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ABSTRACT

This report summarizes and evaluates existing studies of time use in schools. The first section describes theoretical views of time and learning. Two issues are discussed: the sources of variation in learning time (actual days per school year, length of school day, absenteeism), and the effects of learning time on achievement. In the second section, a review is presented of major empirical studies of time and learning, concentrating primarily on more recent studies of the effect of time on task. An analysis is given of the results of the Beginning Teacher Evaluation Study, as well as studies of: the effect of pupil attention on achievement; the relationship between concurrent achievement and attention measures; time allocation and achievement; and student response to different teaching methods. Inconsistent effects of time variables on achievement were found in the reviewed studies, and the conclusion is drawn that the effect of time on task on learning, while important, is not substantial. The final section discusses two elements which have been given scant attention in past studies of time on task: the conditioning effect of classroom/school organizational variables, and the dynamic nature of teaching and learning. (JD)

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TIME ON TASK: A RESEARCH REVIEW

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This report, prepared by the School Organization Program, describes theoretical views and reviews the results of major studies of time and learning, especially studies of time-on-task.

Abstract

This report summarizes and evaluates existing studies of time use in schools, with particular emphasis on the more recent studies of classroom time use and student time-on-task.

The first section of the report briefly describes theoretical views of time and learning. The second section reviews the major empirical studies of time and learning, concentrating primarily on more recent studies of the effect of time-on-task. The final section discusses two elements which have been given scant attention in past studies of time-on-task--the conditioning effect of classroom/school organizational variables and the dynamic nature of teaching and learning.

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TIME IN SCHOOL

Introduction

How time is used in school is a critical topic of practical and research concern. Of particular current interest is the effect that student attention, or time-on-task, has on achievement. Recent studies have suggested the importance of time-on-task for predicting student achievement and have documented specific classroom and student variables which are related to variations in time-on-task.

Results from these studies have been accorded special significance because time factors, unlike many other significant educational variables, are viewed as manipulable facets of school and classroom life. Although time factors may have relatively small impacts on achievement compared to other factors such as family background, they are very significant in a practical way because time is a resource that educators can control (at least in principle). Consequently, the findings connecting time and learning have been widely discussed and accepted. Specific policy recommendations on the basis of this research urge that: "We must now develop effective programs to give teachers both preservice and inservice training in skills and strategies that will increase the time students devote to relevant academic learning" (Borg, 1980, p. 63).

On the surface, training teachers in effective time use seems to offer a practical way to improve learning in classrooms. If spending more time will produce proportionately more learning, advice to increase learning time seems sound, practical and likely to improve achievement.

In practice, training teachers in skills and strategies to increase learning time may not produce the predicted result--more effective teaching. Translating research into practice is an uncertain endeavor at best. Successful improvements to practice occur most often when based on programmatic, careful research that produces consistent findings replicated in a number of settings. It is not clear if the studies to date of time and learning meet this standard. We need to assess the research carefully to determine what results have actually been found, how consistently they have been found, and the likelihood that alterations to practice on the basis of the research will produce the desired effects. These issues need to be addressed before the development of inservice or other programs aimed directly at altering practice.

The purpose of the present paper is to summarize and evaluate existing studies of time use in schools, with particular emphasis on the more recent studies of classroom time use and student time-on-task.

This paper has three sections. The first section briefly describes theoretical views of time and learning. The second reviews the major empirical studies of time and learning, concentrating primarily on more recent studies of the effect of time-on-task. The final section discusses two elements which have been given scant attention in past studies of time-on-task, namely the conditioning effect of classroom/school organizational variables and the dynamic nature of teaching and learning.

THEORIES OF TIME AND LEARNING

The major theories that incorporate time as a variable in learning are based on two broad perspectives: an economic one, in which time appears as a resource to the educational process; and a psychological one, in which time appears as a mediating element in the teaching/learning process.

Economic Perspective

An economist sees time as a school resource which, in combination with other resources or inputs, determines the productivity of the school. The problem to be solved is how to allocate resources to maximize productivity given budgetary and other constraints (Thomas, 1971; Brown and Saks, 1980). Student time is a resource, not because there is a purchase cost associated with it, but because it could be used for other activities, such as leisure, after-school activities, or (for older students) employment, although child labor laws and compulsory schooling laws limit the sphere of alternative activities. Student time should be used efficiently because time can be used otherwise and because there is a finite amount of time which can be devoted to schooling. The goal of economic analyses, then, is to determine the appropriate mixture of educational resources, including student time, which will maximize the productivity of the school.

Knowledge about the effects of alternate ways to allocate time is important because time use, in contrast to other inputs, is a resource over which educators have discretionary control. Moreover, there is often greater flexibility in alternative uses of time than there is in the alternative use of other resources. Thus, from a practical viewpoint of maximizing school efficiency in the production of learning, time factors occupy a special potential role.

Psychological Perspective

Time has also played an important role in the development of models of classroom learning (Carroll, 1963; Harnischfeger and Wiley, 1975; Bloom, 1976; Karweit, 1978). These models differ in their specific details, but are all primarily derived from Carroll's formulation of the dependence of learning on time spent and time needed for instruction.

Carroll's focus on time as a key element for understanding differences in learning outcomes grew out of his work with foreign language acquisition. He observed that aptitude for foreign language determined both the level of proficiency attained and the rate at which the level was reached. Thus, the time needed to attain a certain level was in effect a measure of aptitude for the task. But, time needed was modified by the quality of instruction and by the ability to benefit from or understand the instruction. The time spent in learning was dependent upon the amount of time the student was willing to spend (perseverance) and the amount of time allocated to the task (the opportunity for learning).

Combining these elements, Carroll derived a model (see Figure 1) in which the degree of learning was determined by the ratio of the time needed to the time spent. In turn, the quality of instruction and student aptitude affected the time needed, while the time spent was influenced by the time allocated and the motivation of the student.

FIGURE 1 ABOUT HERE

Carroll's model states that learning is jointly determined by time spent and by time needed. Although this model has been very influential in focusing attention in empirical studies on the use of time, most assessments of the effects of time have not examined time use in terms of the twin components of time needed and time spent. Instead, most studies have focused either on documenting the sources of variation in learning time or in simply documenting the existence of a positive correlation between time spent and learning. The empirical work is only loosely connected to the theoretical endeavors, then, by a common concern with the importance of time spent.

In the next pages, a review of these empirical time studies is presented, concentrating on two issues: the sources of variation in learning time and the effects of learning time on achievement. Following this review, a discussion of possible future research directions for studies of time and learning is undertaken. This discussion emphasizes the need to incorporate both measures of time needed and time spent in future research.

SOURCES OF LEARNING TIME

The amount of time a student is actively engaged with instruction is the result of a complex chain of legal, institutional and individual decisions. Figure 2 suggests how scheduling decisions may be modified by a variety of factors, reducing the amount of allocated time to the amount actually used for instruction. The next paragraphs describe the range of variation in scheduled time and the manner in which particular factors reduce this time to the time actually available for instruction.

FIGURE 2 ABOUT HERE

Scheduled and Actual Days per School Year

State laws prescribe the number of school days per year. The days scheduled per school year are fairly uniform across states, with a range of 175 to 184 days and an average of about 179 days. This scheduled number of days per year is reduced by student absence, teacher strikes, school closings due to fuel shortages, financial difficulties, or inclement weather.

Student absenteeism is a major factor reducing the scheduled school term. The extent of student absence varies by the age and sex of the student (Levanto, 1973), by the location of the school (Statistics of State School Systems, 1978), by the size of the school (Lindsay, 1982) and by the grade organization of the school (e.g. middle schools vs. junior high schools, see Slavin and Karweit, 1982). For most urban school districts, student absenteeism has been and continues to be a major educational disruption. In many urban secondary schools, more students may be absent than present on a given day (Karweit, 1973). For example, in Baltimore in 1973-1974, over one-third of the students were absent forty or more days. This high absenteeism creates serious problems for instructional time use. In addition to the obvious fact that absent students are not exposed to school instruction, there is the secondary consequence of their absence on the instructional time of their classmates as teachers must take time to reintegrate the absent students into the classroom.

Another way that the school term is shortened is by teacher strikes and by school closings due to financial or energy crises. Specific school systems appear to have a history of work stoppages. For example, Philadelphia has had three teacher strikes from 1973 to 1980, one lasting 51 days, one six days, and one 22 days. Other large city systems have been similarly embroiled in teacher strikes or in financial crises necessitating early school closings. The loss of school days due to strikes, financial difficulties and high student absence are often combined in urban school settings and produce, on the average, markedly different amounts of exposure to instruction for these students. However, no systematic evidence concerning the severity of this loss for urban schools or any other school system has been documented.

Scheduled and Actual Instructional Time Per Subject

Length of School Day

Given that school is in session, and that a student is in attendance, the next major determiner of learning time is the number of hours in each school day. The minimum length of the school day is prescribed by state law. Deviations from that minimum occur in response to community or other needs. For example, double shifts may be instituted as a response to overcrowding, shortening the school day. The school day may also be unofficially lengthened for some students by the provision of after-school day care which has an academic focus, after-school tutoring programs, summer schools and the like.

There is little detailed description of the present variation in the length of the school day. An earlier study by Reuter (1963) documents that the length of the elementary school day varied from four to six hours. More recent estimates fix the elementary school day as lasting closer to six hours, depending upon the grade level. For example, the Beginning Teacher Evaluation Study, or BTES (Fisher, Dishaw and Marliave, 1978) indicates that second graders are in school for about five and one-half hours while fifth graders are in school six hours. High school and junior high schools have somewhat longer school days, but again the data on the length of the school day is surprisingly limited.

Scheduled Time for Instruction

The amount of time school is in session and the attendance of the students set the maximum amount of possible instructional time a student can receive. Within this maximum, the scheduling practices of schools and classrooms appear to differ, with no precise amount of time set aside for instructional and non-instructional activities. One recent study of elementary time use (BTES) suggests that of the typical six-hour school day, four hours are scheduled for instruction with the remaining time scheduled for lunch, recess, breaks and non-instructional activities. Of the four hours scheduled for instruction, three are typically scheduled for academic activities while the remaining hour is used for art, music and physical education (Rosenshine, 1980).

The amount of time devoted to a particular topic also varies as classroom teachers have considerable autonomy to decide what topics and subjects to emphasize (Smith, 1977). For example, within one school in Maryland, the time allocated to mathematics instruction ranged from two hours and fifty minutes per week in one classroom to five hours and fifty-five minutes per week in another. Over a year's time, this weekly time difference means that some students receive over 100 hours more math instruction than their schoolmates (Karweit and Slavin, 1981).

Within the scheduled time, the curriculum is certainly not standard. The BTES study (Cahen and Fisher, 1978) for example, documents up to seven fold differences in time allocation to specific content areas. Such differences could arise because the students already knew the material, because students were not prepared for it, or because the teacher thought it non-essential. Thus, the content of the curriculum may vary substantially from place to place, depending on individual teachers' perceptions of what is important to teach (Smith, 1977).

In secondary schools, there is considerable latitude in what courses must be taken to receive a secondary school diploma. Obviously, curricular track placement affects the choice of courses but within each track there is still appreciable variation in formal and informal requirements for high school graduation. For example, a college preparatory program in one school may require two years of foreign language; in another school it may require none. For a particular student, the requirements of the college that he or she hopes to attend may be the most important determinant of what courses are taken.

