achievement in decoding-long vowels (post) was regressed on achievement in decoding-long vowels (pre), academic status, allocated time in decoding-long vowels and allocated time in other decoding. The pattern of correlations among the variables was similar when the matrix for subjects pooled (Table 13) is compared to the matrix for subjects pooled within class (Table 14). The pre-test, posttest and academic status variables were highly inter-correlated in both tables. Allocated time in long vowels was weakly but positively correlated with the posttest, and slightly negatively correlated with all three test scores.

In the regression analyses, the four independent variables accounted for 68 percent (subjects pooled) and 58 percent (subjects pooled within class) of the posttest variance. Although the analyses were dominated by the pre-test, allocated time in decoding-long vowels had a positive regression weight. The effect was stronger for the analyses where subjects were pooled, but in both analyses the partial correlation between allocated time in decoding-long vowels and achievement (post) was quite high (0.31 and 0.17). Time allocated to the other decoding areas yielded a negative weight in both analyses. In the analysis where subjects were pooled the effect was quite strong though much weaker than the effect of time allocated to decoding-long vowels. Since the zero order correlation between the two time variables was positive, the negative weight for time allocated to other decoding was somewhat difficult to explain.

Parallel analyses were computed using estimated engaged time rather than allocated time. The sample on which these analyses were carried out contained 66 students from the six classes for which estimates of engaged time were available. The results for subjects pooled and subjects pooled within class are presented in Tables 15 and 16 respectively. The pattern of inter-correlations among the test scores similar to those presented in Tables 13 and 14. However, the correlations among the test scores and time in long vowels and estimated engaged time in other decoding increased to 0.47 in Table 15 and 0.67 in Table 16. Where there were negative correlations between allocated times and test scores there were essentially zero or positive correlations between estimated engaged times and test scores.

In the regression analysis where subjects were pooled there was a positive relationship between estimated engaged time in decoding-long vowels and the posttest. In the same analysis estimated engaged time in the other areas of decoding entered negatively. Both times have sizeable partial correlations with the posttest. When subjects were pooled within class (Table 16) neither time variable had much impact on the posttest.

In the analyses of achievement in decoding-long vowels the pretest dominated the relationships. However, time in the matched category was positively related to the posttest. A negative relationship occurred between achievement in decoding-long vowels and time in the other decoding areas when subjects were pooled but the relationship disappeared when subjects were pooled within class.

In addition to analyses of relatively narrow content categories (compound words and decoding-long vowels) regressions were run on total decoding which represents a much broader content category and includes much greater amounts of allocated time. In these analyses, time allocated to decoding and all other time allocated to reading were used as independent variables. After trimming the sample to eliminate missing data and to alleviate ceiling effects 103 cases remained for analyses.

The results for the allocated time measures are summarized in Table 18. The correlations among the test scores were extremely high and time allocated to the matched category correlated negatively with the posttest. Nevertheless the weight for time allocated to decoding was positive in the analysis where subjects were pooled. This weight goes slightly negative in the analysis where subjects were pooled within class. In neither case was the effect very strong. However, when subjects were

pooled within class (see Table 18) the time allocated to other reading had a large positive weight and a substantial partial correlation with posttest.

When parallel analyses were run using estimated engaged time (Table 18), the negative zero order correlations disappeared. These analyses were similar to the analyses using allocated time. The result for estimated engaged time (when subjects were pooled within class) was repeated.

The test score variables in the analyses of decoding were very highly correlated. This condition dominated the analyses. The effect of the matched time category was weak and inconsistent, sometimes yielding positive weights sometimes negative weights. The time in other reading however did have a consistent positive relationship to posttest when subjects were pooled within class.

The broadest content category available for analysis was total reading. All of the reading subscores (exclusive of speeded subtests) were added to form a total reading score containing 301 items. Total reading (pre) and academic status are almost identical by definition and not surprisingly their intercorrelation was 0.99 (both when students were pooled and when students were pooled within class). It is also clear that the pre-and posttests were very highly correlated. Allocated time was essentially uncorrelated with the test scores when subjects were pooled and positively but very weakly correlated to the test scores when subjects were pooled within class.

Estimated engaged time was moderately correlated with the test scores and more strongly related to the posttest than with the pre-test both when subjects were pooled and when subjects were pooled within class.

Several regression analyses were carried out on these data. Total reading (post) was regressed on total reading (pre) and either time allocated to reading or estmated engaged time in reading. Analyses were completed where subjects were pooled and where subjects were pooled within class. Even though the analyses were dominated by the very large pre-post correlation, all weights for time were positive. The raw regression coefficients were relatively large in the analyses where subjects were pooled within class (0.012 for allocated time in reading and 0.018 for estimated engaged time in reading). In all analyses the relationships were somewhat stronger between posttest and estimates of engaged time than between posttest and allocated time. In no case did a time variable account uniquely for more than one percent of the variance in total reading. Given that the pre- and posttest were so highly correlated, this situation was not unexpected.

Summary of results for mathematics. Table 17 presents a summary of the relationship found between instructional time and student achievement in mathematics. For the OA-OB period, a positive relationship was found in analyses where subjects were pooled. Differences between classes in the amount of engaged time in place value were related to student achievement in place value. Over the A-B period, achievement and estimated engaged time were weakly related in analyses where subjects were pooled. Stronger relationships were found when a broader definition of time (especially for estimated engaged time) was used. When subjects were pooled within class, time and achievement in matched content areas were weakly but consistently related.

Where substantial relationships were found, time and achievement were positively related. It was also found that, where students had no time in a content area (addition with regrouping), no gain in achievement was observed.

Summary of results for reading. A summary of the regression analyses is presented in Table 18. An examination of the raw regression coefficients for time variables revealed that 15 of the 18 coefficients were positive. With the exception of the decoding results, the coefficients obtained in analyses where subjects were pooled within class were greater than those obtained in corresponding analyses where subjects were pooled. The percentages of variance accounted for uniquely by time variables were quite small. Given the general pre-post correlations and academic status-post correlations, this situation was not unexpected.

DISCUSSION

Mathematics. The findings for the OA-OB period reflected differences between one class (which spent a large amount of time and attained a large achievement gain) and all other classes (which spent relatively little time and had relatively small achievement gains). When the differences in engaged time were small (analyses where subjects were pooled within class), no strong relations with achievement were observed. In the only case where large differences occurred (between classes), a relatively strong relationship between engaged time and achievement was found.

For the A-B period, those analyses where subjects were pooled

followed the same pattern as the results for the OA-OB period. That is, stronger relationships between time and achievement were found when the between-class differences were large. Class 2, with a large achievement gain and large amount of time, differed from the other classes. When the broader time definition was used, this difference between Class 2 and the other classes was increased.

For the analyses where subjects were pooled within class, the findings over the A-B period differed somewhat from the findings over the OA-OB period. Note that positive, though weak, relationships between time and achievement were found, and that the relationships tended to be stronger for estimated engaged time. A relatively strong relationship was found in this set of analyses between estimated engaged time and achievement in subtraction without regrouping. Over the A-B period the accumulated differences in time within class were quite large, and these differences did show a relationship to achievement.

The results obtained from analyses where subjects were pooled provide indirect evidence that more time was related to more learning. However, these effects were essentially between class effects, and cannot be interpreted unambiguously. There may have been many other differences between classes which would account for the achievement differences. The findings from analyses where subjects were pooled within class can be interpreted more straightforwardly. Though not with consistent strength, instructional time and achievement were positively related, regardless of differences between classes. These results were also supported by the fact that, in cases where no time was allocated to instruction (addition with regrouping), no gain in

achievement was detected.

Reading. Instructional time in reading was positively related to student achievement in reading. In general, where students spent more time, achievement was higher; however, there were several exceptions to this statement.

Variables assessing instructional time in reading showed stronger effects when subjects were pooled within class than when subjects were pooled. This implied that if a student spent more time (relative to the mean time spent for his class) then his reading achievement tended to be higher than the mean achievement for his class. An analogous statement can be made about time and achievement in reading relative to the means for the whole sample (regardless of class membership) but the effect tended to be smaller than that found when subjects were pooled within class. For this sample of classes, the variation in average class time in reading instruction was not strongly related to average class differences in achievement. This could have resulted in a number of ways; for example, differential effectiveness of teachers and/or curricula, or the allocation of time (in some classes) to content areas after the students had mastered the areas. It was not within the scope of the present data set to pursue these possibilities. The point here is that, within a given class more time was associated with more learning. Differences between classes in amount of instructional time were also weakly related to achievement.

