DOCUMENT RESUME

ED 244 989 TM 840 312

AUTHOR	Law, Alexander I.
TITLE	Time and Learning in California Schools.
INSTITUTION	California State Dept. of Education, Sacramento.
PUB DATE	84
NOTE	54p.
AVAILABLE FROM	Publications Sales, California State Dept. of Education, PO Box 271, Sacrament, CA 95802 ($1.50 plus sales tax for California residents).
PUB TYPE	Reports - Research/Technical (143)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Academic Achievement; Achievement Tests; College Entrance Examinations; Elementary Secondary Education; Graduation Requirements; *School Schedules; State Programs; Testing Programs; Time Factors (Learning); *Time on Task
IDENTIFIERS	*California Assessment Program; California Basic Educational Data System; High School and Beyond (NCES); Scholastic Aptitude Test

ABSTRACT

This report discusses the availability and use of instructional time in relation to the requirements contained in the Hughes Hart Educational Reform and Finance Act of 1983. The study draws on information from the California Assessment Program, which supplies achievement test scores, time and coursetaking information; verbal and mathematics aptitude scores of the Scholastic Aptitude Test; California results of the High School and Beyond study; and the California Basic Educational Data System. The amount of time California students spend in school, which is currently less than the national average, is examined. The report discusses the distribution of time among subject areas in elementary school, and coursetaking and achievement in high school. National and state recommendations for improving student achievement are discussed. Methods for increasing students' academic achievement are presented. The report is a comprehensive examination of the relationship between the amount of time California students spend in school in comparison with students of other states, and the implications of the differences for learning and achievement. (DWH)

Time and Learning in California Schools

California Assessment Program

CALIFORNIA STATE DEPARTMENT OF EDUCATION Bill Honig—Superintendent of Public Instruction Sacramento, 1984

Time and Learning in California Schools

Prepared Under the Direction of
Alexander I. Law, Director
Planning, Evaluation, and Research Division

Publishing Information

This report, which was prepared by the staff of the California Assessment Program in accordance with the provisions of *Education Code* Section 60660, was published by the California State Department of Education, 721 Capitol Mall, Sacramento, CA 95814, and was distributed under the provisions of the Library Distribution Act and *Government Code* Section 11096.

1984

Copies of this publication are available for $1.50, plus sales tax for California residents, from Publications Sales, California State Department of Education, P.O. Box 271, Sacramento, CA 95802. A list of other publications which are available from the Department, *Selected Publications of the California State Department of Education*, may be obtained by writing to the same address.

Contents

Summary

The study described and reported in this publication was sponsored by the California Assessment Program (CAP) of the State Department of Education and conducted during the 1982-83 school year. It incorporates data from several national and state sources into a comprehensive look at the relationship between the amount of time that California's students spend in school in comparison with that of students in other states and the implications of the differences for learning and achievement. This study was originally published as part of CAP's complete yearly report, Student Achievement in California Schools: 1982-83 Annual Report (Sacramento: California State Department of Education, 1984).

This report focusses on the availability and use of one of the most expensive and indispensable resources underlying that learning--instructional time, especially in relation to the new requirements contained in the Hughes-Hart Educational Reform and Finance Act of 1983. Long ignored as a critical factor in the study of educational productivity, time is now receiving statewide and nationwide attention. Insufficient time is viewed as a cause of weakness in the present state of student achievement. Increased time is viewed as a means--along with other resources and higher expectations--for raising student achievement. Time is also viewed as the foundation of all learning and the usefulness of all resources and efforts aimed at improved achievement.

The Educational Reform Act carries far-reaching implications. At the center of its reform package are requirements for increases in the amount of instructional time and the number of courses taken. The reasoning behind the reforms is that taking more courses and spending more time learning will increase a student's level of achievement. The data gathered and the analyses performed during the 1983 CAP investigation (which includes and elaborates on portions of the 1982 time and learning study) into the relationship between amount and use of instructional time and achievement tend to support the Legislature's reasoning. In some regards, however, the results of the CAP study indicate that the Reform Act does not go far enough.

The investigation reported in this publication includes information on:

1. The amount of time California students spend in school
2. How time is distributed among subject areas in elementary schools
3. How coursetaking patterns and achievement of California high school students compare with those in other states and the nation as a whole
4. The recommendations of national organizations, the State Board, and the Legislature and what must be done to meet them
5. Ways to increase student achievement

In addition, because national attention is now focussed on the critical gap between the preparation of American youth in mathematics and science and that of youth in other developed countries, the investigation emphasized the achievement and coursetaking patterns of California's students in these areas.

The study draws on information from a variety of sources. The chief source is the California Assessment Program, which supplies both achievement test scores and time and coursetaking information. Other key sources are:

- The verbal and mathematics aptitude scores of the College Entrance Examination Board's Scholastic Aptitude Test
- The scores of college-bound students who take the College Entrance Examination Board's advanced achievement tests
- The California and national results of the High School and Beyond study of the 1980 and 1982 graduating classes, carried out by the National Center for Education Statistics of the U.S. Department of Education
- The California Basic Educational Data System (CBEDS)
- A 1981 survey of school day and school year length nationwide carried out by Tod Anton, Superintendent, Lincoln Unified School District, Stockton, California

In this report major and minor findings are developed, supported, and elaborated, and the supporting data are presented and discussed. It is impossible to separate completely the findings of the study from their supporting data. In the body of the report they are, of course, merged for detailed discussion and analysis. For the sake of providing a convenient reference and an overview of the study's contents, five key areas, which correspond to the five major parts of this report, are described below, and, where appropriate, a summary of the most important supporting data is included:

1. Amount of time California students spend in school. California students spend considerably less time in school than their counterparts in other states. The differences are present at all grade levels and, viewed cumulatively, are substantial by the time the students graduate from high school. Even if the rest of the nation does not change, when the Reform Act's requirements are fully implemented in 1986-87, the gap between the time spent in school by California's students and students elsewhere will still not be closed.