Actual Time Available per Subject

The length of the school day and the length of time to be scheduled for instructional and non-instructional activities comprise the broad framework for decisions concerning daily time use in classrooms. These scheduled times represent the maximum amount of in school time for instruction. Several factors affect how much of this scheduled time is actually used for instruction. First, the time scheduled for instruction may be used for another purpose, such as a field trip, standardized testing and special school assemblies. Second, the time scheduled may be routinely reduced by late starts or early endings. For example, in one math class in a Maryland school which was scheduled for the hour before lunch, the first ten minutes were typically used to collect lunch money while the last ten weie used to line the students up for lunch. Third, the manner in which classes are scheduled for instruction may reduce the amount of scheduled time. In particular, the change in recent years in elementary schools from a self-contained classroom structure to a departmentalized structure reduces the amount of time available for instruction because it takes time to move students, especially young students, from one part of the school to another. These transition times typically come out of time once reserved for instruction.

Available Minutes and Time Used for Instruction

Once instruction is underway, the actual minutes that instruction is delivered depends upon how the classroom is organized for instruction, including the grouping practices, the instructional strategies, the size and ability distribution of the class and other factors such as the number and length of interruptions and the teacher's skill as a classroom manager. To illustrate how these factors may work together to determine the amount of instructional time to which a student is exposed, we present hypothetical time usages for a classroom using whole group and sub groups for instruction (see Figure 3).

FIGURE 3 ABOUT HERE

During whole class instruction, non-instructional time is used primarily to prepare students for the day's lesson, to handle interruptions or disciplinary problems, and to prepare students for the transition to the next activity. The use of subgroups entails a somewhat different use of time as procedural time must be used to regroup students and for the teacher to switch across groups.

This example points out how grouping practices affect the use of instructional time. This example also raises the question, which is considered in more detail later in this paper, of how time use may provide insights into understanding the effectiveness of various instructional strategies. As will be discussed subsequently, knowledge about the appropriateness of the time use as well as the duration of time is needed to inform this discussion.

Studies of the amount of instructional time used suggest that instruction may occupy at most 60 percent of the school day. Conant (1973) suggests that about 92 of the 300 minutes per school day were actually used for instruction. Park (1976) documents that somewhere between 21 to 69 percent of the school day was used for instruction in the classes he observed.

Cusick (1973) found that over 200 minutes of the school day in one high school were spent on procedural or maintenance tasks. Summarizing the dearth of academic activity, Cusick states that "the time spent actively engaged with some teacher over a matter of cognitive importance may not exceed twenty minutes a period for five periods a day. This is a high estimate. I would say that if an average student spent an hour to one- and-a-half hours involved on subject matter--that was a good day" (Cusick, 1973:56).

Frederick (1977) documents that interruptions, procedural activities and other non-academic matters are extremely time consuming within the classroom. He points out that low achieving classes are more likely than high achieving classes to be involved in these non-academic uses of time.

Instructional Time and Student Engagement

Student On-Task Behavior

Given that instruction is actually taking place, the final determinant of learning time is the amount of time a student pays attention. Interest in student attention dates back at least to the studies of classroom and teacher efficiency in the 1920's. These early attention studies used group attention scores, obtained by watching the eye involvement of the student with the teacher, and were intended to rate teacher effectiveness. Shannon (1941) questioned this technique and conducted an experiment to test the fallibilty of the connection between attention and learning. An unfamiliar story was read to the class and attention was observed at the exact time that key ideas were presented. Examining the correlation between answers on multiple choice items designed to test these key ideas and attention during presentation, Shannon concluded that group attention scores were not valid indices of student learning or teacher effectiveness.

One reason for this may simply be that eye involvement of the student may be a misleading indicator of actual involvement. Students can have their eyes on the teacher and still not be paying attention. Overt measures of student attention made by behavioral observers cannot readily distinguish between this situation and the one in which the student is actually learning something. Covert measures at specific critical junctures, which ask the student to recall what the lesson was about (such as stimulated recall techniques) get around this problem. Anderson (1973) compared the estimates of on-taskness obtained with overt and covert measures and found a reasonable correspondence between the two. However, Anderson notes that the correspondence was influenced by the mode of instruction--agreement was highest during teacher lecture and lowest during seatwork.

Variations in On-Task Behavior

Several recent observational studies suggest that students pay attention to instructional activities about seventy to seventy-five percent of the time. BTES observers coded whether a student was on or off task during instruction and obtained on-task behavior estimates of .70 and .73 for grade 2 mathematics and reading respectively and .73 and .75 for grade 5 mathematics and reading. Similarly, Karweit and Slavin (1981) report engagement rates of .78 during mathematics instruction for both their grade 2 and grade 5 samples. Good and Beckerman (1978) found rates between .66 and .78.

Variations in the amount of time-on-task occur across days, across students, and across classrooms. The critical question is--how much of the variation in on-task behavior is due to differences between students, differences between classroom practices or due to day-to-day fluctuations? Surprisingly little evidence exists on this important topic, probably because of the shortage of adequate data with which to address the issue. The BTES data, which include multiple observations of a sizable number of classrooms and students on multiple occassions, could be used to determine the relative impact of day, student, and classroom factors, but such analyses to our knowledge have not yet been undertaken.

Student-to-Student Variation

Students differ in the amount of time that they spend engaged in learning. We know little about individual characteristics related to high or low on-task behaviors, except for the influence of aptitude and sex of student. A positive association between intelligence or ability and on-task behavior has been documented many times (e.g. Lahaderne, 1967). Other studies have shown a positive correlation between pre-test score (e.g. Karweit and Slavin, 1981) and on-task behavior, which suggests the connection between on-task behavior and aptitude. In elementary schools, at least, girls have been found to be on-task more than boys. The scarcity of information about the relationship of individual factors to attention may simply reflect the view that the most important sources of student engagement are located elsewhere---such as in classroom organizational arrangements and teacher management practices.

Day-to-Day Variation

In an observational study of fifth grade mathematics classes, Karweit and Slavin (1981) found that students' time-on-task varied markedly from day to day. Some of this variation may be due to differences in classroom organization or content of instruction, but not all of it. Certain periods of the year, such as before or after holidays, may show marked differences from other times of the year. Students may be more distractible on days when there is an important school event (for example a school assembly or sports event). For older students, Mondays and Fridays may exhibit peculiar "warming up" and "winding down" patterns, as do adult work weeks. Although this variation may be simply treated statistically as random noise, it is an important consideration for the sampling scheme used in observational studies (see Karweit and Slavin, 1982). For example, not all observations should be conducted on the same weekday because it is likely that day of the week contributes to the variation in engagement.

Classroom-to-Classroom Variation

The BTES study (Fisher et al, 1980) documents that some classes show average attentiveness rates of 50 percent while others have averages as high as 90 percent. Teacher managerial competencies, the composition of the classroom and mode of instruction are some classroom factors affecting variations in on-task behavior. Because the <u>mode</u> of instruction is a manipulable feature of classroom organization, the differences in on-task behavior here are especially noteworthy. Rosenshine, also using the BTES data, found that engagement was 70 percent during unsupervised seatwork and 84 percent during teacher-led discussion. These differences are of some consequence because most of the time (about 70 percent) in elementary classrooms is spent doing seatwork. This large amount of seatwork is necessitated, at least in part by grouping practices in which the teacher works with a subgroup while other students work independently. These findings have been interpreted to mean that whole group instruction is preferable to subgroup group instruction. But whether whole or small group instruction is better depends upon whether the losses in time through grouping are made up for by qualitative differences in instruction. If the activities undertaken during seatwork are trivial or inappropriate, and if instruction in a smaller group is no better than instruction in a larger group, then grouping probably has negative results. On the other hand, if grouping permits a better match of pace of instruction to student aptitudes and if seatwork is appropriately designed, then there are probably benefits of grouping.

The Relative Impact of Days, Hours and Engagement Rates on Learning Time

As Figure 2 depicts, learning time results from the conversion of the number of days allotted to the number of days attended, from the reduction of the length of the school day to the fraction of the day used for instruction, and from the shrinkage of allocated instructional time in a subject to the time engaged in learning. Each of these conversions reduces learning time appreciably. Because discussions of engagement with learning focus on the individual student, it sometimes inappropriately appears that the major source of variation in engagement is the individual student. However, student engagement is the final point in a long chain of educational events which produce variation in learning time. Figure 4 illustrates how variations in the amount of specific time factors affect the amount of learning time available.

Assuming that a school day of six hours was held for 180 days, the maximum amount of instructional time would be 1,080 hours. In the second column of Figure 4, this figure is reduced by attendance of 140 days (top) and 170 days (bottom), yielding 840 hours and 1020 hours respectively. Next, the time is reduced by the non-instructional uses of school time, including scheduling of other events, interruptions, and any other practice which reduces time available, either intended or not. Using estimates of instructional time of 3 and 4 hours of the six, and attendance of 140 and 170 days, produces a range of instructional hours from 420 to 680 per year. Finally, to see the effect of engagement with learning on the number of hours of instruction, we set the engagement rate to be .75 and .90. These engagement rates produce a range of learning time from a low of 310 to a high of 612 hours per year. The last column indicates the fraction of the total time represented by on-task time.

FIGURE 4 ABOUT HERE

This conversion exercise emphasizes the multiplicity of factors that produce student learning time. In many respects, student time-on-task, despite our present focus on it, may be the least interesting policy variable of the lot. Many factors which affect a student's engagement with learning--such as sex, aptitude, and interest in the subject--are either not possible to change or are difficult to change. Moreover, instructional practices, organizational arrangements and student absenteeism are shown to have quite sizable influences on the amount of learning time available.

STUDIES OF TIME AND LEARNING

Although engagement time or time-on-task may not be the only time variable of interest, most recent studies of time and learning have focused exclusively on engaged time. In part, this interest in student engagement reflects an awareness of the difficulties inherent in detecting effects for such global time measures as days in the school year and hours in the school day. It also reflects a very strong conviction that the amount of time actively engaged with learning must be an important predictor of the amount of learning which occurs. For example, Harnischfeger and Wiley state "it is inconceivable that more schooling, other relevant variables being considered, will not produce more learning" (Harnischfeger and Wiley, 1976, p. 18). For many, the evidence linking time-on-task to achievement is a closed issue. Thus, Borg's review of the Beginning Teacher Evaluation Survey (BTES) study concludes "There can hardly be any doubt, however, that a significant effect is present." Similarly, Sirotnik (1982) examined teacher practices that promoted high time-on-task and asserted that "...the link-up between achievement outcomes and quantity of instruction will not be investigated here; it has already been documented elsewhere." Perhaps Brophy best summarizes the acceptance of this fact and the impatience to move on to new research endeavors as he urges us to "move beyond the now well established relation between time-on-task/student engagement/teacher management skills and student learning...at this point we no longer need to replicate these findings; instead we need to go beyond them in order to observe other relations."

But, there are dissenting views. Frederick and Walberg, reviewing the existing studies of time and learning suggest a rather temperate view of the importance of time: "time devoted to school learning appears to be a modest predictor of achievement." Kepler, evaluating the utility of the influential BTES study, suggests that because of "the limited vision inherent in the study and the inconclusive nature of the findings, a legitimate response would be to postpone discussion until further research is completed" (Time to Learn, p. 153). Earlier studies suggested that the time and learning linkage was conditional (Husen, 1971) or questionned the magnitude of the importance of time factors (Karweit, 1976).

Thus, although there is considerable evidence and support favoring the view of the importance of time-on-task, there is enough reasonable doubt about the generalizability of these studies and the magnitude of the effects to warrant a careful review of the evidence and an evalution of the methodology that produced it. This is the purpose of the next section.

The Beginning Teacher Evaluation Study (BTES)

The Beginning Teacher Evaluation Study (BTES) is probably the most widely known study to examine the effects of time on learning. Because of the importance of this study and its findings, we will address this study first and in some detail. Details of the original statistical analyses are not presented in the usually referenced summary report (Time to Learn), we therefore provide these details in tables 1-4 in Appendix A.