The content areas chosen for analysis were purposely varied in "breadth." Compound words was the narrowest category chosen, in that,

the knowledge to be acquired in the area was relatively small in amount and relatively simple in structure. The long vowels category was somewhat broader in that the concepts involved were more complicated and were also more closely tied to other content categories (for example, short vowels and other decoding categories). The total decoding and total reading categories were broader still. The results for the broadest category (reading) and the narrowest category (compound words) followed the trends (more or less) described above. The results from the two decoding categories were somewhat weaker. A logical analysis of the test items used to assess decoding, pointed out that instruction in decoding may be helpful but not necessary for answering the items correctly. Therefore, students who were not in a phonics-type program could certainly get the items correct even though they had small amounts of time allocated to decoding tasks. In reading, this situation makes it particularly difficult to isolate pieces of instructional time which related uniquely to performance on paper and pencil tests. There was clearly considerable transfer of knowledge from one content area to another. In addition, the broader the content area the greater the potential overlap. The data bore this out, especially in the decoding area. Note that time in other reading was a strong contributor to achievement (when students were pooled within class). The results for decoding-long vowels employed time in other decoding as the secondary time variable. Having recognized this transfer phenomenon, time in other reading may have been a more useful choice for the secondary time variable in the analysis.

General Comments

The findings reported on the relationship between instructional time and achievement were derived from exploratory analyses. Alternative analysis plans might or might not replicate the results. The underlying model relating time and other factors to learning remains unclear. In the analysis reported here, no consideration was given to possible nonlinear relationships. A number of interesting hypotheses could be explored. A conceptually simple and intuitively appealing approach assumes that learning is the product of some learning rate and time. With a zero learning rate or no time, no learning takes place. Where learning rate is constant, learning is a function of time; where time is constant, learning is a function of learning rate. Equal amounts of learning may occur as the result of a small amount of time and a high learning rate, or vice versa. The major difficulty with this notion is the complexity of the "learning rate" concept. Presumably, learning rate is a function of the person and of the learning task. This product model was not explored for this report.

The way in which content areas are subdivided and categorized may affect the relationship between time and achievement. In this study, mathematics and reading instruction was partitioned into mutually exclusive categories. Achievement tests corresponding to the categories were developed, and relationships were sought between achievement and time within the same category. This appears to be the place to start; however, the results and the previous discussion point out the difficulty of developing consistent and meaningful content categories. The

greater the transfer effects in a subject area, the more complex the relation between time-in-content and achievement. It would appear that some subject areas are more amenable to useful content categorization than others (when usefulness is defined in terms of the relationship to paper and pencil test scores).

A slight variation on the transfer issue concerns the relative impact of out-of-school experience on achievement. Of the academic areas taught in elementary school, reading is probably influence more by out-of-oschool experience than other subject areas. This speculation does not invalidate the time to achievement relationship, but it may make the relationship more complex and difficult to investigate. empirically. It is tempting to redefine the content categories and to hierarchically structure the manner in which they should be related to a given achievement measure. Several simple redefinitions have been reported; many other plausible alternatives could also be tried.

Since instructional time tended to be allocated in blocks by subject matter, students in the same class tended to have the same total time allocated to mathematics (neglecting any effects due to absenteeism). This was true for reading as well as mathematics. As a result, the set of content categories for mathematics and reading exhibited partially ipsative properties. The within class correlations among content categories were therefore constrained in a complex fashion. On some occasions, when more than one time variable was entered in a regression analysis, the weights for the variables were opposite in sign. This came about because more time spent on one content category often implied relatively little time spent on another.

The results of this study must be carefully qualified for a number of reasons. The achievement measures were relatively short, and therefore prone to sizeable measurement errors. There were severe ceiling effects on many of the reading scales. Hence, the samples on which reading analyses were conducted usually included from 50 to 80 percent of the students with complete data. Only a few classes were involved; nine for analyses of allocated time in reading and six for analyses of allocated time in mathematics and all analyses of estimated engaged time. In addition, the correlations between test scores were high, especially for the reading scores. The time variables accounted uniquely for small portions of post-test variation. This fact was, at least partly, a function of the multi-colinearity among the variables. In addition, the teacher log-keeping procedures and the direct observation procedures contained relatively large errors.

Instructional time and student achievement were positively related. Substantial amounts of time and substantial differences in amounts of time were necessary before this relationship could be detected. The strength and consistency of the relationship varied considerably. Ceiling effects on the tests prompted relatively severe trimming of subjects from the sample.

This study provides qualified support for the hypothesis that more time yields more learning. This suggests that differences in the amount of time provided for instruction in a given area (either among classes or among students in the same class) are related to the amount learned. Thus, the pattern of time allocation to various subject matter areas and sub-areas is an important consideration when planning and implementing instruction. However, this result does not suggest what to do

during the time allocated to a content area in order to increase the amount of learning. It may be that more effective instructional behaviors can make up for relatively smaller time allocations. The important point in this exploratory study is that differences in quality of instruction did not appear to swamp differences in amount of instruction.

Although the amount of time allocated to a content area appears, in itself, to be a contributor to the amount learned, we must not lose sight of the quality of instruction. It is beyond the scope of these data to comment on the impact of specific teacher behaviors or combinations of teacher behaviors. However, it is interesting to note that, in the main, amount of engaged time (or estimated engaged time) was more strongly related to student achievement than was amount of allocated time. If engagement increases with quality of instruction, then the strengthening of the relationship between instructional time and student achievement obtained by using (estimated) engaged time, can, in part, be attributed to an effect of quality of instruction.

The distinction between allocated and engaged instructional time may have considerable importance for the practice of teaching. Some teaching behaviors and classroom conditions allow the amount of engaged time to approach the amount of allocated time. These teaching behaviors and classroom conditions may result in more engaged time which, in turn, will yield higher achievement (given a constant amount of allocated time). Although it is but speculation at this point, these few concepts provide a potentially powerful way to think about teaching effectiveness. Teachers allocate instructional time to content areas. Then

the task is to optimize the amount of time students are engaged in relevant learning activities which will in turn lead to increased achievement. Hence, amount of engaged time and student engagement rates may offer valuable intermediate criteria in the establishment of effective instruction.

REFERENCES

Bennett, N. Teaching styles and pupil progress. London: Open Books, 1976.

Block J., & Burns, R. Time in school learning: An instructional psychologist's perspective. Paper presented at the annual meeting of the American Educational Research Association, Washington, D.C., 1975.

Bond, G. L., & Dykstra, R. The cooperative research program in first-grade reading instruction. Reading Research Quarterly, 1967, 2, 5-142.

Carroll, J. B. A model of school learning. Teachers College Record, 1963, 64, 723-733.

Carroll, J. B., & Spearritt, D. A study of a model of school learning. Monograph No. 4, Center for Research and Development in Educational Differences, Harvard University, 1967. (ERIC Document Reproduction Service No. ED 045 477).

David, J. L. Summer study: A two part investigation of the impact of exposure to schooling on achievement growth. Unpublished doctoral dissertation, Harvard University, 1974.

Far West Laboratory for Educational Research and Development. Program plan for continuation of Phase III-A: Beginning Teacher Evaluation Study. San Francisco, California, 1975.

Far West Laboratory for Educational Research and Development. Instructional Time Allocation in Fifth Grade Reading (Technical Report II-5). Beginning Teacher Evaluation Study. San Francisco, California, 1976.

Filby, N. N., & Dishaw, M. Development and refinement of reading and mathematics tests for the study of reading and mathematics instruction in Grades 2 and 5 (Technical Report III-1). Beginning Teacher Evaluation Study, Far West Laboratory, San Francisco, 1975.

Filby, N. N., & Dishaw, M. Refinement of reading and mathematics tests through an analysis of reactivity (Technical Report III-6). Beginning Teacher Evaluation Study, Far West Laboratory for Educational Research and Development, San Francisco, 1976.

Fisher, C. W. A study of instructional time in grade 2 mathematics (Technical Report II-3). Beginning Teacher Evaluation Study, Far West Laboratory for Educational Research and Development, San Francisco, 1976a.

Fisher, C. W. A study of instructional time in grade 2 reading (Technical Report II-4). Beginning Teacher Evaluation Study, Far West Laboratory for Educational Research and Development, San Francisco, 1976b.

Harnischfeger, A., and Wiley, D. Teaching-learning processes in elementary school: A synoptic view (Technical Report 75-31-1), San Francisco: Far West Laboratory, 1975.

Harris, A. J., Morrison, C., Serwer, B., and Gold, L. A continuation of the CRAFT project: Comparing reading approaches with disadvantaged urban Negro children in primary grades. New York: City University of New York, 1968. (ERIC Document Reproduction Service No. ED 010 297).

Harris, A. J., & Serwer, B. Comparison of reading approaches in first grade teaching with disadvantaged children. (The CRAFT project) New York: City University of New York, 1966.

Hess, R. & Takanishi, R. The relationship of teacher behavior and school characteristics to student engagement (Technical Report 42). Center for Research and Development in Teaching, Stanford University, 1974.

Karweit, N. Quantity of schooling: A major educational factor? Educational Researcher, 1976, 5 (2), 15-17.

McDonald, F. J. Beginning Teacher Evaluation Study, Phase II: Summary Report. Princeton, New Jersey: Educational Testing Service, 1975.