   - Total instructional time in California is the equivalent of:
     - One-half year less than the national average by the end of grade three
     - One and one-third years less than the national average by the end of high school
   - The 1986-87 standards for yearly minutes of instruction, created by the Reform Act, if fully adopted:
     - Would require an average of 18 minutes more per day in kindergarten, 10-12 minutes more in grades one through three, and an hour more in grades nine through twelve, even with a 180-day year

- Would still fall short of the current national end-of-high-school average by one-fourth of a year

2. Distribution of time to subject areas in elementary school. CAP data on the distribution of instructional time among subject areas in grade six were compiled and compared with similar national data. The data and the comparison reveal that:

   - In grade six, of the five hours of total instructional time per day:
     - Half is spent on the basics: reading (61 minutes), writing/language (47 minutes), and mathematics (53 minutes).
     - One-fifth is spent on science (25 minutes) and social studies (36 minutes).
   - More time is spent on reading in schools serving low socioeconomic populations; this time is taken away from writing/language, science, and social studies, but not from mathematics.

3. High school coursetaking and achievement. About three-fourths of all students are enrolled in a mathematics course in the ninth or tenth grade; about half are enrolled in science in the tenth grade. From these high points, science and mathematics enrollments drop to about 25 percent of twelfth graders in the fall semester and further to only 12 percent by the spring semester. Despite some increases to these enrollments in the last two years, the average California senior still has taken fewer mathematics courses and substantially fewer science courses than the average high school senior nationwide. When California students are compared with students from New York, a state with a strong tradition of high standards for high school graduation and college entrance, the differences are profound. Far fewer California students take college-preparatory science and mathematics courses or the College Entrance Examination Board's achievement tests in those areas. Their achievement is considerably lower on those advanced tests.

   - Nationally comparable data suggest that California high school seniors:
     - Differ little in basic reading and mathematics achievement from the national average
     - In 1982 took College Entrance Examination Board's science achievement tests at half the national rate, but doubled that rate in 1983
   - Comparative data for California versus New York reveal that California high school seniors:
     - Have substantially lower achievement in basic reading and mathematics.
     - Score approximately the same on the verbal section and somewhat lower on the mathematics section of the Scholastic Aptitude Test, even though California's test-taking population is more selective than New York's (approximately half as many California students as New York students take the test).

- Take college-preparatory mathematics and science courses at a lower rate and the more advanced courses (trigonometry, calculus, physics, and chemistry) at one-half the New York rate.

- Take the College Entrance Examination Board's advanced science achievement tests at one-fourth to one-half the New York rate.

- Who take advanced science tests are far more poorly prepared mathematically than New Yorkers on the basis of their average mathematics aptitude scores.

- Perform more poorly on the science tests than New York students with equal aptitude scores.

4. National and state recommendations. Relatively few current graduates--in California or elsewhere--could meet any of the requirements recommended by recent national reports--A Nation at Risk, High School: A Report on Secondary Education in America, and Educating Americans for the 21st Century--especially when the recommendations are considered as a full set. The new course completion standards created by the Educational Reform Act of 1983 are less demanding than those recommended in the national reports. California's new 1986-87 graduation standards created by the Educational Reform Act: (1) are currently not met in mathematics by 39 percent of California seniors and in science by 60 percent of California seniors; and (2) are less stringent than those promulgated by the New York Board of Regents and those advocated in major new national reports.

5. Ways to increase student achievement. This study suggests some ways to improve students' academic achievement. The following methods are discussed:

   - Increasing the amount of time available
   - Increasing the proportion of allocated time devoted to actual instruction
   - Increasing the proportion of actual instructional time devoted to active learning
   - Reducing the time needed to learn

Background

The annual reports of the California Assessment Program have presented information to educators and policymakers on a variety of factors associated with school success. This practice helps fulfill one aspect of the legislative intent of the testing program: "The program of statewide testing shall identify unusual success or failure and the factors which appear to be responsible, so that appropriate action may be taken at the district and state level to obtain the highest quality education for all public school pupils" (Education Code Section 60601). The focus of this year's report is on the coursetaking patterns and the amount and use of instructional time in California schools in relation to the requirements of the Hughes-Hart Educational Reform Act of 1983. The law contains a set of incentives to increase the amount of instructional time and a set of course requirements for high school graduation:

- Time: Based on the number of instructional minutes offered in 1982-83, districts will receive a bonus to increase the number of instructional minutes one-third of the distance per year toward the following goals:

  - 36,000 annual minutes in kindergarten
  - 50,000 annual minutes in grades one through three
  - 54,400 annual minutes in grades four through eight
  - 64,800 annual minutes in grades nine through twelve

  Districts must (1) begin increases in 1984-85 to be eligible for bonuses; and (2) maintain instructional minute increases beyond the three-year phase-in period (1984-85 through 1986-87) to retain the bonuses.

- Course requirements: The law establishes, effective in the 1986-87 school year, new requirements for receipt of a high school diploma, including the following:

  - Three one-year courses in English
  - Two one-year courses in mathematics
  - Two one-year courses in science (including biology and physical sciences)
  - Three one-year courses in social studies (including U.S. history and geography; world history, culture, and geography; and American government, civics and economics)
  - One one-year course in fine arts or foreign language
  - Two one-year courses in physical education (unless otherwise exempted by law)

The Educational Reform Act carries far-reaching implications. The Reform Act is a result of the deep concern over a decade and one-half of decreasing student achievement. The two key variables in this Reform Act policy are instructional time and course content.

Instructional Time

The incentive to increase instructional time through lengthening the school day and school year is a response to a central concern of schooling. Time is

the portal through which all learning must pass, and all resources and efforts aimed at improved learning must directly or indirectly impinge on learning time. But instructional time will result in student learning only if students are actively participating in the teaching-learning process. Recent research has identified important factors that influence students' active learning time. The Reform Act's focus on quality of school personnel, school management, and student discipline accords with the recent research findings. But although instructional time--or more precisely active learning time--is necessary for student achievement, it is not sufficient.