During the six-year project, four separate samples were studied (known as Phase II, Phase III-A, Phase III-A Continuation and Phase III-B). The last of these field studies is the one to be considered here. From a set of volunteer teachers, classrooms were selected which fell into the 30th to 60th percentile range on reading and mathematics tests that were designed specifically for this study. Within these classrooms, six students (three males, three females) were selected for observation, producing a final sample of 139 second-grade students in 25 classrooms and 122 fifth-grade students in 21 classrooms. Achievement data were collected in October 1976, December 1976, May 1977, and September 1977. The inter-test period, October to December, is referred to as the A-B period. From December to May is referred to as the B-C period. The results from the B-C period are of primary interest here. During this seventeen-week period, time allocated to reading and mathematics instruction was documented in teachers' logs. Specific content categories within subject matters were coded (e.g. mathematics speed test, decoding consonant blends). The teachers recorded the allocated time per content and per student for each school day during the 85-day inter-test period.

Observations of selected students within classrooms took place for a complete day. In most instances, each classroom was observed about 15 times. Targeted students were observed once every four minutes to gauge the activity, the content area, the student's engagement, and level of success.

The obtained engagement rate and success rates are global measures of student engagement during reading and language arts or mathematics and not during specific subcontents. Thus, engagement rate and percent easy and hard are the same within each grade x subject quadrant for a particular student.

The post- and pretests were designed especially for this study to test what was taught during the intertest period. The allocated minutes are the number of minutes, from teachers' logs, that instruction occurred in the particular subtests. To covert these minutes into the number of minutes per day it is necessary to divide by the number of data days in the study. Although there were 85 possible data days during the B-C period, the actual number of days with data is appreciably smaller. For grade 2 reading, there were 71.5 data days, for grade 2 mathematics there were 65.6, for grade 5 reading there were 55.7 data days, and for grade 5 mathematics there were 52.8 data days. This loss of days came about either because scheduled instruction did not take place due to field trips or other events, or because observation did not take place.

The major findings of the BTES study which are of interest here are:

1) The amount of time that teachers allocate to instruction in a particular content area is positively associated with student learning in that content area.

2) The proportion of allocated time that students are engaged is positively associated with learning.

3) The proportion of time that reading or mathematics tasks are performed with high success is positively associated with student learning.

(Fisher, et al., 1980, p. 15).

Separate regression analyses for grades 2 and 5 for reading/ language arts and mathematics were carried out, with the individual as the unit of anlaysis. ALT (Academic Learning Time) was entered into the regression as four separate variables--allocated time, engaged rate, percent of low-difficulty questions, and percent of high-difficulty questions. Then the contribution, unique and residual, to R square was compared to a regression predicting posttest by pretest alone.<1> Separate analyses were carried out for each grade for each sub-test using matched pre-test, time, and post-test measures or 29 different regressions (see Table 2.6, pp. 70 and 71 in <u>Time to Learn</u>). Borg, summarizing the B-C period results, indicates that 41 or 35 percent of the ALT variables were significant. The residual variances for the equation ranged from .03 to .21 (average .12) for grade 2 reading and from .01 to .22 (average .08) for grade 2 mathematics. For grade 5 reading, the residuals ranged from .05 to .21 (average .13) and from .01 to .30 (average .11) for grade 5 mathematics.

<1> The calculations for unique and residual variance are detailed below. Given two regression models:
(1) POST = a+b1(pre)
(2) POST = a+b1(pre)+b2(alloc)+b3(rate)+b4(low)+b5(high)
The difference between the r squared of these two models is the unique contribution to variance accounted for by ALT--allocated time, engaged rate, low and high error rate. This unique contribution divided by the proportion of variance unaccounted for by the pretest score is the residual variance. The residual variance thus indicates how much of the remaining variance was accounted for by the ALT variables.

Primarily on the basis of these residual variances, we are told that "a major finding of the study is that increases in Academic Learning Time are associated with increases in student achievement" (Fisher et al.).

Another way to assess the significance of the ALT effects is to take specific goals of improvement for achievement and ask what amount of allocated time would be required to produce these results. Assume that we wanted to increase the posttest score by a quarter of a standard deviation unit. To provide some concrete meaning to this example, this increase would correspond to about 25 points on the SAT test. How much extra time would have to be allocated to achieve these results? Consider the results for reading comprehension in grade 2 as an example. Based on the regression weights computed in the BTES (see table 1 in Appendix for details and notes to table for exact computational procedures), an additional 60 minutes per day in time allocated to reading comprehension alone would be needed to increase scores in this area by .25 standard deviations.

Determining the amount of additional time needed to make noticeable changes adds important information not suggested by the presentation of residual variances alone. It suggests that although results are statistically significant dramatic changes would be required to increase achievement by a quarter of a standard deviation. Of course, the BTES results are directed toward the collectivity ALT, which includes engagement rate and success rates. Suitable manipulation of the regressions could be carried out to suggest how simultaneous changes in all these variables would affect achievement.

These effects for time are likely to be overestimates, for several reasons. As noted earlier, because pre-achievement, engagement, and post-achievement are all highly correlated, controlling for pre-achievement is critical to remove ability effects from the correlation between engagement and post-achievement. However, partialling out the effect of a third variable from the correlation between two other variables does not completely remove the effect of the third variable when the intercorrelations are high and the reliability of the control variable is less than perfect (see Lord, 1960). In other words, because students who tend to be highly engaged are usually significantly higher in ability than minimally engaged classmates, controlling for ability will only partially remove ability effects from the engagement/post achievement correlation. In fact, the use in the BTES of short, criterion-referenced pretests as control variables may exacerbate this problem, as such scales would likely to be less reliable than longer norm-referenced measures, such as IQ or standardized test scores. Further, use of "percent easy" and "percent hard" as part of ALT almost certainly inflates the uncontrolled effect of student ability on student achievement. Because these measures are derived from student responses to questions, more able students will obviously answer correctly more often than less able students.

The problem of under-controlling for prior achievement would be largely solved by analysis of class means rather than individual scores on all variables. Use of class means would focus the analysis on classroom practices rather than on student-to-student ability differences. "Percent easy" and "Percent hard" for the whole class might be influenced by the overall class ability level, but less so than individual students' "percent of correct answers" would be influenced by their own abilities. Class-level analyses were conducted in the BTES (Fisher, Dishaw and Marliave, 1980), and in fact show even less consistent or strong effects for time.

From our vantage point, the most interesting finding of the BTES is that the connection between time and learning is as small as it is. Given the carefulness of the study design and execution, it seems unlikely that measurement difficulties or problems with implementation of the study are totally responsible for the minimal effects detected. Basically, we argue that the BTES did not detect stronger effects for time measures on student achievement because the effects themselves are weak, not because of methodological or statistical artifacts.

Other Studies of Time and Learning

Of course, the BTES is not the only study that purports to show that time-on-task is related to student learning, net of ability. The following section discusses several other time studies, in chronological order. Consult Table 5 in Appendix A for summaries of these studies.

Edminston and Rhoades' (1959) study, although not intended to addr the issue of how pupil attention affects achievement, has often been cited to indicate the positive effects of time on achievement (see Bloom, 1964). They report the correlation between CAT general achievement and attention to be .58. Because this study did not control for ability or intelligence, partial correlations with this entering level controlled are not available. As an exercise, we assumed a hypothetical pre-test was given which correlated .7 with the post-test and .46 with attention. These values are typical correlations, observed in other studies. With these zero-order correlations, the partial correlation between post-test and attention becomes .40. Looking at the results in terms of the amount of variance accounted for by the attention variable indicates that attention accounts for about 1 percent of the residual variance. We cast Edminston and Rhoades' study in this framework to show that the presentation of the zero-order correlation of attention and achievement is deceptive, for it implies a more important effect than is indicated either by the partial or by the increment to R square.

Lahaderne (1967) examined the effect of student attention on sixth grade reading and arithmetic achievement, controlling for IQ. Attention was measured by observer rating over a three-month inter-test period. The partial correlations between attention and post-test score, controlling for IQ, were significant in three of the eight subtests, with a range of .26 to .31. How important are these effects in terms of variance accounted for? This determination requires making some assumptions about the zero-order correlations between IQ and post-test score, which Lahaderne does not report. She does, however, report the other correlations between attention, post-test score and IQ. Using the reported correlations, and the reported partials, we determined what the unreported correlations must have been. This estimated correlation matrix was then used to determine the unique and residual variance accounted for by the attention measures. The unique contributions hover around .04, with a maximal residual variance accounted for of .08. Lahaderne's study is often cited as indicating the importance of time-on-task. In actuality, the partials were significant in three of eight cases examined and accounted for at most a residual variance of .08 and unique of .04 in the three cases.

Cobb's (1972) study, which examined the relationship between concurrent achievement and attention measures, is also frequently cited. The attentiveness of 103 students in five fourth-grade classrooms was observed. The correlations between attention and achievement were reported to be .44 (reading) and .25 (arithmetic). To assess what the partial correlations might have been had an IQ or pretest been given, we set the correlation between this hypothetical covariate and achievement to be .7 and the correlation between the covariate and attention to be .20. Using this derived correlation matrix, partial correlations for reading and arithmetic of .43 and .16 were obtained. These partials probably represent maximal effects, given the rather low estimate of the correlation between attention and pretest used. The unique amount of variance accounted for by the time measure was at most two percent. The attention score accounted for about six percent of the residual variance.

Smith (1979) used data from teachers' logs in a pretest, time, posttest study of social studies achievement. The regressions indicated that allocated time was not a significant factor in post-test achievement. We computed the partial coefficient between allocated time and social studies achievement, with prior ability controlled, to be .17. In terms of the unique and residual variance explained, allocated time accounts for 1 and 3 percent respectively, hardly impressive indications of independent effects of time.

The independent effect of time-on-task on the achievement of 462 students in 23 classes was assessed in a study by Bell and Davidson (1976). The achievement tests were teacher-made and were specific to the content of instruction. Bell and Davidson used observational indices of time-on-task and additionally employed measures of IQ as a control variable. Analyses were carried out separately for the twenty-three classes. They report the partials between time and achievement, controlling for IQ, in each class. In only three of the twenty-three classes are these partials significant. Using the correlations supplied in the article and weighting these by the number of students in each classroom, we derived a weighted correlation matrix across the twenty-three classes. From this correlation matrix, an average partial correlation of .27 was obtained between posttest and attention, controlling for IQ. In terms of variance explained, the attention measure accounted for less than one percent of the variance both in terms of unique and residual variance.

The studies of Everston, Emmer, and Clements (1980) provide data on the importance of time-on-task for achievement for junior high school students. Using content-specific English and math tests and controlling for CAT scores, the partial correlation of time-on-task and English score was computed to be .20, and was .34 for mathematics. The unit of analysis here was the class (n=150). The unique and residual variance accounted for by the attention variable was less than one percent for both reading and mathematics.

Karweit and Slavin (1981) report the effects of student engaged time from a pretest-observation-posttest design where the observation interval was about three months. Six mixed second and third grade classes and twelve mixed fourth and fifth grade classes comprised the sample. Within each class, the attentive behavior of six students was observed for a period of at least ten consecutive school days.

An observation consisted of coding an <u>activity</u>, <u>response</u> to the activity, and the <u>content</u> of instruction during repeated thirty-second intervals. The activities included teacher lecture, seatwork (with or without teacher involvement) and procedural activities. The coding scheme allowed multiple activities to be defined in one time frame, so that different activities in the classroom could be coded. For example, a group of students could be working with the teacher, while another group could be working independently on seatwork.