Stallings, J. A., & Kaskowitz, D. Follow-through classroom observation evaluation, 1972-1973. Menlo Park, California: Stanford Research Institute, 1974.

Thorndike, R. L. (Ed.). Educational measurement (2nd Ed.). Washington, D.C., American Council on Education, 1971.

Wiley, D. E. Another hour, another day: Quantity of schooling, a potent path for policy. Studies of Educative Processes, No. 3. Chicago, July, 1973.

Table 1

Reliability coefficients[a] for reading subscales at each testing occasion

A - B INTERVAL

Scale	Number of Items	Occasion A				Occasion B			
		N	Mean	S.D.	α	N	Mean	S.D.	α
Decoding - Consonant Substitutions	10	147	2.5	3.6	0.75	149	4.0	3.8	0.75
Decoding - Long Vowels (final e)[b]	12	147	6.7	3.9	0.75	149	7.8	3.6	0.76
Decoding - Long Vowels (digraphs)[b]	10	147	4.4	4.0	0.81	149	5.6	4.0	0.82
Decoding (total)[c]	124	142	59.6	33.0	0.97	135	72.4	33.0	0.97
Context Clues - Form of Word	10	147	1.8	3.2	0.68	149	2.3	4.0	0.75
Context Clues - (total)	30	147	8.5	9.2	0.89	149	12.2	10.5	0.90
Word Structure - Compound Words	10	150	4.2	4.8	0.82	136	6.5	4.5	0.83
Word Structure (total)	65	139	15.0	18.0	0.92	135	24.8	19.5	0.93
Word Meaning - Synonyms	18	148	3.6	5.2	0.82	144	5.4	6.1	0.86
Comprehension - Description	13	133	2.1	3.6	0.70	134	3.9	4.2	0.73
Comprehension (total)	50	138	9.5	12.5	0.90	134	15.1	14.3	0.91

OA - OB INTERVAL

Scale	Number of Items	Occasion OA				Occasion OB			
		N	Mean	S.D.		N	Mean	S.D.	
Decoding - Long Vowels	22	117	12.1	7.8	0.89	112	11.4	8.0	0.89
Decoding	14	117	8.4	4.2	0.74	112	7.8	4.7	0.80
Compound Words	10	117	6.1	4.1	0.77	112	6.6	3.5	0.71

[a]Alpha coefficients (Cronbach, 1951) are presented for each scale.

[b]The scores on Decoding-Single Consonants (speeded test) and Decoding-Blends and Digraphs (speeded test) were added to form a scale named Decoding-Consonant Sounds (speeded test). The combined scores were used in subsequent analyses. All other subtests included in this report had liberal time limits.

[c]The scores on Decoding-Long Vowels (final e) and Decoding-Long Vowels (digraphs) were added to form a scale named Decoding-Long Vowels which was used in subsequent analyses.

Table 1 (continued)

Reliability coefficients[a] for reading subscales at each testing occasion

A-B Interval

Scale	Number of Items	Occasion A N	Mean	S.D.	α	Occasion B N	Mean	S.D.	α
Place Value	15	105	3.3	3.6	0.64	112	6.7	4.3	0.75
Subtraction w/ Regrouping	10	105	3.4	2.6	0.56	112	4.8	3.4	0.74
Addition with Regrouping	10	105	1.5	2.5	0.57	112	1.8	3.2	0.74

OA-OB Interval

Scale	Number of Items	Occasion OA N	Mean	S.D.	α	Occasion OB N	Mean	S.D.	α
Place Value	15	117	4.8	3.5	0.61	112	6.3	4.7	0.81
Subtraction w/o Regrouping	10	117	3.1	2.8	0.60	112	3.4	3.1	0.69
Addition with Regrouping	10	117	1.7	2.7	0.60	112	1.5	3.0	0.70

[a]Alpha coefficients (Cronbach, 1951) are presented for each scale.

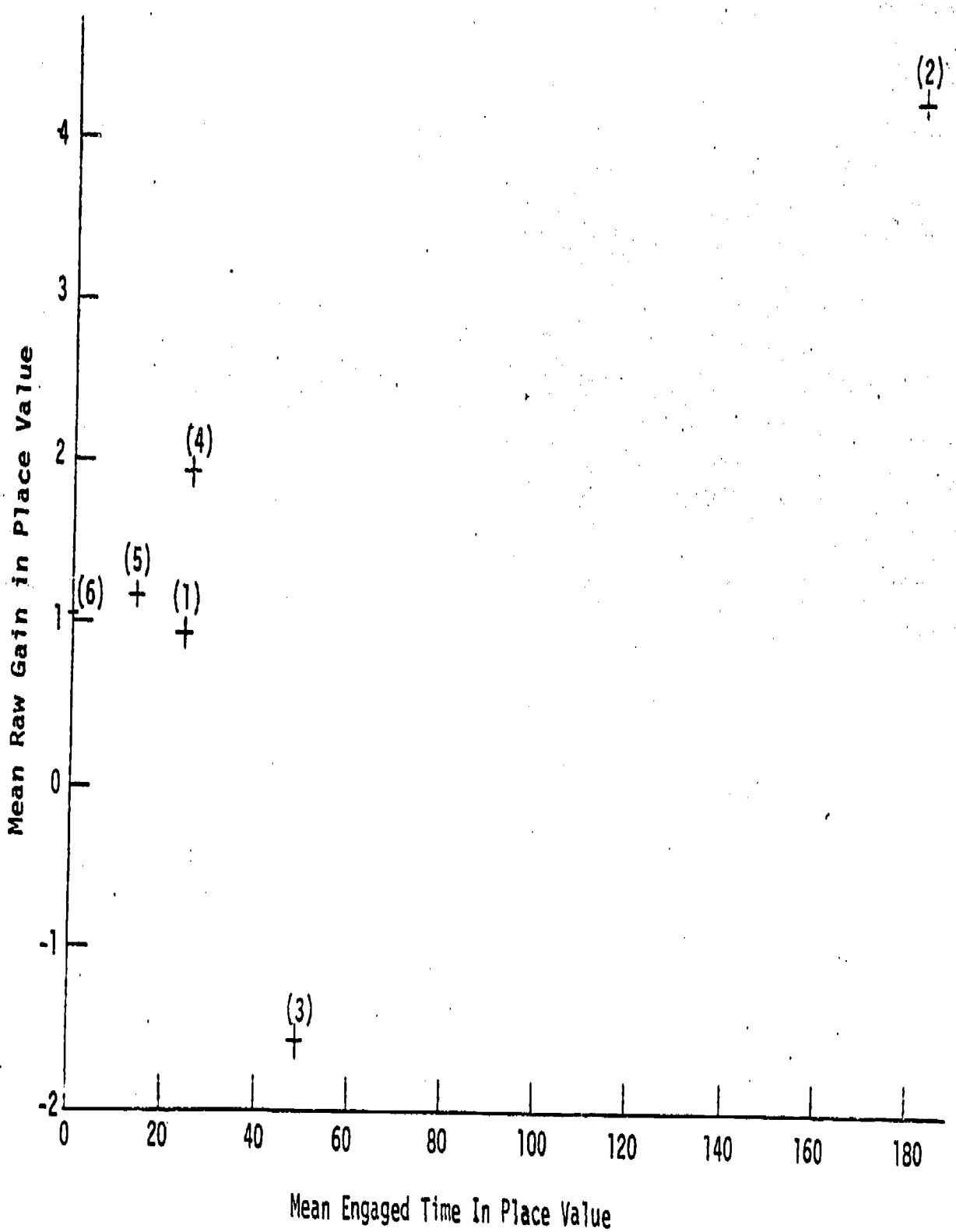

Figure 1

Mean raw gain on achievement in place value vs. mean engaged time in place value over the OA-OB period for six grade 2 classes (class identification numbers are shown in parentheses)

Table 2

Means and standard deviations for achievement measures and engaged time in matched content categories over the CA-OB period for six grade 2 classes.