Course Content

Another important factor that affects student achievement is content. Legislators have focussed on this aspect by strengthening high school graduation requirements. For central subject matter areas, the Reform Act specifies minimum years of coursework. In doing that, legislators obviously assume that more coursework in such subjects as mathematics and science will mean more content in these subject areas. However, the recent legislation falls short of specifying graduation requirements beyond minimum time per subject area.

It would be unfortunate if the reader got the impression from the singular focus of this report that time is the only important aspect of education in California worthy of study and comparison. While time is a crucial issue, it may well be that California students are equally shortchanged in the rigor, breadth, or depth of course content and its presentation. That issue, however, was not addressed by this study.

This report addresses content only as a means of categorizing achievement and time use data, not as a factor that affects achievement itself. An extraordinary amount of resources will be needed to mount the additional courses and total schooling that the legislation will stimulate; therefore, it becomes of paramount importance to focus on how that time is used. For example, using two semesters for content that can be covered in a single semester will hardly increase student achievement but only double the resources expended. It should become a high priority to ensure that students are placed in courses that do not repeat previously covered material and that new courses also provide new content. But even that is insufficient. Beyond increasing learning time and subject matter requirements, we will also have to scrutinize present courses. Could pacing be increased, i.e., could the time needed for learning be decreased and consequently more content be covered? Is learning time efficiently allocated and structured so that students have the time they need to master specified skills and that students are not allocated learning time for skills they have already mastered?

At the end of this report, we suggest various routes that should be taken to increase student learning and ultimately student achievement. The Hughes-Hart Educational Reform Act of 1983 sets a new time frame for schooling and points to priority learning areas in setting high school graduation standards. This report includes statistical support for the important reforms in the act, but it also includes evidence to show that merely allocating more instructional time, i.e., more resources, is insufficient. Beyond quantity of schooling, it is quality of instruction and curricular priorities that educators have to focus on.

Learning Time

The past ten years of research on schooling have strikingly shifted attention toward the uses of resources--especially teaching time--and their consequences for learning (see Wiley and Harnischfeger, 1974). Much of the conceptual underpinnings of this work are due to Carroll (1963) and have been extended by Bloom (1976) and Harnischfeger and Wiley (1976, 1978, 1983). Important empirical results as well as conceptual summaries may be found in Denham and Lieberman (1980) and Fisher and Berliner (1983).

Thus, active learning time is a concept that has redirected much of the earlier research on school and teaching effectiveness to focus on the teaching-learning process and its determinants. This research has led to one simple but profound insight: A student's active learning time is a strong determinant of his or her achievements.

This research implies that there are only four ways to increase achievement (Harnischfeger and Wiley, 1983). One is via a reduction in the time needed to learn. All the others depend on increasing active learning time. These latter three routes consist of:

- Increasing the total amount of time allocated to learning
- Increasing the portion of that allocated time that is actually allowed for learning
- Increasing the amount of this allowed time that students actively devote to learning

The primary focus of studies of total school time--day length and year length--is on the quantity of time available, not its use. The use of that time determines what is learned and how it is learned, thus directly influencing active learning. Total time is allocated to particular subject areas, learning topics, and learning tasks. Only the time made available for these activities can be used for learning; all other time uses can never result in learning.

Time Spent in School

Two years ago, a survey of elementary and secondary schools by a California school superintendent (Anton, 1981) concluded that California pupils are offered less schooling than pupils nationwide. This finding stirred deep concern because of its obvious implication that less schooling results in lower achievement. It became one force in legislative actions that resulted in the Hughes-Hart Educational Reform and Finance Act of 1983.

Anton's estimates of scheduled instructional time were compared to those found in a national study of known high accuracy (Compensatory Education Study, 1978). These 1976 data closely correspond to Anton's national time estimates (Table 1), as does CAP's sixth grade survey, made one year later than Anton's (1981-82 vs. 1980-81). CAP collected from school officials information on subject matter time allocations, as well as on practices and policies concerning time allocations. CAP's data collection resulted in an even slightly lower estimate of instructional time allocation than Anton's. Sixth graders' daily

Table 1

Mean Daily Minutes of Instruction and Length of School Year for California and the Nation, by Grade

	Nation		California		
Grade	1975-76	1980-81	1980-81	1981-1982	1982-83
K	203	191	182		
1	304	310	268		
2	308	311	268		
3	311	314	270		266
4	321	322	303		
5	323	323	304		
6	329	326	308	299	
7	349	332	308		
8	350	333	309		310
9		331	302		
10		332	305		308
11		331	305		
12		331	305		
Days per year	177.5	178.5	176.0		

Sources: 1975-76 national data are from the tabulations that were done as part of the 1978 Compensatory Education Study by the National Institute for Education; 1980-81 data for the nation and California are from Anton, 1981; the 1981-82 figure is from the CAP grade six survey, 1981-82; the 1982-83 California Data are from Study of the Length of the School Day and School Year in California Schools, 1982-83, prepared by the Division of Planning, Evaluation, and Research, California State Department of Education, 1983.

scheduled instruction is estimated as slightly greater than five hours in Anton's 1980-81 survey (308 minutes), while the average is just about five hours (299 minutes) in the 1981-82 CAP survey.

A comparison of CAP's estimate for sixth graders in California to Anton's 1980-81 nationwide estimate, with consideration given to the shorter school year in California, shows that sixth graders in California are offered 93 hours less schooling than sixth graders nationwide.[1] This is equivalent to 19 instructional days, or nearly one month of schooling.[2] This difference is substantial and consistent--the daily scheduled instructional times for all grades in California are systematically shorter than those in the nation as a whole.