The response category was coded only during instruction. Thus, if a student were engaged in a procedural task (such as getting out a book or sharpening a pencil), on- and off-task responses were not coded. Behavior was coded as off-task only when the student was obviously not attending, e.g. whispering to another student, engaging in horseplay, sleeping, etc. Content of instruction was noted by referring to the page number in the text or by recording a sample of seatwork or boardwork. Achievement was measured by the mathematics subtest of the CTBS and by chapter-specific tests. In regressions examining the effects of engaged minutes, inconsistent results were obtained. Significant engagement effects were found in grade 2/3 for the standardized tests, but not the chapter tests. Grade 4/5 had significant effects for the chapter tests, but not the standardized tests. Translating the regression results into the time required to increase achievement by .25 of a standard deviation indicates that a 10-minute increase in <u>engaged</u> minutes would be required for grade 2/3. Recalling that students are on task about 70 percent of the time, for this increase to occur, instructional time would have to be increased from 46 to 65 minutes in this case.

Rephrasing the results of the study in this fashion suggests how likely (or unlikely) it is that <u>feasible</u> alterations in learning time can produce noticable results. Quite sizable changes in learning time would have to occur before having a detectable effect on achievement.

Summarizing the results of these studies of time-on-task and achievement, we found the engagement measures to be related to achievement in the range of .25 to .58. Once initial ability was controlled, the partial correlation between achievement and engagement was found to lie in the range .09 to .43. In terms of the proportion of variance explained, the engagement variables were found to explain between one and ten percent of the unique variance in achievement outcomes.

Thus, looking at several studies of time-on-task and achievement, it is clear that the inconsistent effects of time variables on achievement (net of ability) are not unique to the BTES, but are generally found in studies examing these variables.

One might ask why it is worthwhile to quibble about effect sizes and consistency of findings on a variable so obviously positive and benign in its effects on student achievement as time-on-task. We would note that very few negative effects of time-on-task on achievement are found, and we would agree that it would probably be helpful (and certainly not harmful) to encourage teachers to minimize time wasted and to try to increase student engagement. However, as researchers attempting to discover the critical elements of classroom practice, we must be clear about where the strong effects really lie. For a theory of classroom organization, it is of considerable consequence that time-on-task is so weakly associated with learning after ability is partialled out. We would argue that these findings point toward an explanation of classroom learning based more on accomodating student diversity in readiness for instruction and rate of learning and on quality of instruction than on the gross quantity of instruction delivered to or consumed by students. In other words, if time-on-task is not a strong factor influencing achievement, then we must consider how quality and level of instruction might influence learning. This is elaborated upon in the next section.

CLASSROOM/SCHOOL ORGANIZATION

Grouping

A basic school organizational problem is how to organize group instruction given students of differing backgrounds and abilities (Slavin, 1982). Procedures to cope with student diversity include assignment to classes on the basis of ability, grouping within classes, and individualizing instruction. Any grouping decision affects the distribution of teacher and student time. These decisions determine the amount of time available for instruction and the efficiency of the use of time during instruction. We do not supply a precise definition of efficiency, conceptualizing it as the extent of the match between teacher and student efforts, with a good match implying high efficiency.

Figure 5 suggests the nature of time use under three different forms of classroom grouping strategies --whole group, subgroup and individualized. There are two portions to the time use consideration: the amount of actual instructional time (deducting classroom management activities) and the efficiency of that instructional time use. The three methods are argued to differ in both of these aspects of time use.

FIGURE 5 ABOUT HERE

For whole group instruction, 10 minutes is given as a typical amount of management time in an hour of instruction. This time includes any disciplinary, managerial or other time not devoted to instruction. While instruction is taking place (50 minutes), assume that the teacher paces instruction so that the middle ability students can comfortably keep up with the lesson. The efficiency of the time use will be reduced because the pace of instruction is too slow for the brighter students and too fast for the slower students. Using a hypothetical estimate, we set the efficiency of whole group instruction to be .5, implying that, on average, instruction is appropriate half the time. Multiplying the efficiency by the number of minutes of instruction suggests that 25 minutes of effective instruction occurs within the hour.

When within-class ability groups are used, the teacher must divide her time between (among) the various groups. While the teacher is teaching one group, the other group(s) are typically assigned seatwork. Classroom management time is probably increased as it takes additional time to form groups and to shift attention among groups.

Because the instructional groups are smaller and probably have a narrower range of abilities, the efficiency of the instructional time should be greater than it is during whole-group instruction. However, in terms of the total use of instructional time, there may be little gain, given losses in efficiencies when students work independently doing seatwork. Students tend to pay less attention during seatwork and seatwork is often inappropriately designed, either being too difficult or too easy or too little or too much. Assuming that the net efficiency is slightly higher (.6), and that instruction takes place for 45 minutes, the effective instructional time is very similar to that under whole group instruction (see middle part of Figure 5).

The bottom portion of Figure 5 suggests how individualized instruction might affect classroom time use. Although this form of instruction takes more management time than either whole group or subgrouping, the effective instructional time is similar because the presumed efficiency of instruction is greater. The instructional time is assumed to be more efficient both becasue students can proceed at their own rate and because the level of instruction is appropriate to their needs.

This hypothetical example suggests why classroom studies need to focus on more than the sheer amount of instructional time. The same amount of instructional time will have different learning results depending upon the efficiency of that time use. Different amounts of instructional time can have comparable learning results depending upon the efficiency of the time use. The overall effect of any instructional technique depends upon the outcome of the trade-off between quantitative losses (e.g., increased procedural or management time) necessary to implement the technique and qualitative gains (e.g., greater efficiency of instruction) from using the technique.

Diversity

The basic objective in grouping students within a classroom or in assigning students to different classes on the basis of ability, is to reduce student diversity so that instruction can be made more appropriate. However, on-going grouping practices are not necessarily carried out to accomplish this goal. Hallinan and Sorensen note that teachers divide the class into equal-sized groups, irrespective of the ability distribution in the classroom or of class-size. To maximize the appropriateness of instruction, other grouping strategies which consider the diversity of the group would probably be more effective. For example, one might want to group the very low ability students into a small group while leaving the middle to high students in a larger group. There may be negative, unwanted effects of drawing attention to the poor performance of the low group, however.

Reducing diversity within groups is important if subgrouping is to have enough gains in efficiency to compensate for instructional time lost in managing grouping and seatwork. If within-class groups are small and fairly homogeneous, instructional efficiency is likely to be enhanced. The overall outcome of time use, though, will depend upon the balance between the gains in efficiencies and the losses in instructional time and efficiencies incurred because of seatwork. Students often have a lower engagement rate during seatwork because they are not directly involved with or supervised by the teacher. Although seatwork is probably not inherently a bad procedure, its present use has many examples of poor applications.

The extreme response to diversity is individualization in which each student proceeds at his or her own rate through relevant materials. Diversity of instructional groupings is thus not a problem, although management of materials and schedules is clearly problematic.

Curriculum

Studies of time use and its effects have paid little attention to how the nature of the subject matter affects the efficiency of instruction. Many features of the subject matter determine the effect of time; for example, the BTES focused on how the difficulty of the task affected achievement. Cumulativeness, or the degree to which learning each skill or concept depends on mastery of prior skills or concepts, affects time use. Subjects such as mathematics are more cumulative than subjects such as history. The failure to master a previous task will be more detrimental in cumulative subjects (such as math) than in less cumulative subjects (such as history). For example, a student who does not know how to multiply by a single digit cannot learn from instruction on two-digit multiplication, while a student who retained nothing about the American Revolution could profit from instruction on the Civil War. This effect of curriculum is reflected in the student's learning rate. Figures 6 and 7 suggest how incomplete learning at one time affects the learning rate for a cumulative and less cumulative subject.

In Figure 6, a student experiencing difficulty keeping up with the class is learning a non-cumulative subject. The student's success at learning what is taught during the interval _t_ to _t+1_ does not depend directly upon what was learned in the previous interval. Thus, the student's learning rate is uniform across the instructional period. The student experiencing difficulty might have a lower learning rate than other students, but could learn each new concept equally well (or poorly).

FIGURE 6 ABOUT HERE

In Figure 7, the student is learning a cumulative subject. What is learned at one time is highly dependent upon what is mastered previously. In this case, the incomplete learning at one interval carries over to the next, reducing the learning rate at each succeeding interval. Thus, the learning rate for a student who is experiencing difficulties declines over time, and at some point the student may stop accumulating knowledge altogether (see the right hand panel of Figure 7, where the learning rate goes to zero and the amount of learning stays the same).

Thus, a student's learning rate in a particular subject may depend not just upon his attention level and effort, but on the nature of the subject matter being studied as well. Students may therefore have different learning curves depending upon the nature of the subject matter as well as their aptitude for the subject.

FIGURE 7 ABOUT HERE

Instructional Pace

The pace of instruction is a primary element in understanding classroom time use. Pace determines the amount of material that can be covered in a given span of time. In addition, the pace of instruction affects the appropriateness of instruction for a student. If instructional pace is too fast, the learner will not be able to master new material. Similarly, if the pace of instruction is too slow, the student will not learn at an optimal rate. The mismatches between the pace of instruction the student needs and the pace of instruction delivered reduces the efficiency of instruction.

Figure 8 suggests how efficiency of instruction is affected by student needs and instructional pace. Maximum efficiency occurs when the pace of instruction is most appropriate-- when the student's level of information about the subject, or ability to understand the subject, is about where the teacher thinks it is. When the student knows less than the teacher expects or when the student knows more than the teacher expects, efficiency will be reduced. In Figure 8, the x axis represents the difference between what the student knows and what the teacher expects the student to know. The y axis represents student efficiency in learning, and is maximized when teaching rate and student knowledge level are matched, but is diminished on either side of this point.

FIGURE 8 ABOUT HERE

The nature of the curriculum also affects mismatches between teacher pace and student ability to benefit from that pace. In a less cumulative subject, such as history, knowing less than the teacher expects will not have the same cumulative impact as in a subject such as math.

The primary determinants of instructional pace are the amount of time which can be allotted to instruction and the diversity of the group to be instructed. Given that a specific amount of material is to be covered in a certain time, a specific rate of instruction must be used. It is not clear if teachers make decisions about coverage and pace and then allocate time or decide on the time and then determine pace and coverage. Teachers' decisions concerning instructional pace are not well understood, but the distribution of ability in the classroom apparently conditions how teachers pace instruction. Dahllof (1971) concludes that teachers pace their instruction so that the bottom quarter of the ability distribution will not be lost. This pacing level implies that efficiency of instruction is very much reduced during whole group instruction for the more able students. Barr's (1975) study confirms that the pace of instruction differs in whole group and small group instruction and that more able students perform better when instruction is delivered in homogeneous subgroups, so that a more rapid pace of instruction can be used.

This discussion hints at the difficulties in offering gross amounts of instructional time as an explanation of learning differences. Unless the necessary classroom conditions which influence the effect of time on learning are also considered, it is impossible to distinguish between instruction which is needed, instruction which is not needed, instruction which is irrelevant and instruction which is appropriate. Paying perfect attention to a poorly organized or incorrect exposition on a topic obviously does not affect learning the same way as paying attention to an excellent appropriate lecture. Learning depends upon both student attention and appropriate instruction. These two elements--attention and appropriate instruction--depend upon pacing, grouping, diversity and the nature of curricular materials.

This view of classroom learning suggests some shortcomings of our usual approach to thinking about instructional time and organizational arrangements. First, the usual models do not capture the interactive nature of teacher and learner pursuits. For example, in studies of classroom time use, teacher pursuits are seen to affect student activities but not vice versa. Second, the interactive nature of learning which we are suggesting implies that the factors affecting learning vary in time and that these variations are important for understanding the classroom instructional process. The next section discusses the dynamic and interactive nature of classroom learning in greater detail.