Class	Max N	Min N	Academic Status	Place Value			Subtraction Without Regrouping			Addition With Regrouping		
				Pre Test (15 items)	Post Test (15 items)	Engaged Time (minutes)	Pre Test (10 items)	Post Test (10 items)	Engaged Time (minutes)	Pre Test (10 items)	Post Test (10 items)	Engaged Time (minutes)
1	16	16	160.5 (91.1)	6.5 (4.5)	7.3 (5.2)	23 (10)	3.2 (3.1)	2.6 (2.8)	22 (8)	2.5 (2.7)	2.6 (3.3)	1 (1)
2	18	17	138.9 (77.0)	5.4 (1.9)	9.7 (3.3)	176 (45)	3.9 (2.4)	5.0 (2.8)	7 (4)	1.9 (2.4)	1.6 (2.9)	0 (0)
3	20	19	36.4 (35.0)	3.0 (2.4)	1.5 (2.3)	47 (10)	2.3 (2.5)	2.9 (2.9)	45 (14)	0.7 (1.5)	0.0 (1.8)	0 (0)
4	13	12	147.3 (94.7)	5.8 (4.1)	7.8 (4.1)	20 (12)	2.7 (2.9)	2.7 (2.8)	1 (0)	2.6 (2.6)	1.8 (3.1)	0 (0)
5	26	24	133.0 (65.5)	5.5 (3.5)	7.1 (4.1)	13 (7)	4.3 (3.1)	4.3 (3.7)	68 (24)	1.0 (3.2)	1.8 (3.2)	3 (1)
6	18	17	75.3 (47.0)	2.7 (2.4)	3.8 (2.0)	0 (0)	2.3 (1.8)	1.9 (2.6)	43 (18)	1.7 (2.5)	1.3 (3.0)	0 (0)
Average Over Students	112	106	113.3 (80.8)	4.8 (3.4)	6.1 (4.5)	45 (62)	3.2 (2.8)	3.3 (3.1)	35 (28)	1.6 (2.6)	1.5 (2.9)	1 (2)
Average of Class Means (Unweighted)	6	6	115.2 (48.5)	4.8 (1.6)	6.2 (3.0)	47 (65)	3.1 (0.8)	3.2 (1.2)	31 (26)	1.7 (0.8)	1.5 (0.9)	1 (1)

Notes

Engaged time was assessed by direct observation.

Standard deviations are shown in parentheses.

Table 3

Achievement in place value (post) regressed on achievement in place value (pre), academic status and engaged time in place value (general content category 5) from direct observation over the OA-OB period (subjects pooled, moderate trim, N = 94).

I DESCRIPTIVE INFORMATION

	Variable	Mean	Standard Deviation	Correlations 1	2	3	4
1	Place Value (Post)	5.3	3.9	1.00			
2	Place Value (Pre)	4.1	2.5	.50	1.00		
3	Academic Status	101.5	73.2	.50	.30	1.00	
4	Engaged Time GCC 5	50.4	66.2	.45	.22	-.12	1.00

II SUMMARY OF MULTIPLE REGRESSION ANALYSIS

Multiple R	0.70	(p = 0.00)[a]
Multiple R Squared	0.49	
Std. Error of Est.	0.83	
Constant	0.33	

Independent Variable	Beta, Stand. Coefficient	B, Raw Coefficient	Stand. Error Of B	F To Delete	Probability[a]	Partial Corr. With Dep.
Place Value (Pre)	0.3128	0.4840	0.1243	15.15	0.00	0.38
Academic Status	0.3668	0.0196	0.0042	21.54	0.00	0.44
Engaged Time GCC 5	0.3380	0.0199	0.0045	19.22	0.00	0.42

[a] Probabilities rounded to two places.

Table 4

Achievement in place value (post) regressed on achievement in place value (pre), academic status, and engaged time in place value (general content category 5) from direct observation over the OA-OB period (subjects pooled within class, moderate trim, N = 94).

I DESCRIPTIVE INFORMATION

	Variable	Mean	Standard Deviation	Correlations 1	2	3	4
1	Place Value (Post)	0.0[a]	2.9	1.00			
2	Place Value (Pre)	0.0	2.3	.39	1.00		
3	Academic Status	0.0	61.9	.32	.15	1.00	
4	Engaged Time GCC 5	0.0	19.0	.05	-.05	-.06	1.00

II SUMMARY OF MULTIPLE REGRESSION ANALYSIS

Multiple R	0.48	(p = 0.00)[b]
Multiple R Squared	0.23	
Std. Error of Est.	2.58	
Constant	0.00	

Independent Variable	Beta, Stand. Coefficient	B, Raw Coefficient	Stand. Error Of B	F To Delete	Probability[b]	Partial Corr. With Dep.
Place Value (Pre)	0.3518	0.4398	0.1173	14.05	0.00	0.37
Academic Status	0.2704	0.0126	0.0044	8.29	0.01	0.29
Engaged Time GCC 5	0.0853	0.0130	0.0142	0.84	0.64	0.10

[a] Since the scores are mean deviated, all means are equal to zero.

[b] Probabilities are rounded to two places.

Table 5

Means and standard deviations for achievement measures and engaged time in matched content categories over the OA-OB period for six Grade 2 classes.

Class	Max N	Min N	Academic Status	Decoding - Long Vowels			Decoding			Compound Words		
				Pre Test (22 items)	Post Test (22 items)	Engaged Time (minutes)	Pre Test (14 items)	Post Test (14 items)	Engaged Time (minutes)	Pre Test (10 items)	Post Test (10 items)	Engaged Time (minutes)
1	16	16	160.5 (91.1)	14.1 (7.6)	15.0 (6.3)	27 (25)	9.5 (4.4)	9.5 (3.5)	203 (48)	6.7 (3.2)	7.3 (3.4)	22 (39)
2	18	17	138.9 (77.0)	12.7 (8.3)	12.5 (7.6)	4 (5)	8.9 (4.4)	9.6 (4.2)	108 (35)	7.4 (3.1)	7.2 (3.1)	3 (5)
3	20	19	36.4 (35.0)	5.7 (5.0)	2.8 (5.4)	39 (4)	5.2 (3.7)	3.8 (3.7)	112 (20)	2.1 (4.2)	3.0 (4.0)	14 (5)
4	14	13	147.3 (94.7)	14.0 (8.0)	14.1 (6.7)	8 (12)	10.2 (3.3)	9.9 (3.8)	224 (54)	6.9 (3.9)	7.5 (3.4)	16 (3)
5	26	24	133.0 (65.5)	14.9 (6.7)	14.0 (6.9)	3 (5)	9.5 (3.5)	8.5 (4.6)	55 (36)	7.0 (2.7)	7.3 (2.4)	4 (11)
6	18	17	76.5 (53.7)	10.4 (7.2)	10.0 (7.5)	18 (22)	7.2 (3.1)	6.1 (3.9)	79 (26)	7.2 (3.5)	7.6 (2.5)	1 (3)
Average over students	112	106	113.5 (81.4)	12.0 (7.7)	11.3 (7.9)	16 (19)	8.3 (4.1)	7.8 (4.5)	120 (70)	6.2 (3.9)	6.6 (3.5)	9 (17)
Average of class means (unweighted)	6	6	115.4 (48.3)	12.0 (3.5)	11.4 (4.6)	17 (14)	8.4 (1.9)	7.9 (2.4)	130 (68)	6.2 (2.0)	6.7 (1.8)	10 (9)

Notes

Engaged time was assessed by direct observation.

Standard deviations are shown in parentheses.

Table 6

Means, standard deviations and intercorrelations for achievement in compound words and associated measures of engaged time[a] assessed over the OA-OB interval.

Variable	Mean	Standard Deviation	Correlations[c] 1	2	3	4	5
1 Compound Words (Post)	4.5	3.4 (3.1)[b]		0.63	0.44	0.05	0.24
2 Compound Words (Pre)	3.6	2.7 (2.5)	0.57		0.50	0.01	0.35
3 Academic Status	65.4	47.8 (37.0)	0.33	0.43		0.15	0.69
4 Engaged Time in Compound Words	14	24 (19)	0.12	0.00	0.07		0.22
5 Engaged Time in Other Word Structure	8	13 (9)	0.07	0.23	0.54	0.03	

Note
N = 47
(Students from Classes 1 through 6 were included.)

[a] Engaged time was assessed by direct observation.

[b] Standard deviations, calculated when students were pooled within class, are shown in parentheses.

[c] Correlations, computed when students were pooled within class, are shown below the major diagonal.

Table 7

Means and standard deviations for achievement measures and allocated time in matched content categories over the A-B period for six grade 2 classes.

Class	Max N	Min N	Academic Status	Place Value			Subtraction Without Regrouping			Addition With Regrouping		
				Pre Test (15 items)	Post Test (15 items)	allocated Time (minutes)	Pre Test (10 items)	Post Test (10 items)	allocated Time (minutes)	Pre Test (10 items)	Post Test (10 items)	allocated Time (minutes)
1	16	15	160.5 (91.1)	4.9 (3.6)	7.1 (4.7)	30 (2)	2.3 (1.8)	4.5 (3.1)	311 (76)	1.8 (2.1)	2.4 (3.5)	12 (2)
2	18	18	138.9 (77.0)	2.3 (3.2)	9.7 (2.6)	146 (26)	4.1 (2.4)	5.8 (3.3)	546 (35)	1.3 (2.6)	1.9 (3.4)	7 (3)
3	20	17	36.4 (35.0)	0.7 (2.2)	3.3 (2.8)	272 (21)	1.6 (2.0)	5.2 (3.2)	347 (50)	0.2 (0.9)	1.1 (2.2)	12 (1)
4	14	13	147.3 (94.7)	5.6 (4.3)	7.4 (5.0)	127 (34)	2.5 (2.7)	3.7 (3.7)	109 (34)	1.5 (3.2)	1.1 (2.9)	17 (10)
5	26	23	133.0 (65.5)	4.8 (3.4)	7.8 (3.6)	139 (15)	4.7 (2.8)	5.2 (3.3)	453 (48)	1.8 (3.1)	3.4 (3.8)	11 (2)
6	18	15	75.3 (47.0)	1.2 (1.7)	4.1 (2.4)	15 (3)	3.8 (1.9)	3.5 (3.2)	275 (95)	1.8 (2.1)	0.5 (2.8)	25 (18)
Average Over Students	112	102	113.3 (80.8)	3.3 (3.6)	6.5 (4.1)	127 (88)	3.3 (2.6)	4.7 (3.3)	357 (143)	1.4 (2.5)	1.8 (3.2)	14 (10)
Average of Class Means (Unweighted)	6	6	115.2 (48.5)	3.3 (2.1)	6.6 (2.4)	122 (93)	3.2 (1.2)	4.7 (0.9)	340 (151)	1.4 (0.6)	1.7 (1.1)	14 (6)

Notes

Allocated time was assessed by daily teacher logs.