Most commonly, high schools in California offer six 50-minute periods of instruction (Table 2), i.e., a 300-minute instructional day (Table 3). Over a third of the high school students (35.7 percent) are in schools that follow this pattern. Generally, California high schools have 50- or 55-minute periods and schedule between five and seven periods per day.

Table 2

High School Instructional Patterns:
Combinations of Length and Number of Periods

Minutes/ period	Percent* of students in high schools with specific patterns Periods per day				
	5	6	7	Other	Total
45	0.3	5.4	2.7	0.2	8.6
50	14.5	35.7	7.0	1.4	58.6
55	3.8	21.7	2.4	0.2	28.1
Other	0.7	1.1	0.9	2.0	4.7
Total	19.3	63.9	13.0	3.8	100.0

SOURCE: CAP data, 1982-83

*The percentage of schools with each pattern is about the same as the percentage of students, except for seven periods of 45 minutes--a small school pattern which represents 7.2 percent of all high schools. The primary patterns (45 to 55 minutes, 5 to 7 periods) represented 96 percent of the schools and 93.5 percent of the students.

[1] Total hours are calculated by dividing the product of the minutes per day and days per year by 60. This process was carried out for sixth graders in California and the nation, using the figures in Table 1. The resulting discrepancy is 93 hours.

[2] Ninety-three hours divided by five hours per day (299 minutes) equals 19 days.

Table 3

Total Daily Instructional Minutes,
by Pattern of Instruction

Minutes per period	Daily minutes of instruction		
	Periods per day		
	5	6	7
45	225	270	315
50	250	300	350
55	275	330	385

SOURCE: CAP data, 1982-83

Comparing California data for instructional offerings in high school to national data shows that California high school students also have received less schooling because of fewer periods per day and a shorter school year (Table 4). California students have been offered less coursework than students in the nation as a whole. On the average, this shortfall is 73 hours in each year of high school. This is equivalent to 13 school days in California. Thus, over four years of high school, California high school students are offered the equivalent of 52 days, or about two and a half months, less schooling than high school students nationwide.

Table 4

High School Instructional Time, California and the Nation, 1980

Time concepts	California	Nation
1. Minutes per period	54.1	52.1
2. Periods per day	6.1	6.7
3. Minutes per day [(1) x (2)]	330.0	349.1
4. Days per year	177.3	180.1
5. Hours per year* [(3) x (4)÷ 60]	975	1,048

*Total high school instructional time in California is 7.0 percent less than that in the nation according to data from High School and Beyond. According to the Anton survey (Table 1), the corresponding shortfall is 9.2 percent.

Hypothetically, a typical California student's school life, as exhibited in Table 1, from kindergarten through twelfth grade is 72,000 minutes shorter than that of a typical student in the nation; this is the equivalent of one and one-third sixth grade school years. This large discrepancy is the result of

shorter instructional days and a shorter school year. California ranks among the ten states with the shortest school year in the nation (Digest of Educational Statistics, 1980).

The extent of the differences in amount of schooling shows that relative to the nation, the instructional days in California are especially short in the primary grades (K-3). By the end of grade three, California students have been offered one-half year less schooling than students nationwide. The yearly discrepancies in later grades are somewhat smaller, but they consistently increase the cumulative shortfall.

The New California Standards for Instructional Time

This summary picture of instructional offerings truly calls for new efforts, as taken in the Hughes-Hart Educational Reform and Finance Act of 1983. This legislation specifies new state standards for instructional offerings in elementary and secondary schools which are to be met by the 1986-87 school year to qualify districts for supplementary funding (Table 5).

Table 5

Total Yearly Minutes of Instruction Required to Meet 1986-87 State Standards for Supplementary Funding

Grade range	Yearly minutes of instruction
K	36,000
1-3	50,400
4-8	54,000
9-12	64,800

In line with these new standards, CAP calculated on the basis of the Anton data (Table 1) by what amount the school day or the school year needs to be extended to qualify for supplementary state funding (Table 6). If districts would maintain a 176-day school year, school days for all grades, except for grades six, seven, and eight, need to be extended and the largest increase--of over one hour--would have to occur in high school. If school districts would move to or maintain a 180-day school year, only grades four to eight would not have to lengthen the instructional day to comply with the new state standards. If school districts would retain daily instructional offerings as assessed by Anton for 1980-81 (Table 1), then school years need to be substantially longer for all grades except grades four through eight. On the average, kindergarten would have to be offered for 198 days, the primary grades (one through three) would have school years of between 187 to 189 days, and high school offerings would have to be increased to between 213 and 215 days to comply with new state standards. Obviously, extensive resources are needed to meet the new legislated standards.

If these new standards were fully implemented, would California students then be offered the same amount of schooling as students nationwide? Basing comparisons on Anton's national estimates (Table 1), the answer is no. A California student is offered 72,000 fewer minutes of schooling from kindergarten

through twelfth grade than a typical student in the nation. The new California standards reduce this gap by 80 percent to 13,000 fewer minutes. Thus, instead of having the equivalent of one and one-third school years less schooling, students in California would be offered one-fourth less of a school year. Even with the huge increase in offerings that is supported by the new legislation, California students would still lag behind students nationwide.

Table 6

Increases in School Day and Year Required
to Meet 1986-87 State Standards for Supplementary Funding

	Required minutes per day				Required days per year if 1980-81 minutes per day* are maintained	
	176-day year		180-day year			
Grade	Daily required minutes	Increase beyond 1980-81 days*	Daily required minutes	Increase beyond 1980-81 days*	Required days	Increase beyond 176 days
K	205	23	200	18	198	22
1	287	19	280	12	189	13
2	287	19	280	12	189	13
3	287	17	280	10	187	11
4	309	6	300	0	178	2
5	309	5	300	0	178	2
6	309	1	300	0	176	0
7	309	1	300	0	176	0
8	309	0	300	0	175	0
9	368	66	360	58	215	39
10	368	63	360	55	213	37
11	368	63	360	55	213	37
12	368	63	360	55	213	37

*See Table 1 for 1980-81 minutes per day by grade.