A DYNAMIC VIEW OF LEARNING IN CLASSROOMS

A dynamic view of learning in classrooms assumes that the factors affecting classroom learning vary in time and that on-going events in the classroom affect this variation. The learning rate of an individual student, the primary determiner of amount learned, varies during any lesson, depending on the attentiveness of the learner and the appropriateness of instruction for the learner. We can depict the attentive behavior of a student as in the top portion of Figure 9.

FIGURE 9 ABOUT HERE

The learner may drift in and out of attention depending upon interest in the subject, distractions which are present, and whether he or she needs to pay attention. Similarly, instruction may vary in terms of its appropriateness or inappropriateness depending upon whether the learner knows the subject matter, whether instruction is too fast or too slow, and whether the lesson is poorly organized . (See the middle portion of Figure 9.) The basic assumption about classroom learning made here is simply that learning occurs when the student is attending to appropriate instruction. Engagement and appropriate instruction must simultaneously occur before learning can take place. In Figure 9 (bottom portion) we display "learning time", or the times when attention and the appropriate level of instruction coincide. The fact that learning depends upon the joint occurrence of engagement and needed instruction means that to understand the effect of attention, or of appropriateness, their simultaneity must be considered.

Student attention and the quality of instruction will vary during any instructional session due to both their mutual dependence upon one another and their dependence upon other instructional and classroom organizational variables. Instructional pace, for example, is likely to vary within an instructional group and across instructional groups. Teacher decisions regarding instructional pace are likely to be adjusted as the teacher perceives how well or poorly the class is receiving instruction. Inattention to the lesson is probably one key way that the teacher determines that an alteration in the pace or the topic of instruction is needed. In this way, attention is both a consequence and a determiner of instructional pace. Other elements of classroom instruction, such as when to time a transition to a new topic or when to take a break , are no doubt cued by the attentive level of the students. Thus, instructional decisions by the teacher are influenced by on-going classroom uses of time and vice versa.

Teaching and learning are simultaneously determined. A major difficulty with present studies of time use is the failure to appreciate the significance of this simultaneity for understanding classrooms. Although models of learning in classrooms point to the centrality of teacher pursuits and learner activities, they do not point to their mutuality of definition. For example, in the BTES model, teacher activities determine student activities, but not the other way around. Similarly, in the Wiley-Harnischfeger model, teacher activities determine pupil pursuits, but not the other way around. Because it is this give and take between teacher and students which defines the character, climate, and operation of the classroom, this interdependence is a significant part of what makes a classroom tick. We argue here that it is this mutuality of teaching and learning which must be at the heart of any useful model of classroom instruction. Given this focus, it is natural to ask, for example, how teacher decisions about time use, grouping practices, or pacing of instruction get modified, abandoned, and realigned in the face of the everyday business of instructing thirty or so students. Central to our understanding of these myriad and confusing details of classroom life is an uncomplicated view that learning depends upon attention to appropriate instruction. The maze of interactions of students with each other, with their teacher and with the curriculum, may become more understandable and more predictable if we wander through it with a useful guide. Such a guide must go considerably beyond our present concerns with sheer amount of instructional time. The present paper is a beginning attempt to describe some needed elements in future considerations of time allocations and their effects on individual learners.

SUMMARY AND DISCUSSION

It is widely believed that recent studies of time and learning have produced conclusive and appreciable effects for time on learning. It is difficult to argue with this almost definitional assertion that more time produces more learning. Given the commonsense nature of the assertion, it perhaps is most surprising that so much attention has been paid to it.

Nevertheless, the review conducted here concludes that, by a variety of criteria for the importance of an effect, the most astounding finding relating the effects of time-on-task to learning is that the effects are as small as they are.

Even had the effects been significant in every subtest across all grades, the results could not be interpreted to mean that all the variance accounted for could be actually manipulated were time allocations changed. It is not clear how much of the variation in time-on-task is actually open to manipulation. Students differ in their willingness and tendencies to stay on task. Some of this variation can probably be altered, but certainly not all of it can be. Similarly, teachers use time well or poorly. Some teaching practices may use time more efficiently, but even with the same teaching techniques, some teachers will simply be more efficient in their time use and more aware of what is going on in their classrooms than will other teachers. Thus, like student variation in engaged time, teacher variation in the use of time is not entirely open to manipulation.

Also, the sources of differences in time-on-task may not be uniform, making alteration of time-on-task a less general enterprise than it first appears. The factors responsible for loss of learning time in one classroom may not be problematic in another classroom. For example, Karweit and Slavin (1981) decompose the number of scheduled minutes for classroom instruction into minutes lost to instruction and minutes used for instruction. The sources of the lost minutes were shown to vary across the classrooms studied, in some instances being heavily dependent on the inattention of the student, and in others being determined more by intrusions into the schedule caused by late starts or early closings.

Despite the weakness of these effects for time-on-task, the emphasis on time has been fruitful. Several important findings have emerged from these studies of time and learning; findings which are likely to have genuine impact on teaching practice and school organization in the future.

The Non-standard Nature of the School Curriculum

The topics which are covered and the emphases given them are apparently greatly determined by individual teacher preferences. The BTES, for example, documented seven-fold differences in allocation times to topics in the mathematics curriculum. Such differences may reflect differences in needs of the students or may simply reflect what the teacher thinks is important to be learned. The experience of being a fifth-grade student is certainly not uniform. Although few would seriously consider instituting a national curriculum, schools and their teachers could assess how time is allocated to particular topics to see if this allocation is in line with their priorities. Because part of the meaning of professionalism for teachers is probably rooted in this sense of control over what is taught and how it is taught, this area is fraught with potential for conflict. Nonetheless, an understanding of how such differences in time allotments arise and an assessment of whether these differences are intended or are arbitrary is an important determination for schools and their teachers.

The Non-Instructional Use of the School Day

A consistent finding emerging across the studies of time in school is that a limited part of the school day is actually used for instruction. Estimates differ, but studies basically indicate that about half to sixty percent of the school day is used for instruction. No one wants to turn schools into humorless, timedriven factories where students and teachers are working constantly. On the other hand, it isn't at all clear that a more business-like and serious approach to the use of time would harm the students' or the teachers' view of why they are in school in the first place. Such a trivial innovation as making sure that classroom instruction is not interrupted unless it is really necessary, for example, may give teachers and students alike a sense of the importance of classroom time. Such a sense of seriousness of purpose is the first step toward a recommitment to public education. The introduction of new ways of organizing elementary schools, such as departmentalization, should also be looked at from the standpoint of time. Do the gains from this method of organization compensate for the losses in potential instructional time?

It is highly likley that schools and teachers are unaware of how they actually spend the school day. So much energy is devoted to surviving through the day that little reflection can be made on whether the day was spent doing what was planned or needed. By simply making teachers more aware of how instructional time gets eroded, they may be able to adjust their activites accordingly.

Instructional Practices Related to Efficient Use of Time

One finding from the time studies which is frequently discussed is the lack of student attention when not directly interacting with the teacher. Seatwork is a necessary response to grouping practices in which the teacher spends some time in direct involvement with one group of students while other groups are working independently. The fact that independent seatwork has lower engagement rates has been offered, or implied, to justify whole group instruction. We should be cautious about carrying this interpretation of low engagement during seatwork too far. If seatwork is carefully designed and is appropriate to the level of the student, then grouping may be a more efficient method than whole group instruction. Barr's (1975) study of grouping within the classroom suggests that grouping is superior to whole group instruction, primarily because the pace of instruction is more appropriate. The resolution of this issue must take on a more serious discussion than a simple noting of the fact that seatwork is often inappropriate and that students attend less during independent work than while the teacher is directly involved with them. The issue needs to consider the relative effectiveness of the two modes of instruction balanced by the losses in quantity of instruction necessary to achieve the effectivness. Moreover, justifications for one method over another on the basis of present practice may be misleading. Seatwork is not intrinsically a bad alternative to listening to the teacher; it may simply be designed poorly at present. There may be a place for independent work in which students learn to benefit from and correct their own mistakes and to figure something out for themselves without being pointedly told. A careful and sytematic examination of grouping practices, pacing differences and student attention is needed to inform this basic question.

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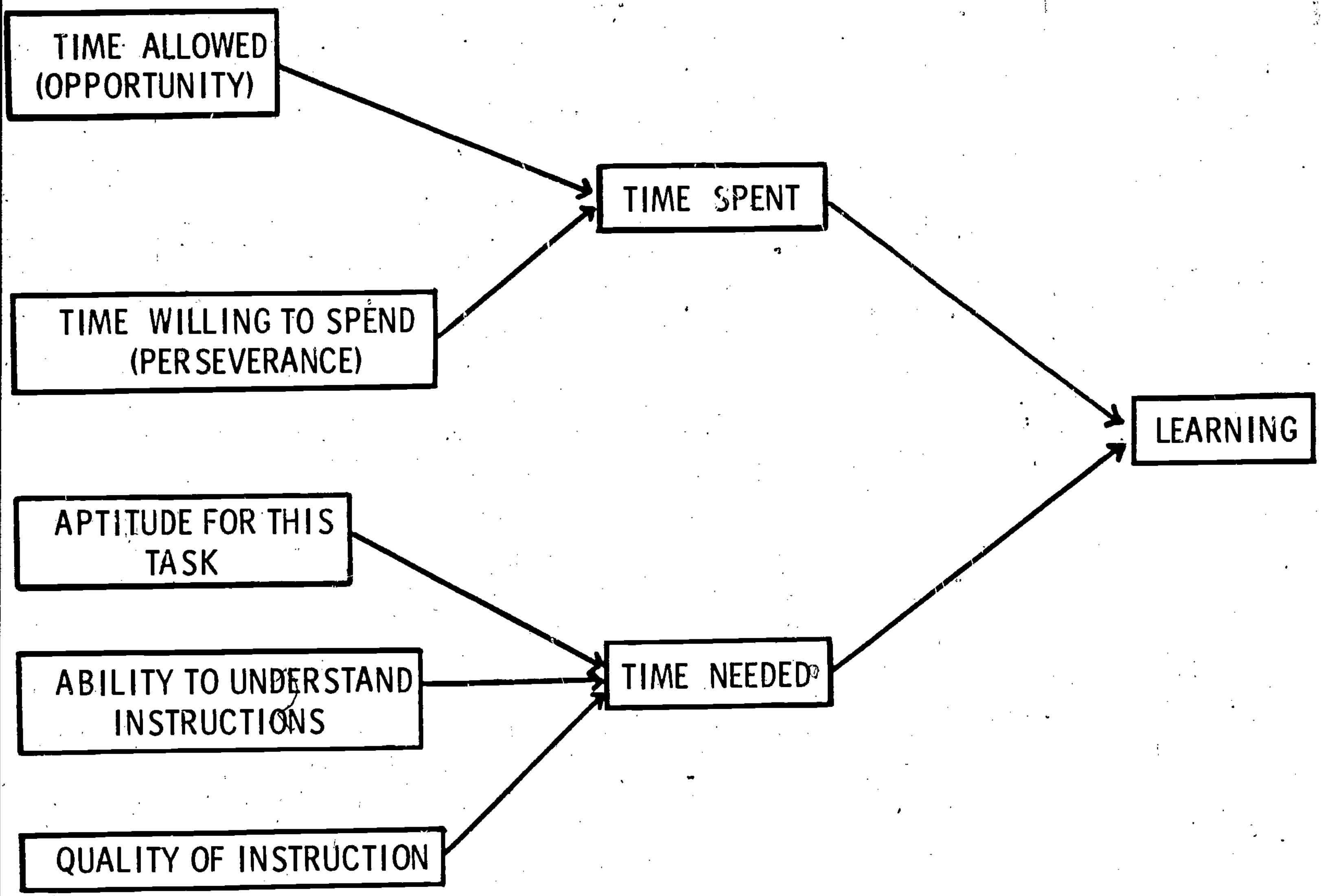