Standard deviations are shown in parentheses.

Table 8

Achievement in place value (post) regressed on achievement in place value (pre), academic status and allocated time in place value (general content category 5) from teacher logs over the A-B period (subjects pooled, moderate trim, N = 87)

I DESCRIPTIVE INFORMATION

	Variable	Mean	Standard Deviation	Correlations 1	2	3	4
1	Place Value (Post)	6.2	3.7	1.00			
2	Place Value (Pre)	2.8	2.5	.45	1.00		
3	Academic Status	110.8	78.7	.54	.50	1.00	
4	Allocated Time GCC 5	126.9	88.4	-.07	-.21	-.27	1.00

II SUMMARY OF MULTIPLE REGRESSION ANALYSIS

Multiple R	0.59	(p = 0.00)[a]
Multiple R Squared	0.35	
Std. Error of Est.	3.04	
Constant	2.34	

Independent Variable	Beta, Stand. Coef-ficient	B, Raw Coef-ficient	Stand. Error Of B	F To Delete	Proba-bility[a]	Partial Corr. With Dep.
Place Value (Pre)	0.2465	0.3628	0.1510	5.77	0.02	0.25
Academic Status	0.4471	0.0210	0.0049	18.39	0.00	0.43
Allocated Time GCC 5	0.0979	0.0041	0.0039	1.12	0.29	0.12

[a] Probabilities rounded to two places.

Table 9

Achievement in place value (post) regressed on achievement in place value (pre), academic status, and allocated time in place value (general content category 5) from teacher logs over the A-B period (subjects pooled within class, moderate trim, N = 87).

I DESCRIPTIVE INFORMATION

	Variable	Mean	Standard Deviation	Correlations 1	2	3	4
1	Place Value (Post)	0.0[a]	3.0	1.00			
2	Place Value (Pre)	0.0	2.2	.44	1.00		
3	Academic Status	0.0	66.0	.41	.38	1.00	
4	Allocated Time GCC 5	0.0	18.1	.08	-.19	-.05	1.00

II SUMMARY OF MULTIPLE REGRESSION ANALYSIS

Multiple R	0.54	(p = 0.00)[b]
Multiple R Squared	0.29	
Std. Error of Est.	2.57	
Constant	-0.00	

Independent Variable	Beta, Stand. Coef-ficient	B, Raw Coef-ficient	Stand. Error Of B	F To Delete	Proba-bility[b]	Partial Corr. With Dep.
Place Value (Pre)	0.3641	0.4871	0.1359	12.85	0.00	0.37
Academic Status	0.2828	0.0128	0.0045	8.01	0.01	0.30
Allocated Time GCC 5	0.1591	0.0262	0.0155	2.86	0.09	0.18

[a] Since the scores are mean deviated, all means are equal to zero.

[b] Probabilities are rounded to two places.

Table 10

Achievement in place value (post) regressed on achievement in place value (pre), academic status and engaged time in place value (general content category 5) estimated from teacher logs over the A-B period (subjects pooled, moderate trim, N = 87).

I DESCRIPTIVE INFORMATION

	Variable	Mean	Standard Deviation	Correlations 1	2	3	4
1	Place Value (Post)	6.2	3.7	1.00			
2	Place Value (Pre)	2.8	2.5	.45	1.00		
3	Academic Status	110.8	78.7	.54	.50	1.00	
4	Est. Engaged Time GCC 5	64.7	47.4	.12	-.21	-.17	1.00

II SUMMARY OF MULTIPLE REGRESSION ANALYSIS

Multiple R	0.63	(p = 0.00)[a]
Multiple R Squared	0.40	
Std. Error of Est.	2.92	
Constant	1.44	

Independent Variable	Beta, Stand. Coef-ficient	B, Raw Coef-ficient	Stand. Error Of B	F To Delete	Proba-bility[a]	Partial Corr. With Dep.
Place Value (Pre)	0.2793	0.4110	0.1458	7.94	0.01	0.30
Academic Status	0.4475	0.0210	0.0046	20.72	0.00	0.45
Est. Engaged Time GCC 5	0.2541	0.0198	0.0068	8.47	0.00	0.30

[a] Probabilities rounded to two places.

Table 11

Achievement in place value (post) regressed on achievement in place value (pre), academic status, and engaged time in place value (general content category 5) estimated from teacher logs over the A-B period (subjects pooled within class, moderate trim, N = 87).

I DESCRIPTIVE INFORMATION

	Variable	Mean	Standard Deviation	Correlations 1	2	3	4
1	Place Value (Post)	0.0[a]	3.0	1.00			
2	Place Value (Pre)	0.0	2.2	.44	1.00		
3	Academic Status	0.0	66.0	.41	.38	1.00	
4	Est. Engaged Time GCC 5	0.0	18.0	.06	-.15	-.11	1.00

II SUMMARY OF MULTIPLE REGRESSION ANALYSIS

Multiple R	0.53	(p = 0.00)[b]
Multiple R Squared	0.29	
Std. Error of Est.	2.57	
Constant	0.00	

Independent Variable	Beta, Stand. Coefficient	B, Raw Coefficient	Stand. Error Of B	F To Delete	Probability[b]	Partial Corr. With Dep.
Place Value (Pre)	0.3520	0.4709	0.1351	12.15	0.00	0.36
Academic Status	0.2952	0.0134	0.0046	8.65	0.01	0.31
Est. Engaged Time GCC 5	0.1431	0.0238	0.0156	2.32	0.13	0.16

[a] Since the scores are mean deviated, all means are equal to zero.

[b] Probabilities are rounded to two places.

Table 12

Means and standard deviations for achievement measures and allocated time in matched content categories over the A-B period for nine Grade 2 classes.

Class	Max N	Min N	Academic Status	Decoding - Consonant Sounds (speeded test)[1]			Decoding - Long Vowels			Decoding - Consonant Substitutions		
				Pre Test (24 items)	Post Test (24 items)	Allocated Time (minutes)	Pre Test (22 items)	Post Test (22 items)	Allocated Time (minutes)	Pre Test (10 items)	Post Test (10 items)	Allocated Time (minutes)
1	15	11	160.5 (91.1)	17.5 (6.7)	18.3 (6.0)	181 (95)	15.8 (6.2)	18.1 (3.2)	497 (89)	4.7 (3.5)	6.7 (2.7)	143 (79)
2	18	16	138.9 (77.0)	15.6 (6.0)	18.6 (6.1)	160 (26)	12.8 (8.0)	14.2 (8.2)	267 (68)	3.2 (4.1)	6.1 (3.1)	11 (11)
3	20	16	36.4 (35.0)	4.2 (4.0)	8.9 (7.5)	240 (45)	6.3 (5.2)	5.1 (4.7)	279 (28)	-0.6 (1.3)	0.8 (2.1)	115 (35)
4	14	11	147.3 (94.7)	9.5 (6.4)	19.1 (4.7)	144 (40)	13.1 (6.7)	15.0 (6.7)	170 (98)	3.3 (4.3)	4.6 (4.1)	79 (32)
5	26	23	133.0 (55.5)	11.7 (4.5)	16.9 (5.1)	134 (139)	13.7 (6.3)	17.6 (5.3)	212 (177)	4.0 (2.9)	5.4 (3.5)	140 (70)
6	18	16	76.5 (53.7)	7.6 (5.4)	13.3 (5.3)	80 (20)	9.5 (7.1)	13.5 (4.5)	437 (176)	1.3 (3.0)	1.2 (2.5)	62 (30)
7	14	11	124.8 (61.8)	13.7 (8.0)	17.8 (5.5)	198 (103)	11.3 (7.1)	15.7 (5.9)	122 (81)	3.3 (3.9)	4.8 (3.7)	137 (36)
8	13	12	26.1 (30.3)	4.9 (5.2)	5.9 (5.2)	461 (147)	2.8 (5.4)	5.0 (5.8)	254 (55)	0.5 (1.5)	0.2 (2.7)	102 (48)
9	13	11	117.8 (92.4)	11.6 (6.6)	10.0 (9.3)	426 (177)	11.3 (8.3)	14.5 (7.2)	445 (48)	1.9 (3.7)	5.7 (3.1)	9 (5)
Average Over Students	152	131	107.2 (81.2)	10.7 (7.1)	14.4 (7.5)	209 (151)	11.0 (7.5)	13.4 (7.3)	295 (162)	2.5 (3.6)	4.0 (3.3)	92 (67)
Average of Class Means (Unweighted)	9	9	106.8 (48.8)	10.7 (4.6)	14.3 (4.9)	224 (131)	10.7 (4.0)	13.2 (4.9)	268 (132)	2.4 (1.7)	3.9 (2.5)	89 (52)