Time and Learning in Elementary School

The sixth grade time allocations to subject areas--from the 1981-82 assessment of California sixth graders and a national study carried out in 1976-77 (Hinckley et al., 1978)--are displayed in Tables 7 and 8. Table 7 exhibits national data on minutes per day of instruction offered in reading and mathematics in grades one through six in 1976-77 (Hinckley et al., 1978). The data indicate that nationally the number of minutes per day of reading instruction decreases substantially and continuously from grade one (about one and three-fourth hours) to grade six (about one hour). The California data for grade six match those for the nation. In mathematics the national data are essentially constant (at about an hour per day) across the elementary grades.

Table 7

Mean Daily Minutes of Instruction in Reading and Mathematics, Nationally, by Grade, and California, for Grade Six

	Reading		Mathematics	
Grade	Nation (1976-77)*	California (1981-82)**	Nation (1976-77)*	California (1981-82)**
1	107	-	58	-
2	100	-	59	-
3	86	-	61	-
4	73	-	61	-
5	68	-	61	-
6	62	61	57	53

*Adapted from Hinckley et al., 1978

**California Assessment Program, Grade Six Survey, 1981-82

Table 8 shows that in grade six in California the basic skills areas--reading (61 minutes), writing/language (47 minutes), and mathematics (53 minutes)--have the largest time allocations, each approaching an hour on the average. These are followed by social studies (36 minutes), physical education (27 minutes), and science (25 minutes). Art, music, and health trail with about a quarter of an hour each. In total, the average instructional time per day is reported as about 5 hours, and noninstructional time (recess, lunch, and so on) is reported at about one hour, yielding a total school day of about 6 hours.

These time allocations are averages in two senses. First, they are the assessment of a school principal or other school official of the typical daily time spent on these subject areas. In a sense these are "average" values over different school days and over different school classes. Some of this variation is reflected in Table 9. About one-half of the schools report that there is little or no variation in subject area time allocations. This report differs, however, depending on school organization. About three-quarters of schools with completely departmentalized sixth grades report lack of variation.

Data collected from teachers in other studies (DeVault et al., 1977; Denham and Lieberman, 1980) indicate that the principals' estimates might understate the actual variation--especially the figure of 46 percent for schools with self-contained classrooms. These other studies, which include data from California and other states, indicate that basic skills time allocations may differ by three- or four-to-one across self-contained classes in the same school.

Instructional time allocations also vary for students from different socioeconomic backgrounds (Table 10). Using CAP's socioeconomic status (SES) index, we have assessed the sixth grade time allocation data for schools with very low, typical, and very high socioeconomic student backgrounds. We have compared subject area time allocations for reading, writing/language, mathematics, science, and social studies. Although the total amount of time allocated to these subject areas is the same for all schools, there are sizable differences among types of schools, by subject area. These differences are largest for reading.

Table 8

Mean Time Allocations, by Subject Area, in California, Grade Six, 1981-82

Subject area	Mean minutes per day
Reading	61
Writing/language	47
Mathematics	53
Science	25
Social studies	36
Art	16
Music	14
Health	16
Physical education	27
Other	7
Total	302*
Total instructional time	299*
Total noninstructional time	67
Total school time (sum)	366
School day length	365

*The "Total" does not equal the "Total instructional time" because of adjustments for outlying (obviously incorrect) values.

Table 9

Organization of Sixth Grade Classes in California and Reported Variation in Time Devoted to Subject Areas, 1981-82

Reported variation in time devoted to subject areas over classes	Percent of schools by organization of sixth grade classes				
	Self-contained classrooms	Modified self-contained classrooms	Partially depart-mentalized	Completely depart-mentalized	All schools
Only one class per grade	9	4	4	6	8
Little or none	46	58	65	76	52
Variation	45	38	31	18	40
Total	100	100	100	100	100
Percent of all schools	59	23	15	3	100

Schools serving communities of low socioeconomic levels (the lowest 10 percent) allocate the largest amount of time to reading (63 minutes per day). Students in these schools are offered 9 percent more reading instruction than students who are enrolled in schools in communities of high socioeconomic level (the highest 10 percent). Since the total time allocation to the above-named subject areas is the same for all schools, the extra reading time must effect a shorter time allocation in other subject areas. Mathematics time allocation is not cut. But an increase in time allocation to reading tends to decrease the time allocations to writing/language, science, and social studies, but not to mathematics.

Table 10

Time Allocations Across Subject Areas for California Schools Serving Communities of Different Socioeconomic Levels, Sixth Grade, 1981-82

SES percentile	Instructional time (minutes/day)					
	Reading	Writing/ language	Mathematics	Science	Social studies	Total
10	63.0	44.9	56.0	25.9	35.5	225.3
50	60.1	46.1	55.9	26.6	36.4	225.1
90	57.4	47.8	55.7	27.2	37.3	225.4
Differences (10 - 90) Minutes per day	+5.6	-2.9	+0.3	-1.3	-1.8	---
Percent	+9.3	-6.3	+0.5	-4.9	-5.0	

It should be noted, however, that these numbers refer to somewhat arbitrary indicators of efforts to structure the teaching day to achieve general curricular ends. As such, they may not be good indicators of the types of learning that take place; subject areas are heavily overlapping and interactive. For example, a reading lesson may very effectively communicate important scientific or historical concepts or principles. Similarly, the act of reading for a history project can improve reading skills. In fact, the case can be made that the increased effectiveness of modern reading programs is largely cancelled by ignoring this basic principle, i.e., by teaching reading as reading, history as history, etc. Research findings support the logic that the current emphasis on content areas--and reading and writing in the content areas--is the best way to improve achievement in all school subjects.

At the sixth grade level, the assignment of homework varies considerably, by subject area (Table 11). Ninety-five percent of sixth graders report regular homework in mathematics, but only 61 percent do so for writing. And only 66 percent of these students report having had homework in any subject the previous day.