FIGURE 1

CARROLL'S LEARNING MODEL

Scheduled Time Factors	Modified by these factors	Actual Time Used
Scheduled days per school year	Teacher Strikes Student Absence School Closings	Actual days schools are in session
Scheduled school day Scheduled time/subject	Double shifts After-school programs Non-academic events Scheduling practices	Actual hours of time available for instruction in specific subjects
Available time for instruction in specific subject	Teacher managerial skills Classroom size and composition Grouping and instruction Interruptions	Actual hours of time used for instruction
Instructional time in specific subject	Student interest, aptitude Student motivation	Actual student engagement with learning specific subject

FIGURE 2

Modification of scheduled school time to produce student engaged time

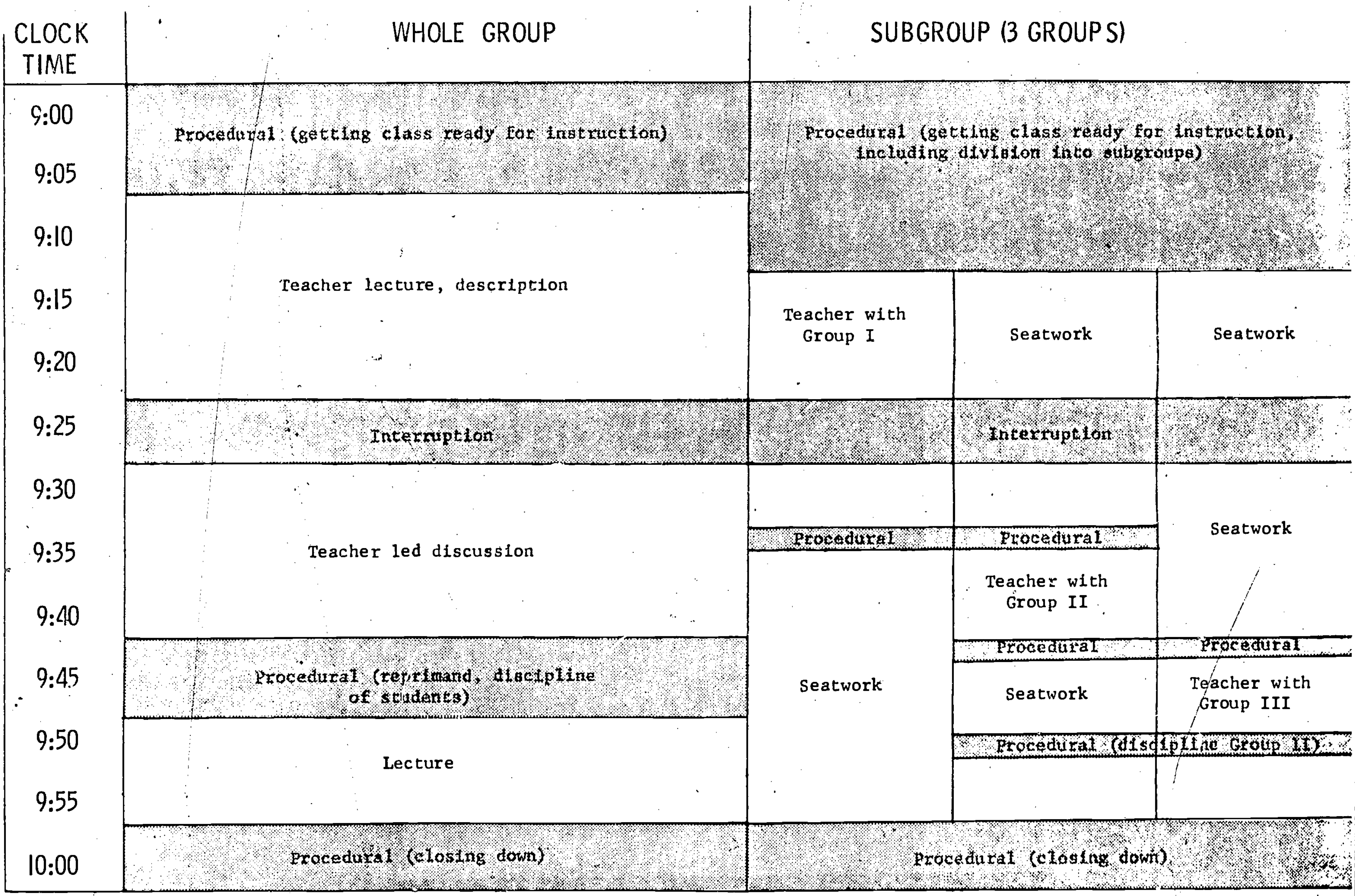

FIGURE 3
Instruction with Whole Group and Subgroups

MAXIMUM TIME	REDUCED BY: ABSENCE	REDUCED BY: NON-INSTRUCTION	REDUCED BY: NON-ATTENTION	ON-TASK PERCENT
1080 HOURS (180 days x 6 hrs.)	840 HOURS (140 days x 6 hrs.)	420 HOURS (140 days x 3 hrs.)	315 HOURS (140 days x 3 hrs. x .75)	29
			378 HOURS (140 days x 3 hrs. x .90)	35
		560 HOURS (140 days x 4 hrs.)	420 HOURS (140 days x 4 hrs. x .75)	39
			504 HOURS (140 days x 4 hrs. x .90)	47
	1020 HOURS (170 days x 6 hrs.)	510 HOURS (170 days x 3 hrs.)	383 HOURS (170 days x 3 hrs. x .75)	35
			459 HOURS (170 days x 3 hrs. x .75)	43
		680 HOURS (170 days x 4 hrs.)	510 HOURS (170 days x 3 hrs. x .90)	47
			612 HOURS (170 days x 4 hrs. x .90)	56