Table 12 (Continued)

Class	Max N	Min N	Academic Status	Decoding (total)[2]			Context Clues - Form of Word			Context Clues (total)		
				Pre Test (86 items)	Post Test (86 items)	Allocated Time (minutes)	Pre Test (10 items)	Post Test (10 items)	Allocated Time (minutes)	Pre Test (30 items)	Post Test (30 items)	Allocated Time (minutes)
1	16	11	160.5 (91.1)	53.8 (23.1)	61.5 (18.0)	1401 (173)	3.2 (3.8)	4.0 (4.6)	42 (7)	12.8 (9.8)	18.7 (10.7)	200 (41)
2	18	16	138.9 (77.0)	51.1 (24.8)	58.2 (23.0)	1491 (154)	2.6 (3.3)	3.7 (4.8)	0 (0)	11.1 (8.6)	16.6 (11.2)	24 (26)
3	20	16	36.4 (35.0)	18.1 (15.8)	20.8 (13.2)	1134 (75)	0.7 (1.9)	0.1 (2.4)	1 (1)	2.4 (2.6)	4.1 (5.1)	117 (11)
4	14	11	147.3 (94.7)	48.9 (23.7)	60.0 (21.7)	524 (179)	3.2 (4.9)	3.1 (4.6)	10 (11)	13.9 (12.4)	16.7 (10.1)	107 (88)
5	26	23	133.0 (65.5	49.1 (16.3)	60.0 (18.1)	715 (391)	1.3 (3.0)	2.7 (4.0)	14 (12)	10.6 (9.5)	15.1 (9.6)	76 (46)
6	18	16	76.5 (53.7)	31.3 (17.2)	45.6 (15.2)	1223 (151)	0.6 (2.9)	1.3 (2.7)	15 (31)	3.5 (6.5)	9.1 (7.3)	78 (35)
7	14	11	124.8 (61.8)	44.8 (21.0)	53.6 (18.4)	846 (75)	1.5 (2.8)	2.5 (3.3)	40 (10)	7.3 (5.3)	12.3 (9.4)	143 (42)
8	13	12	26.1 (30.3)	15.3 (12.9)	20.5 (16.0)	1234 (171)	0.2 (1.7)	0.1 (2.5)	23 (12)	0.5 (3.7)	1.0 (4.8)	88 (48)
9	13	11	117.8 (92.6)	40.0 (25.9)	53.0 (24.6)	1170 (237)	3.0 (2.9)	2.3 (4.3)	9 (7)	11.8 (8.4)	13.8 (11.5)	220 (46)
Average Over Students	152	131	107.2 (81.2)	39.7 (23.8)	48.4 (23.8)	1072 (371)	1.8 (3.2)	2.2 (3.9)	16 (19)	8.4 (9.1)	12.1 (10.5)	111 (72)
Average of Class Means (Unweighted)	9	9	106.8 (48.8)	39.1 (14.4)	48.1 (16.3)	1082 (321)	1.8 (1.2)	2.2 (1.4)	17 (15)	8.2 (5.0)	11.9 (6.1)	117 (62)

Table 12 : (Continued)

Class	Max N	Min N	Academic Status	Word Structure - Compound Words: Pre Test (10 items)	Word Structure - Compound Words: Post Test (10 items)	Word Structure - Compound Words: Allocated Time (minutes)	Word Structure (total): Pre Test (65 items)	Word Structure (total): Post Test (65 items)	Word Structure (total): Allocated Time (minutes)	Word Meaning - Synonyms: Pre Test (18 items)	Word Meaning - Synonyms: Post Test (18 items)	Word Meaning - Synonyms: Allocated Time (minutes)
1	16	11	160.5 (91.1)	6.3 (4.7)	8.2 (3.6)	131 (91)	25.1 (22.1)	33.5 (19.8)	629 (210)	6.6 (6.8)	8.2 (6.0)	14 (19)
2	18	16	138.9 (77.0)	4.9 (5.4)	7.4 (3.3)	13 (4)	19.2 (20.3)	29.8 (20.8)	101 (89)	5.9 (5.6)	9.2 (7.1)	0 (0)
3	20	16	36.4 (35.0)	-0.3 (1.9)	3.1 (4.7)	80 (16)	2.4 (7.4)	4.7 (11.8)	96 (24)	1.0 (3.6)	1.4 (3.9)	0 (0)
4	14	11	147.3 (94.7)	5.5 (4.6)	8.3 (2.1)	52 (8)	18.5 (17.0)	33.7 (14.2)	60 (19)	4.2 (6.4)	7.4 (7.4)	0 (0)
5	26	23	133.0 (65.5	6.0 (3.5)	8.1 (2.9)	34 (30)	17.4 (14.0)	33.7 (14.0)	256 (169)	4.7 (5.3)	8.2 (5.5)	2 (4)
6	18	16	76.5 (53.7)	3.9 (4.6)	7.8 (3.3)	17 (26)	10.9 (8.8)	26.1 (11.8)	181 (53)	1.2 (2.6)	2.3 (4.4)	6 (23)
7	14	11	124.8 (61.8)	6.5 (3.7)	7.5 (5.3)	47 (27)	23.1 (14.6)	29.8 (18.0)	137 (69)	3.0 (3.4)	5.0 (5.0)	13 (11)
8	15	12	26.1 (30.3)	.7 (3.8)	1.3 (5.4)	9 (14)	-2.0 (11.3)	2.8 (16.0)	89 (62)	0.5 (2.1)	1.5 (3.2)	0 (0)
9	13	11	117.8 (92.4)	3.8 (4.7)	6.1 (4.7)	104 (72)	18.5 (23.9)	27.2 (19.8)	249 (151)	3.6 (5.0)	4.7 (5.3)	95 (46)
Average Over Students	152	131	107.2 (81.2)	4.1 (4.7)	6.5 (4.5)	52 (56)	14.8 (17.7)	24.8 (19.5)	203 (198)	3.5 (5.1)	5.4 (6.1)	12 (31)
Average of Class Means (Unweighted)	9	9	106.8 (48.8)	4.1 (2.4)	6.4 (2.5)	54 (43)	14.8 (9.2)	24.6 (12.1)	200 (176)	3.4 (2.2)	5.3 (3.1)	14 (31)

Table 12 (Continued)

Class	Max N	Min N	Academic Status	Comprehension - Description			Comprehension (total)			Reading (total)[2]		
				Pre Test (13 items)	Post Test (13 items)	Allocated Time (minutes)	Pre Test (50 items)	Post Test (50 items)	Allocated Time (minutes)	Pre Test (301 items)	Post Test (301 items)	Allocated Time (minutes)
1	16	11	160.5 (91.1)	3.0 (4.0)	5.0 (3.4)	0 (0)	12.1 (14.2)	20.0 (15.0)	207 (49)	130.3 (85.9)	164.1 (79.9)	3398 (255)
2	18	16	138.9 (77.0)	2.9 (3.2)	5.9 (3.7)	0 (0)	13.0 (9.4)	22.6 (13.2)	381 (104)	119.3 (70.9)	161.3 (83.4)	3544 (213)
3	20	16	36.4 (35.0)	-0.1 (1.5)	0.8 (2.9)a	7 (4)	0.5 (1.5)	2.6 (7.5)	439 (138)	30.0 (32.6)	37.6 (34.4)	3192 (238)
4	14	11	147.3 (94.7)	4.9 (5.1)	7.1 (4.8)	59 (43)	20.0 (16.8)	27.0 (14.9)	506 (149)	128.4 (86.1)	170.5 (79.7)	2344 (193)
5	[illegible]	23	133.0 (65.5)	2.7 (4.2)	5.0 (4.2)	36 (30)	11.4 (13.7)	18.7 (13.8)	339 (174)	107.6 (62.1)	157.2 (65.7)	2084 (482)
6	18	16	75.5 (53.7)	1.2 (2.8)	1.9 (3.3)	1 (1)	6.3 (7.3)	11.4 (10.3)	79 (75)	58.5 (43.3)	106.7 (48.5)	2774 (207)
7	14	11	124.8 (61.8)	1.3 (2.3)	4.8 (3.5)	66 (11)	6.2 (6.3)	15.6 (11.2)	454 (70)	102.5 (54.0)	133.7 (59.3)	2866 (263)
8	13	12	26.1 (30.3)	0.8 (2.0)	0.3 (3.1)	7 (11)	0.8 (6.7)	1.2 (5.6)	289 (31)	16.4 (24.6)	30.8 (42.9)	3007 (180)
9	13	11	117.8 (92.4)	2.5 (4.4)	4.4 (4.1)	30 (7)	13.0 (15.2)	15.7 (14.1)	248 (37)	98.1 (87.4)	127.9 (63.0)	3312 (173)
Average Over Students	152	131	107.2 (61.2)	2.1 (3.6)	3.9 (4.2)	22 (30)	9.1 (12.2)	14.9 (14.2)	326 (168)	83.3 (73.2)	121.6 (81.6)	2895 (566)
Average of Class Means (Unweighted)	9	9	106.8 (48.8)	2.1 (1.5)	3.9 (2.4)	23 (26)	9.3 (6.3)	15.0 (8.6)	327 (136)	87.9 (42.5)	121.1 (53.3)	2940 (484)

Notes

Allocated time was assessed by teacher logs.