Not reported in Table 11 is the relationship between the students' social backgrounds and the assignment of homework. The highest rates of homework assignment for reading, writing, and mathematics are for students whose parents are employed in unskilled occupations. On the other hand, these same students have the lowest rates of homework assignments--in comparison to other occupational groups--for science and social studies. These findings are strongly consistent with the earlier finding of greater emphasis on reading and less emphasis on science and social studies in schools serving low socio-economic status communities.

Table 11

Sixth Grade Students' Reports of Amounts of Homework Assigned, by Percents, by Subject Area (CAP 1981-82)

Subject area	Percent reporting
Usually have homework	
Reading	82
Writing	61
Mathematics	95
Science	63
Social studies	80
Yesterday did homework	
Any subject	66

SOURCE: CAP data, 1981-82

Aside from direct policy issues about the amounts of time to be spent on homework and the subject-area priorities for this time, central questions arise about who sets these policies. CAP's sixth grade school questionnaire touched on this issue (Table 12). The most surprising finding is that these policies are either set at the district level or left to the individual teacher. The school principal--who has emerged in recent research on school effectiveness as the key instructional leader--seemingly plays almost no role in homework policy in California.

This brief look at the important topic of homework merely serves to show the complexity of the issue. The appropriate amount of homework must vary according to the students' needs, school priorities, and the subject being studied. Finally, the roles of parents, teachers, principals, district personnel, and school board members in developing and implementing homework policy and priorities need to be clarified.

Table 12

Origin of Homework Policies,
California Elementary Schools, 1981-82

Origin of policy	Percent of schools
Teacher, not school	42.8
School, not district	1.2
District	56.0
Total	100.0

Time and Learning in High School

In this section we explore and compare time and learning in California high schools, our touchstones for comparison being the nation as a whole and the State of New York. The latter was chosen because of similarities in size and because New York's educational system--with its regents' examinations and diploma and its long-standing statewide graduation requirements--served as a major comparison point in the debates which led up to the California reform legislation. The section is divided into four parts:

First, the achievement test scores of California students are compared with those of other students. Separate comparisons are made on the basis of (1) all students; (2) the college bound; and (3) those who took only advanced achievement tests for college entry.

Second, these groups are compared on the basis of the number of high school courses the students in the groups completed in the basic academic subjects.

Third, the results of a special 1982-83 CAP survey of California seniors are reported. This survey focussed on the specific mathematics and science courses the students have taken, the number of semesters of study for each, and the grade the students were in at the time of study.

Fourth, some relationships between CAP grade twelve mathematics test scores and the number of mathematics courses taken are analyzed and discussed.

National Achievement Comparisons and Trends

In this section the aptitude and achievement of California's high school seniors are compared with those of students nationwide. The bases for the comparisons are provided by the High School and Beyond study and scores on the Scholastic Aptitude Test and the College Entrance Examination Board's achievement tests.

High School and Beyond Test Information

The High School and Beyond study allows for comparison of reading and mathematics achievement of California twelfth graders and that of twelfth graders nationwide (Table 13). California twelfth graders compare favorably to twelfth graders in general. Given the lower amount of schooling that California students are offered, the data in Table 13 might imply higher productivity of California schools. Focussing on the New York contrast, however, we find fairly large differences. In reading and mathematics New York seniors outperform Californians by about 20 percent of the standard deviation.

Scholastic Aptitude Test Results

Although California high school seniors in general compare favorably in their reading and mathematics achievement test scores to high school seniors nationwide, concern has been voiced over the recent SAT scores, because the California college-bound seniors did not match the new, slightly upward trend of SAT scores for twelfth graders nationwide (Table 14). Some clarification on this issue is needed. The Scholastic Aptitude Test is taken by about one-third of high school seniors nationwide. Also, about one-third of high school seniors take the SAT in California. The mathematics scores of California college-bound seniors on the 1983 SAT indicated higher mathematics aptitudes than those of college-bound seniors nationwide. However, the verbal aptitudes of California college-bound seniors were lower than the verbal aptitudes of college-bound seniors across the nation.

A comparison of California college-bound seniors' verbal scores to those of college-bound seniors nationwide over the past ten years, however, reveals a much larger test score drop for California test takers. In California, verbal SAT scores dropped by 30 points; nationwide, verbal scores dropped 20 points. Ten years ago, California SAT test takers had much higher verbal SAT scores than SAT takers nationally.* Mathematics SAT scores have dropped less dramatically over the past decade than those of college-bound seniors nationwide.

Table 13

Mean Reading and Mathematics Scores of High School Seniors, California and the Nation, 1979-80

Test area	Mean score,* by location			Difference	
	California	New York	Nation	CA vs Nation	CA vs NY
Vocabulary					
Part I	51.4	52.3	50.0	1.4	-0.9
Part II	50.3	51.7	50.0	0.3	-1.4
Reading	50.1	52.1	50.0	0.1	-2.0
Mathematics					
Part I	50.6	52.6	50.0	0.6	-2.0
Part II	50.3	52.1	50.0	0.3	-1.8

SOURCE: Special analysis of the High School and Beyond base year data by CAP and the New York State Education Department

*These are standardized scores. The values have been transformed so that the weighted national mean is 50 and the standard deviation is 10. The vocabulary tests are five-option, multiple-choice questions requiring selection of a synonym. The reading test consists of five passages, each followed by four multiple-choice questions. The mathematics tests cover basic mathematics (Part I) and more advanced high school content (Part II), primarily algebra.

*If the comparison is extended to 1972, the first year that state-level information became available, the decreases for California and the nation were 42 and 27 points, respectively.