FIGURE 4

HYPOTHETICAL LEARNING TIME
RESULTING FROM VARIOUS
TIME USAGES

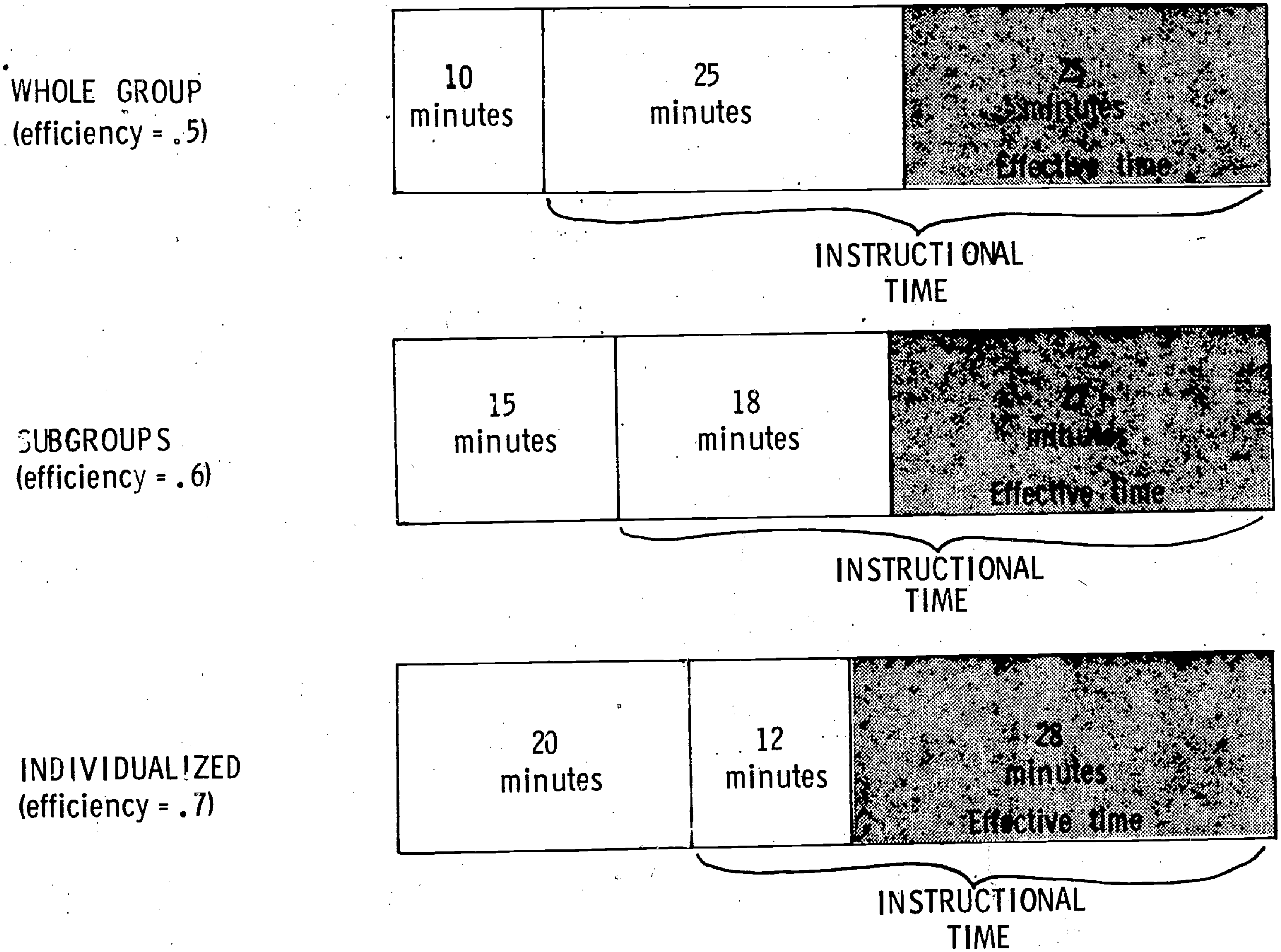

FIGURE 5
AMOUNT AND EFFICIENCY OF INSTRUCTION DURING 3 MODES

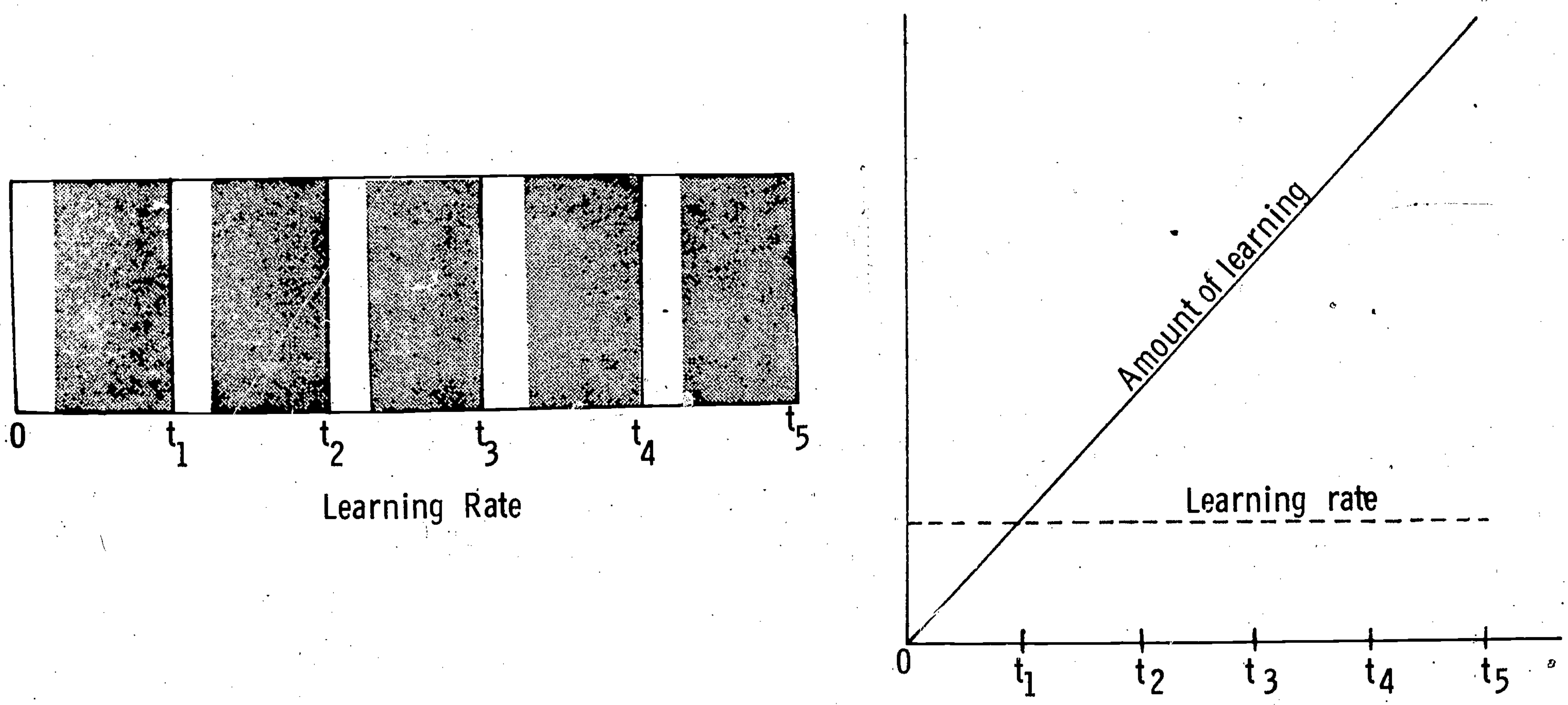

FIGURE 6
UNIFORM LEARNING

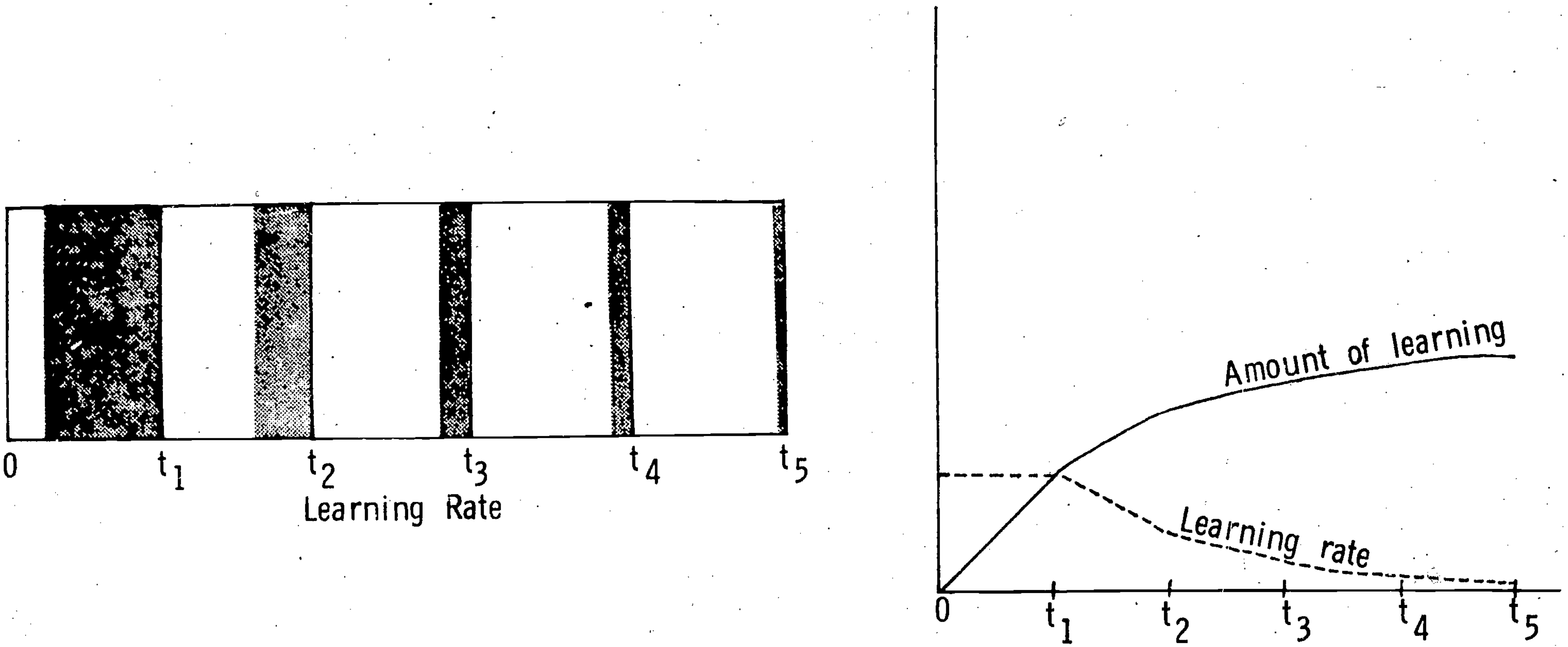

FIGURE 7

NON-UNIFORM LEARNING RATE

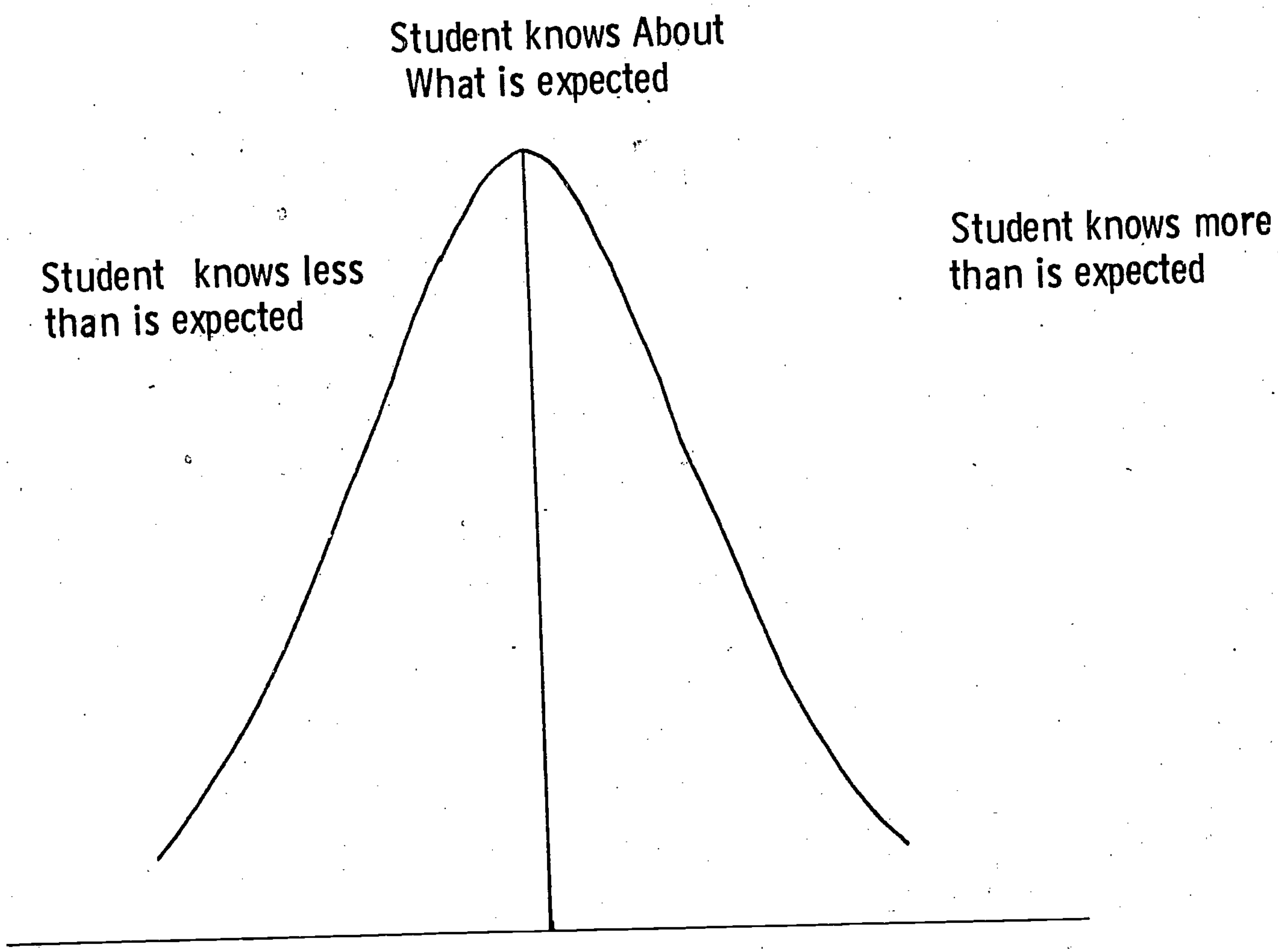

FIGURE 8

STUDENT LEARNING EFFICIENCY

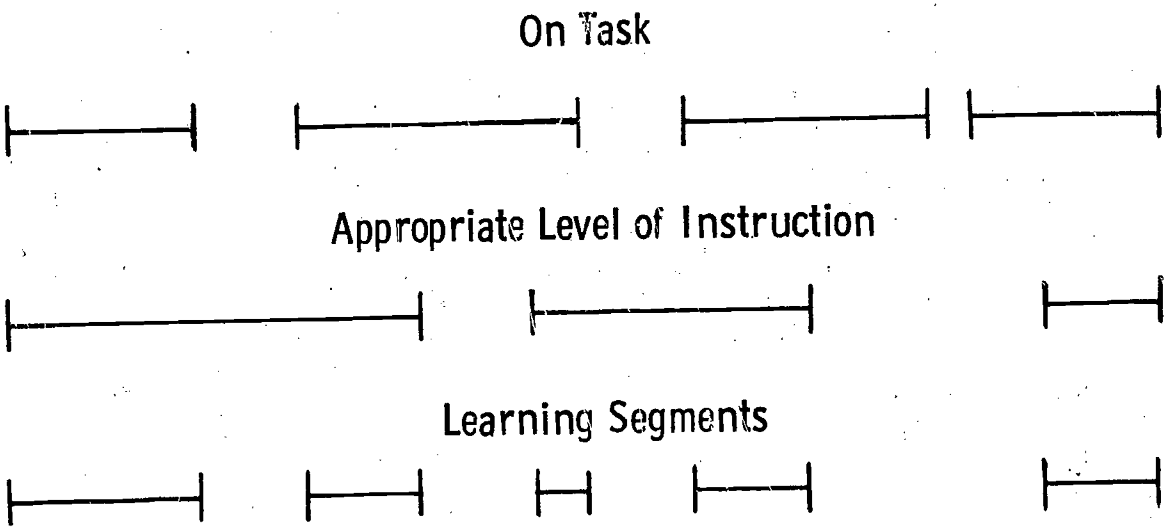

FIGURE 9

ATTENTION, APPROPRIATE LEVEL

AND

LEARNING

Appendix A

Notes to Accompany Tables 1-4

The calculations of the amount of time needed to yield a .25 standard deviation increase in the dependent variable were accomplished by setting the new level of the posttest score to be the old posttest score plus one quarter of its standard deviation. Using the regression results, the value for allocated time needed to produce this posttest score was found, assuming the relationships among the other variables were to remain unchanged. The equivalent minutes per day is given underneath the newly computed allocated times. These were obtained by dividing the allocated minutes by the number of data days in the B-C period for that grade/subject.