Standard deviations are shown in parentheses.

[1] Analyses of the speeded test are not included in this paper.

[2] This total score does not contain the speeded subtest.

Table 13

Achievement in long vowels (post) regressed on achievement in long vowels (pre), academic status and measures of allocated time (from teacher logs) over the A-B interval (subjects pooled, N = 91).

I DESCRIPTIVE INFORMATION

Variable	Mean	Standard Deviation	Correlations 1	2	3	4	5
1 Long Vowels (Post)	10.7	6.7					
2 Long Vowels (Pre)	7.1	5.4	0.76				
3 Academic Status	65.4	46.1	0.73	0.76			
4 Allocated Time Long Vowels	304	175	0.14	-0.01	-0.06		
			-0.29	-0.32	-0.24	0.25	
5 Allocated Time Other Decoding	783	258					

II SUMMARY OF MULTIPLE REGRESSION ANALYSIS

Multiple R	0.82	(p = 0.00)[a]
Multiple R Squared	0.68	
Std. Error of Est.	3.90	
Constant	3.10	

Independent Variable	Beta, Stand. Coefficient	B, Raw Coefficient	Stand. Error Of B	F To Delete	Probability[a]	Partial Corr. With Dep.
Long Vowels (Pre)	0.4367	0.5422	0.1205	20.24	0.00	0.44
Academic Status	0.3876	0.0565	0.0138	16.86	0.00	0.40
Allocated Time Long Vowels	0.1929	0.0074	0.0024	9.19	0.00	0.31
Allocated Time Other Decoding	-0.1102	-0.0029	0.0017	2.71	0.10	-0.17

Note
To provide complete data and to reduce ceiling effects a relatively large number of cases were trimmed from the sample. Data on 91 students (out of 152) representing nine classes were analyzed.

[a] Probabilities rounded to two decimal places.

Table 14

Achievement in long vowels (post) regressed on achievement in long vowels (pre), academic status and measures of allocated time (from teacher logs) over the A-B interval (subjects pooled within class, N = 91).

I DESCRIPTIVE INFORMATION

	Variable	Mean[a]	Standard Deviation	Correlations 1	2	3	4	5
1	Long Vowels (Post)	0.0	5.4					
2	Long Vowels (Pre)	0.0	4.8	0.74				
3	Academic Status	0.0	38.2	0.66	0.76			
4	Allocated Time Long Vowels	0	117	0.02	-0.12	-0.06		
5	Allocated Time Other Decoding	0	139	-0.21	-0.24	-0.22	0.22	

II SUMMARY OF MULTIPLE REGRESSION ANALYSIS

Multiple R	0.76	(p = 0.00)[b]
Multiple R Squared	0.58	
Std. Error of Est.	3.53	
Constant	0.00	

Independent Variable	Beta, Stand. Coefficient	B, Raw Coefficient	Stand. Error Of B	F To Delete	Probability[b]	Partial Corr. With Dep.
Long Vowels (Pre)	0.5602	0.6198	0.1187	27.24	0.00	0.49
Academic Status	0.2384	0.0334	0.0150	4.99	0.03	0.23
Allocated Time Long Vowels	0.1145	0.0052	0.0033	2.57	0.11	0.17
Allocated Time Other Decoding	-0.0483	-0.0019	0.0028	0.44	0.52	-0.07

Note
To provide complete data and to reduce ceiling effects a relatively large number of cases were trimmed from the sample. Data on 91 students (out of 152) representing nine classes were analyzed.

a The means of within-class deviation scores are zero.

b Probabilities rounded to two decimal places.

Table 15

Achievement in long vowels (post) regressed on achievement in long vowels (pre), academic status and measures of estimated engaged time (from teacher logs) over the A-B interval (subjects pooled, N = 66).

I DESCRIPTIVE INFORMATION

	Variable	Mean	Standard Deviation	Correlations 1	2	3	4	5
1	Long Vowels (Post)	11.6	6.7					
2	Long Vowels (Pre)	8.1	5.5	0.76				
3	Academic Status	71.4	48.0	0.70	0.74			
4	Est. Eng. Time Long Vowels	150	90	0.24	0.03	0.16		
5	Est. Eng. Time Other Decoding	389	259	-0.01	-0.09	0.21	0.47	

II SUMMARY OF MULTIPLE REGRESSION ANALYSIS

Multiple R	0.82	(p = 0.00)[a]
Multiple R Squared	0.67	
Std. Error of Est.	4.62	
Constant	2.08	

Independent Variable	Beta, Stand. Coefficient	B, Raw Coefficient	Stand. Error Of B	F To Delete	Probability[a]	Partial Corr. With Dep.
Long Vowels (Pre)	0.5071	0.6237	0.1458	18.30	0.00	0.48
Academic Status	0.3165	0.0444	0.0169	6.89	0.01	0.32
Est. Eng. Time Long Vowels	0.2374	0.0178	0.0063	7.94	0.01	0.34
Est. Eng. Time Other Decoding	-0.1407	-0.0037	0.0024	2.41	0.12	-0.20

Note
To provide complete data and to reduce ceiling effects a relatively large number of cases were trimmed from the sample. Data on 66 students (out of 112) representing six classes were analyzed.

[a] Probabilities rounded to two decimal places.

Table 16

Achievement in long vowels (post) regressed on achievement in long vowels (pre), academic status and measures of estimated engaged time (from teacher logs) over the A-B interval (subjects pooled within class, N = 66).

I DESCRIPTIVE INFORMATION

	Variable	Mean[a]	Standard Deviation	Correlations 1	2	3	4	5
1	Long Vowels (Post)	0.0	5.3					
2	Long Vowels (Pre)	0.0	5.1	0.76				
3	Academic Status	0.0	40.6	0.64	0.75			
4	Est. Eng. Time Long Vowels	0	74	0.08	-0.01	0.04		
5	Est. Eng. Time Other Decoding	0	94	0.14	0.08	0.16	0.67	

II SUMMARY OF MULTIPLE REGRESSION ANALYSIS

Multiple R	0.77	(p = 0.00)[b]
Multiple R Squared	0.59	
Std. Error of Est.	3.53	
Constant	0.00	

Independent Variable	Beta, Stand. Coefficient	B, Raw Coefficient	Stand. Error Of B	F To Delete	Probability[b]	Partial Corr. With Dep.
Long Vowels (Pre)	0.6327	0.6656	0.1314	25.67	0.00	0.54
Academic Status	0.1617	0.0213	0.0166	1.65	0.20	0.16
Est. Eng. Time Long Vowels	0.0712	0.0051	0.0079	0.42	0.53	0.08
Est. Eng. Time Other Decoding	0.0177	0.0010	0.0064	0.03	0.87	0.02

Note
To provide complete data and to reduce ceiling effects a relatively large number of cases were trimmed from the sample. Data on 66 students (out of 112) representing six classes were analyzed.

[a] The means of within-class deviation scores are zero.

[b] Probabilities rounded to two decimal places.