Table 14

Average SAT Scores of College-Bound Seniors, California and the Nation, 1973-1983

Category	SAT scores										
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Verbal											
California	452	450	435	430	427	427	428	424	426	425	421
Nation	445	444	434	431	429	429	427	424	424	426	425
Difference	7	6	1	-1	-2	2	1	0	2	-1	-4
Mathematics											
California	485	484	473	470	470	466	473	472	475	474	474
Nation	481	480	472	472	470	468	467	466	466	467	468
Difference	4	4	1	-2	0	-2	6	6	9	7	6

SOURCE: College Entrance Examination Board's reports on college-bound seniors

Despite decreases in aptitude scores, the California verbal score (425) in 1982 was nearly the same as that of New York (429). There was a greater difference in the mathematics scores for California and New York--474 and 492, respectively. The difference is magnified by the fact that a considerably smaller proportion of California students take the SAT (see Table 15). In California, 25.4 percent of high school age students took the test; in New York, 44.3 percent did. In other words, the California students form a statistically more select group and should, therefore, be expected to be approximately the top 25 percent among California's high school students. They were outscored by approximately the top 45 percent of New York students.

College Entrance Examination Board's Achievement Test Results

Beyond the verbal and mathematics aptitude tests, many college-bound high school seniors also take achievement tests in various subject matter areas. The achievement test scores show a more revealing picture of school learning, because they are linked more directly to specific course content. A comparison of achievement test scores of California college-bound high school seniors to college-bound high school seniors elsewhere cannot merely focus on their achievement test scores, because relatively more students in California take one or more of these achievement tests than do similar groups of students nationwide. One reason for this is that one entrance requirement of the University of California is that students take three achievement tests: English composition, mathematics, and a foreign language or social sciences area test. Thus, in contrast to the verbal and mathematics aptitude tests for which the California and national proportions are quite similar, the subject-matter-specific achievement tests are taken by larger proportions of California students than by students nationwide.

Achievement tests are given in English composition and literature, mathematics (I and II), biology, chemistry, physics, American history, foreign languages, and several other areas. Most California students take the tests

in English composition, mathematics, and American history; the history test fulfills the social science requirement in California. In this section, however, we will restrict our focus to test scores in mathematics and science. We will also contrast the performance of California seniors with those in New York State as well as those in the nation as a whole.

As we noted above, students in different parts of the country take the College Entrance Examination Board's tests with different frequencies. Although about a quarter of all students aged fourteen to seventeen take the basic SAT tests in California and in the nation as a whole, almost 45 percent take them in New York (Table 15). When we examine the implications of this for the proportion taking the College Entrance Examination Board's achievement tests, we see further differentials. For example, in 1982, about 2 percent of California SAT takers took the biology achievement test, and about 9 percent of New York SAT takers did so. As a percent of an age group, however, the rates were 0.5 percent and 4 percent, respectively, an eight-fold difference.

If we examine these rates in Table 15, three striking facts emerge:

- The rates of mathematics achievement test taking (in terms of age groups) are similar for both states and the nation as a whole.
- Science achievement test taking in New York is much more common than in either California or the nation as a whole. This is undoubtedly due to much larger proportions of an age group reaching advanced courses. We will discuss this issue further below.
- There was a doubling of science achievement test taking in California between 1982 and 1983. This brought test taking levels in California to the national level, but they still remain at about one-third of New York's 1982 levels.

To evaluate these data, we must also consider Table 16. In general, within a single educational system, if a larger proportion of an age group were to take an achievement test, we would expect that the larger group would have lower average aptitude than the smaller, i.e., be less highly selected. This is because we generally expect the most able students to take advanced tests. An example of this phenomenon occurred between 1982 and 1983 for California physics test takers. The percentage of the age group taking the test doubled from 0.2 to 0.4, and the average mathematics aptitude score of the test takers fell from 663 to 651. A similar result occurred for New York in 1982 versus California: With 0.8 percent of the age group taking the test, the mean mathematics score in New York was only 636, lower than either year for the California test takers.

This pattern, however, is not repeated for the other tests. In chemistry, biology, and mathematics I, the mathematics aptitude levels of New York seniors taking these achievement tests are either about equal or absolutely greater than those with substantially lower rates of test taking. Clearly, New York is doing a better job of mathematical preparation for those in the top 1 to 7 percent of an age group than either California or the rest of the nation.

Table 15

Percent of Students Taking the College Entrance Examination Board's Aptitude and Selected Achievement Tests, California, New York, and the Nation, 1982 and 1983

Category	California		New York	Nation	
	1982	1983	1982	1982	1983
Percent of students taking SAT*	25.4	26.3	44.3	24.3	24.7
Percent of SAT takers taking achievement test					
Mathematics I	26.0	26.1	15.7	14.7	14.8
Mathematics II	6.3	7.1	2.4	3.8	4.1
Biology	2.0	4.6	8.8	4.1	4.4
Chemistry	1.4	2.9	5.7	3.5	3.7
Physics	0.7	1.4	1.9	1.6	1.7
Percent of students taking achievement test					
Mathematics I	6.6	6.9	7.0	3.6	3.7
Mathematics II	1.6	1.9	1.1	0.9	1.0
Biology	0.5	1.2	3.9	1.0	1.1
Chemistry	0.4	0.8	2.5	0.9	0.9
Physics	0.2	0.4	0.8	0.4	0.4

*These are the total numbers of SAT takers as a percent of the average single-year age group in the state or nation for individuals fourteen to seventeen years of age in 1980--for 1982 figures--and in 1981--for 1983 figures.

If we now turn to the science achievement test performances themselves, we must be careful to state what we are evaluating. Differential performance can come about because of differences in preparation--arrived at because of either better earlier training generally or by more stringent selection of those few who have better preparation. Or it may come about by differences in the quality and quantity of the science education itself. Since our evaluation of performance differences and their implications will strongly depend on whether they are a consequence of prerequisite skills at course entry or caused by the quality of the subject-specific course instruction itself, we must relate the achievement levels to the aptitude levels of the test takers.