Table 1

Regressions Analyzing the Combined Effects of ALT Variables on Reading and Language Arts Achievement in Grade 2
BTES Survey B-C Period

Content Category for Postachievement Preachievement and Allocated Time	Post x s.d.	Intercept	Pre Test x s.d.	Pre Test b	Alloc Time x s.d.	Alloc Time b	Engaged Rate x s.d.	Engaged Rate b	Low Error x s.d.	Low Error b	High Error x s.d.	High Error b	Variances Pre Ach Unique Residual	Allocated Time to Produce Post test + .25 sd
Total Comprehension	11.5 (7.0)	3.57	6.8 (6.3)	.55	760.0 (319.8)	.0005	.74 (.10)	2.0	.50 (.18)	5.1	.02 (.03)	-10.0	.32 .03 .04	4220 (60 MD)
Decoding Blends and Long Vowels	24.7 (6.5)	6.33	18.9 (8.8)	.44	351.0 (255.9)	.0033		9.5		5.0		-31.7	.49 .09 .18	843 (12 MD)
Decoding Variant Consonants	8.2 (4.8)	-.64	5.5 (5.5)	.22	50.1 (67.9)	.0056		4.7		7.9		-4.9	.12 .11 .12	267 (4 MD)
Decoding Complex Patterns: Spelling Time	9.5 (5.0)	-2.17	6.2 (4.7)	.58	394.9 (303.3)	.0017		5.1		7.6		-11.6	.47 .12 .22	1166 (16 MD)
Word Structures: Meaningful Units	17.5 (5.0)	7.35	13.2 (5.6)	.0021	258.8 (184.5)	.0021		1.3		2.2		-4.4	.49 .01 .02	843 (12 MD)
Word Structure: Syllables	5.4 (2.8)	1.85	3.0 (2.7)	.17	68.5 (81.5)	.0085		1.3		3.3		-9.0	.09 .13 .14	154 (2 MD)
Total Reading	90.7 (30.4)	18.00	61.9 (32.1)	.68	4475.2 (1056.8)	.0013		20.6		22.1		-87.3	.68 .05 .15	10507 (147 MD)

Table 2

Regressions Analyzing the Combined Effects of ALT Variables on Mathematics Achievement in Grade 2
BTES Survey B-C Period

Content Category for Postachievement Preachievement and Allocated Time	Post x s.d.	Intercept	Pre Test x s.d	b	Alloc Time x s.d.	b	Engaged Rate x s.d	b	Low Error x s.d.	b	High Error x s.d	b	Variances Pre Ach Unique Residual	Allocated Time to Produce Post test + .25 sd
Add and Subtract: No Regrouping	25.7 (6.7	15.70	18.3 (8.2)	.35	449.7 (276.3)	-.0005	.70 (.12)	1.7	.50 (.21)	5.4	.05 (.07	-1.9	.24 .04 .05	-2700 (-41 M/D)
Add and Subtract: Speeded Test	16.7 (6.9)	.13	11.5 (6.2)	.56	54.3 (70.2)	.0148		5.5		11.0		-0.9	.35 .14 .22	172 (3 M/D)
Add and Subtract: With Regrouping	2.3 (7.5)	-5.10	-0.3 (3.0)	.59	272.6 (270.0	.0010		6.6		4.7		6.4	.06 .03 .03	2162 (33 M/D)
Computational Transfer	10.2 (5.6)	2.85	6.2 (4.9)	.59	401.6 (300.1)	.0014		0.3		5.6		1.3	.32 .04 .05	1441 (22 M/D)
Place Value and Numerals	13.0 (6.4)	8.84	7.8 (5.4)	.79	309.6 (184.2)	-.0010		-2.9		1.2		-5.8	.47 .00 .01	-1318 (-20 M/D)
Word Problems	6.8 (4.2)	2.73	4.3 (3.2)	.66	116.8 (107.9)	.0049		0.4		1.4		-8.0	.27 .05 .07	347 (5 M/D)
Money	7.4 (2.7)	3.21	5.2 (2.9)	.47	88.9 (101.2)	-.0005		1.8		1.7		-6.6	.34 .08 .13	-1282 (-20 M/D)
Linear Measurement	8.1 (1.8)	4.56	7.3 (1.9)		68.4 (76.[illegible])	.0000		0.2		1.2		-2.2	.19 .04 .04	44000 (670 M/D)
Fractions	4.7 (3.4)	2.65	6.2 (4.9)	.10	70.9 (89.1)	.0126		-0.6		1.6		2.0	.05 .10 .11	113 (2 M/D)
Total Mathematics	94.9 (30.5)	17.52	61.5 (23.7)	.91	2242.8 (531.6)	.0005		15.3		19.8		-4.5	.58 .03 .08	17310 (264 M/D)

Table 3

Regressions Analyzing the Combined Effects of ALT Variables on Reading and Language Arts Achievement in Grade 5
BTES Survey B-C Period

Content Category for Postachievement Preachievement and Allocated Time	Post x s.d.	Intercept	Pre Test x s.d.	b	Alloc Time x s.d.	b	Engaged Rate x s.d.	b	Low Error x s.d	b	High Error x s.d.	b	Variances Pre Ach Unique Residual	Allocated Time to Produce Post test + .25 sd
Total Word Meaning	28.8 (12.4)	-5.42	23.6 (12.4)	.78	594.8 (232.0)	-.0019	.75 (.11)	23.6	.46 (.15)	-0.4	.01 (.02)	-30.8	.69 .08 .24	1070 (19 M/D)
Total Comprehension	25.3 (12.7)	9.80	19.3 (12.7)	.81	1547.0 (1065.4)	.0026		-3.4		-0.7		-88.9	.66 .05 .16	-897 (-16 M/D)
Word Structure: Syllable	10.7 (5.6)	4.88	9.4 (6.0)	.51	99.6 (91.4)	-.0016		2.7		-0.7		-44.0	.35 .03 .05	-727 (-13 M/D)
Total Reading	71.4 (29.1)	8.57	57.8 (28.0)	.89	4341.0 (1429.5)	.0014		16.7		-11.7		-121.6	.77 .02 .07	9097 (163 M/D)

Table 4

Regressions Analyzing the Combined Effects of ALT Variables on Mathematics Achievement in Grade 5
BTES Survey B-C Period

Content Category for Postachievement Preachievement and Allocated Time	Post x s.d.	Intercept	Pre Test x s.d.	Pre Test b	Alloc Time x s.d.	Alloc Time b	Engaged Rate x s.d.	Engaged Rate b	Low Error x s.d	Low Error b	High Error x s.d.	High Error b	Variances Pre Ach Unique Residual	Allocated Time to Produce Post test + .25 sd
Total Geometry	5.3 (4.8)	0.41	3.6 (3.9)	.34	144.4 (180.4)	.0016	.73 (.13)	6.1	.34 (.21)	-1.9	.03 (.06)	-12.7	.12 .06 .07	900 (17 M/D)
Total Multiplication	14.2 (5.2)	9.94	12.3 (6.6)	.36	388.9 (438.6)	.0007		-1.4		3.6		-18.7	.33 .08 .11	2130 (40 M/D)
Multiplication: Speed test: basic facts time	21.5 (10.4)	-2.23	17.8 (9.0)	.92	28.2 (37.9)	-.0088		6.4		7.9		6.2	.65 .03 .10	-263 (-5 M/D)
Division	7.4 (5.5)	8.00	4.4 (5.1)	.59	579.1 (444.5)	.0010		-4.1		-0.5		-19.3	.30 .06 .08	1921 (36 M/D)
Fractions	5.6 (4.9)	1.06	2.0 (4.0)	.55	728.3 (677.8)	.0027		3.7		-2.2		-13.8	.28 .23 .31	1158 (22 M/D)
Computational Transfer	16.8 (4.8)	7.02	15.3 (4.6)	.73	146.5 (181.7)	-.0001		-2.6		2.9		-12.4	.58 .04 .10	-10950 (-207 M/D)
Word Problems	3.7 (3.3)	2.56	2.1 (3.2)	.60	156.3 (194.7)	-.0007		0.0		0.3		-3.5	.38 .01 .01	-1011 (-19 M/D)
Total Mathematics	87.7 (27.9)	13.96	70.0 (26.3)	.84	2349.9 (606.3)	.0062		1.5		2.4		-41.3	.69 .03 .10	3426 (65 M/D)

NOTES TO TABLE 5

a. Edminston and Rhoades report only zero order correlations with post-test scores. Estimates of the correlation between "pre-test," (had one been given) and post-tests approximate reasonable values of this estimate of pre-test, attention correlation from Lahaderne.

b. Lahaderne reports significant partial correlations for time on past net of IQ for SF and SA for boys and SF for girls. From these partials and from descriptions of usual correlations between pre and post-tests, a correlation matrix was derived which would produce these partials. Regressions were run based on these estimated correlations.

c. Cobb used no control for pre-test differences, reporting only correlation with post-test. Correlation matrices were created using a range of pre-post correlation of .6 to .8 and pre-time correlations roughly half the post-time correlations. From these matrices low and high estimates of partials and unique and residuals were obtained.

d. Partials and regressions results computed from correlations provided in Table 5, p. 42-43.

e. Bell and Davidson present separate statistics for 23 classrooms. Computation of the average and the median partials are reported using only positive partials.

f. Partial and unique and residual variance explained computed.

g. Criterion referenced test reversed pattern of results, significant 5th grade, non-significant 2nd grade. See Karweit and Slavin (1981).

Table 5

Summary of Time-on-Task Effects on Achievement

Study	Post	Pre	Time	Sample	Correlations Pre	Post Time	Partial Time, Post	Variance Unique	Resid
Edminston and Rhoades	CAT general achievement	--	attention	n = 94 high school seniors in one school system	.70[a]	.46 .58	.43	.01	.03
Lahaderne	Scott Foresman Reading	Kuhlman Anderson IQ	attention	n = 65 boys in 4 sixth grade classes	.62[b]	.48 .51	.31	.03	.07
	Stanford Arithmetic	IQ	attention	"	.85[b]	.48 .53	.26	.04	.08
	Scott Foresman Reading	IQ	attention	n = 62 girls in 4 sixth grade classes	.77[b]	.44 .49	.26	.03	.07
Cobb	Stanford Reading	--	attention	n = 103 fourth grade students in 5 classes in 2 schools	.70[c]	.20 .49	.43	.02	.07
	Stanford Arithmetic				.70[c]	.20 .44	.16	.00	.00
Smith	STEP Social Studies	CAT Nonverbal battery	allocated time	n = 68 fifth grade classes	.69	.16 .23	.17[d]	.01	.03
Bell and Davidson	Teacher made Ach Test	IQ	attention	n = 23 classrooms of 4,5,6, grade students	.33	.07 .25	.27[e]	.00	.00
Evertson, Emmer and Clements	English Content Specific	CAT	attention	n = 50 classrooms, junior high	.97	.25 .29	.20[f]	.00	.00
	Math Content Specific	CAT	attention	n = 50 classrooms, junior high	.96	.31 .39	.34[f]	.00	.00
Karweit and Slavin	CTBS	CTBS	engaged minutes	n = 33 students in 6 classes, grade 2/3	.91	.30 .42	.38[g]	.03	.18
	CTBS	CTBS		n = 62 students in 12 classes, grade 4/5	.89	.43 .42	.09	.01	.03