Table 17

Summary of Results of Regression Analyses for Time Variables and Mathematics Achievement In Six Grade 2 Classes

1 RESULTS FOR OA-OB PERIOD (2 weeks)

		SUBJECTS POOLED			SUBJECTS POOLED WITHIN CLASS		
Dependent Variable	Time Variable	Raw Reg. Coefficient	Standard Error of B	Unique Variance Accounted for by Time Variable[a]	Raw Reg. Coefficient	Standard Error of B	Unique Variance Accounted for by Time Variable[a]
Place Value (OB)	Engaged Time: Place Value	.0199	.0045	10.8	.0130	.0142	0.7
Place Value (OB)	Engaged Time: addition, subtraction, place value	.0129	.0059	3.1	-.0044	.0077	0.3

2 RESULTS FOR A-B PERIOD (8 weeks)

Place Value (B)	Allocated Time: Place Value	.0041	.0039	0.9	.0262	.0155	2.4
Place Value (B)	Estimated Eng. Time: Place Value	.0198	.0068	6.4	.0238	.0156	2.0
Place Value (B)	Allocated Time: addition, subtraction, place value	.0033	.0010	7.8	.0000	.0026	0.0
Place Value (B)	Estimated Eng. Time: add., subtraction, place value	.0057	.0011	16.9	.0036	.0029	1.3
Subtraction (B)	Allocated Time: subtraction without regrouping	.0024	.0024	1.2	.0074	.0054	2.0
Subtraction (B)	Estimated Eng. Time: Subtraction without regrouping	.0041	.0028	2.0	.0232	.0074	9.6

[a] Percent of variance in dependent variable uniquely accounted for by time variable when entered with pretest and academic status.

Table 18

Summary of Results of Regression Analysis for Time Variables and Grade 2 Reading Achievement

I RESULTS FOR OA-OB PERIOD (2 Weeks)			Subjects Pooled			Subjects Pooled Within Class		
Dependent Variable	Matched Time Variable	Related Time Variable	Raw Reg. Coefficient	Standard Error of B	Unique Variance Accounted for by Time Variable[a]	Raw Reg Coefficient	Standard Error of B	Unique Variance Accounted for by Time Variable[a]
Compound Words (OB)	Engaged Time Compound Words	Engaged Time Other Word Structure	.0054/-.0327	.0171/.0445	0.1/0.7	.0177/-.0530	.0204/.0509	1.2/1.6
II RESULTS FOR A-B PERIOD (8 weeks)								
Compound Words (B)	Allocated Time Compound Words	Allocated Time Other Word Structure	.0031/.0034	.0110/.0041	1.3/0.6	.0246/-.0009	.0150/.0062	3.7/0.0
Compound Words (B)	Est. Eng. Time Compound Words	Est. Eng. Time Other Word Structure	-.0091/.0113	.0249/.0077	0.3/3.0	.0416/.0050	.0359/.0098	3.7/0.4
Long Vowels (B)	Allocated Time Long Vowels	Allocated Time Other Decoding	.0074/-.0029	.0024/.0017	2.7/1.0	.0052/-.0019	.0033/.0028	1.1/0.2
Long Vowels (B)	Est. Eng. Time Long Vowels	Est. Eng. Time Other Decoding	.0178/-.0037	.0063/.0024	3.1/1.3	.0051/.0010	.0079/.0064	0.7/0.0
Decoding (B)	Allocated Time Decoding	Allocated Time Other Reading	.0022/.0027	.0027/.0030	0.2/0.2	-.0005/.0144	.0038/.0047	0.1/2.0
Decoding (B)	Est. Eng. Time Decoding	Est. Eng. Time Other Reading	.0053/.0005	.0045/.0034	0.8/0.0	-.0037/.0149	.0065/.0055	0.3/2.4
Reading (B)[b]	Allocated Time Reading		.0058	.0059	0.2	.0123	.0118	0.3
Reading (B)[b]	Est. Eng. Time Reading		.0079	.0051	0.8	.0179	.0105	1.1

[a] For matched time variables this column gives the percent of variance in the dependent variable uniquely accounted for after pretest and academic status have been entered. For related time variables this column gives the percent of variance in the dependent variable accounted for after pretest, academic status and the matched time variable have been entered.

[b] The regressions carried out on reading scores did not include the academic status variable or a related time variable.

Appendix A

Content Categories for Reading and Mathematics Instruction

Specific Content Categories for Grade 2 Reading Instruction

Specific Content Category Number	Specific Content Category Name	General Content Category Number	Observation Content Category Number
	Decoding		
1	Single consonants	2	2
2	Consonant blends and digraphs	2	2
3	Variant consonants (c,g)	2	2
4	Vowels - short	2	2
5	Vowels - final e pattern - long vowels	1	1
6	Vowels - digraphs	1	1
7	Vowels - dipthongs	2	2
8	Vowels - vowels + r (car)	2	2
9	Complex, multi-syllabic	2	2
10	Silent letters	2	2
11	Sound substitution tasks	2	2
58	Spelling	2	2
14	Other decoding	2	2
	Context Clues		
15	Choosing word(s)which fit gram. context	3	5
16	Choosing word(s)which make best sense (semantic appropriateness)	3	5
17	Choosing correct form of word	3	5
18	Choosing word with correct initial cons.	3	5
19	Choosing correct pronoun	3	5
20	Other context clues	3	5
	Word Structure		
21	Compound words		3
22	Identification of root words	5	4
23	Prefixes - meaning and use	5	4
24	Suffixes - meaning and use	5	4
25	Contractions	5	4
26	Syllables	5	4
27	Other word structure	5	4
	Word Meaning		
28	Synonyms	6	5
29	Antonyms	6	5
30	Vocabulary building	6	5
31	Pronoun reference	6	5
32	Multi-meaning words in context	6	5
33	Unfamiliar words in context	6	5
34	Figurative language	6	5
35	Other word meaning	6	5

Comprehension

36	Understanding event detail	7	5
37	Understanding description	7	5
38	Understanding relationships	7	5
39	Understanding main idea	7	5
40	Literal recall	7	5
41	Translation of ideas	7	5
42	Synthesis of ideas, inference	7	5
43	Going beyond the text, prediction	7	5
44	Recognizing facts and opinions	7	5
45	General comprehension	7	5
46	Understanding directions	7	5
47	Picture interpretation to aid comprehension	7	5
51	Understanding signs	7	5
52	Understanding letters	7	5

Areas Related to Reading

48	Dictionary skills		
49	Reference sources in books (table of contents, index, glossary)	8	7
50	Choosing reference sources (dictionary, encyclopedia, card catalog)	8	7
53	Understanding Maps	8	7
54	Understanding Graphs	8	7
59	Grammar	8	7
60	Creative writing	8	7

Reading Practice

12	Sight words	9	6
13	Automaticity of word recognition	9	6
55	Reading for different purposes	9	6
56	Oral reading	9	6
57	Reading for enjoyment	9	6
61	Reading in content areas	9	6
62	Silent reading	9	6
67	Music (reading lyrics)	9	6

Miscellaneous

63	Listening (to story or tapes)	10	-
64	Penmanship and copying	10	-
65	Standardized tests	10	-
66	Foreign language	10	-
68	Dramatics (plays, choral reading...)	10	-

General Content Categories for Grade 2 Reading Instruction

General Content Category Number	General Content Category Name	Observation Content Category Number
1	Long vowels	1 (RL)
2	Other decoding	2 (RD)
3	Context clues	5 (RM)[a]
4	Compound words	3 (RC)
5	Other word structure	4 (RS)
6	Word meaning	5 (RM)[a]
7	Comprehension	5 (RM)[a]
8	Areas related to reading	7 (RO)
9	Reading practice	6 (RP)
10	Miscellaneous	--

[a] Observation content category 5 included general content categories 3, 6 and 7.

General and Specific Content Categories for
Grade 2 Mathematics Instruction

Specific Content Category Number	Category Name	General Content Category Number
	Computation	
1	Addition without regrouping	1
2	Addition with regrouping	2
3	Subtraction without regrouping	3
4	Subtraction with regrouping	4
5	Multiplication - with both factors being less than 10	9
6	Speed tests/timed drill in addition	1
7	Speed tests/timed drill in subtraction	3
8	Number sentences involving equalities and inequalities	6
9	Family of facts/renaming numerals equation form	1,3*
10	Number patterns/sequences	6
25	Missing addends - both in addition and subtraction	1,3*
11	Other - computation**	10
	Concepts	
12	Numerals and ordinals	6
13	Place value with compact or expanded notation	5
14	Fractions involving sets, regions, or lines (1/4,1/3,1/2,2/3,3/4)	9
15	Properties (associative, commutative, and identity elements)	6
16	Associative property with expanded notation	5,6*
17	Money	9
18	Linear measurements	7
19	Measurement concepts: order, capacity, conservation of length	7
20	Geometric figures:	8
21	Curves and points	8
26	Developmental activities	6
22	Other - concepts**	10

Specific Content Category Number	Category Name	General Content Category Number
	Applications	
23	Word problems	9
27	Standardized tests	10
24	Other - applications**	10

*Specific content categories 9,16, and 25 are logically related to two general content categories. In each case time in a specific content category was divided equally and assigned to the appropriate general content categories.

**Time in specific categories 11,22,24 was assigned to general content category 10 if it was not clear that the event could be assigned to general content categories 1-9.

General Content Categories

General Content Category Number	Category Name	Observation Content Category Number
1	Addition without regrouping	1
2	Addition with regrouping	2
3	Subtraction without regrouping	3
4	Subtraction with regrouping	4
5	Place value	5
6	Number system	6
7	Measurement	
8	Geometry	
9	Word problems	
10	Other	