Because the basic scale of the achievement scores is similar to that of the aptitude scores (ranging from 200 to 800), the rough adjustment of subtracting the aptitude level from the achievement level is employed. This is not a precise adjustment, but it is sufficiently accurate to allow the assessment of gross differences in performance.

Table 16

Mean Achievement and Aptitude Test Scores of College-Bound Students in California, New York, and the Nation Who Took Selected College Entrance Examination Board Achievement Tests, 1982 and 1983

Achievement test	Achievement test scores			Aptitude test scores: Mathematics			Aptitude test scores: Verbal		
	CA	NY	Nation	CA	NY	Nation	CA	NY	Nation
1982									
Mathematics I	522	575	545	532	580	552	479	525	501
Mathematics II	655	670	661	638	658	646	533	569	553
Biology	541	587	548	565	576	564	524	540	527
Chemistry	590	604	575	649	617	619	550	545	539
Physics	614	612	592	663	636	642	537	544	537
1983									
Mathematics I	521	Not	543	535	Not	556	475	Not	500
Mathematics II	646	avail-	655	637	avail-	649	520	avail-	550
		able			able			able	
Biology	518		544	561		570	495		523
Chemistry	562		569	633		624	510		536
Physics	590		595	651		647	505		536

SOURCE: The College Entrance Examination Board's reports on college-bound seniors

Table 17 exhibits these differences and contrasts them. A higher assigned value of the difference indicates that the performance, adjusted for aptitude level, is "better" than the performance corresponding to a lower value. Thus, for California in 1982 the mean biology achievement level was 24 points below the mean mathematical aptitude level of the test takers (565 - 541). For the nation the achievement level was only 16 points below the aptitude level. Thus, the contrast column indicates a superiority of 8 points in adjusted performance for the nation vs. California.

Examining the adjusted contrasts, we find:

- Small differences in adjusted mathematics performance between California, New York, and the nation
- Large differences in science performance, favoring New York, especially, and the nation over California

Our main conclusion must be that New York is doing a superior job of science education* in three regards:

- Mathematical preparation
- High proportions of students taking advanced courses
- Superior achievement in the courses themselves

Table 17

Differences Between the College Entrance Examination Board's Mathematics and Science Mean Achievement Scores and Mathematics and Verbal Aptitude Scores, California, New York, and the Nation, 1982 and 1983

	Achievement scores minus aptitude scores							
	1982					1983		
Achievement test	CA	NY	Nation	CA minus NY	CA minus nation	CA	Nation	CA minus nation
	Achievement minus mathematical aptitude							
Mathematics I	-10	-5	-7	-5	-3	-14	-13	-1
Mathematics II	+17	+12	+15	+5	+2	+9	+6	+3
Biology	-24	+11	-16	-35	-8	-43	-26	-17
Chemistry	-59	-13	-44	-46	-15	-71	-55	-16
Physics	-49	-24	-50	-25	+1	-61	-52	-9
	Achievement minus verbal aptitude							
Mathematics I	+43	+50	+44	-7	-1	+46	+43	+3
Mathematics II	+122	+101	+108	+21	+14	+126	+105	+21
Biology	+17	+47	+21	-30	-4	+23	+21	+2
Chemistry	+40	+59	+36	-19	+4	+52	+33	+19
Physics	+77	+68	+55	+9	+22	+85	+59	+26

High School Coursetaking

The data and discussion of the coursetaking characteristics of high school seniors are presented in two parts: (1) for all high school seniors; and (2) for college-bound seniors.

*We note that in areas in which we expect a verbal aptitude component--biology and, perhaps, chemistry--that New York's performance superiority is still large if we adjust for verbal rather than mathematical aptitude.

All High School Seniors

Table 18 exhibits average coursework of California twelfth graders from the ninth through twelfth grade in several subject areas. Students take more English than any other type of coursework. The average number of years of English taken is 3.8. This is followed by social studies (3.1 years), physical education (3.1 years), mathematics (2.8 years), science (2.1 years), and foreign language (1.5 years). Twenty-nine percent of California seniors report no foreign language coursework in high school.*

Table 18

Percent of California High School Seniors Reporting Various Amounts of Coursework, by Subject Area, 1981-82

Subject area	Mean years	Percent of students, by number of years of coursework					
		0	1	2	3	4+	Total
English	3.8	0	1	3	22	74	100
Mathematics	2.8	0	9	30	32	29	100
Science	2.1	1	33	36	20	10	100
Social studies	3.1	1	6	15	41	37	100
Foreign language	1.5	29	21	31	13	6	100
Physical education	3.1	1	2	24	33	40	100

SOURCE: CAP data, 1981-82

On the other hand, 74 percent report taking four or more years of English. The percent of students reporting similarly high levels of courses taken in other subject areas is substantially lower--physical education (40 percent), social studies (37 percent), mathematics (29 percent), science (10 percent), and foreign language (6 percent).

*The response format for data reported in this section (1979-80 and 1980-81), both in CAP and High School and Beyond, may result in biases toward overestimation because of the reporting method (students reported the number of years of a subject, rather than which course was taken each semester of high school). This overestimation bias is obvious for the data reported in Table 18. For example, 74 percent of the 1982 seniors in California claimed four years of English courses, whereas an analysis of the transcripts done as a part of the High School and Beyond follow-up study for a sample of those seniors showed that 48 percent completed four years of English (see Table 31). However, because of similarity in reporting format for California and national data prior to 1983--including the College Entrance Examination Board's data on college-bound seniors--CAP places great confidence in the reported comparisons of California with New York and the nation.

In additional tabulations, we found that only 1 percent of California seniors take four or more years each of English, mathematics, science, and foreign language. Even when the criterion is dropped to three years of science and foreign language but four years of English and mathematics, only 5.5 percent of California high school seniors report taking that amount of higher level academic coursework.

Comparing the California data on courses taken to national data is difficult for two reasons. Purely statistical national data on courses taken are based on institutional reports that yield enrollment rates for particular courses but do not link aggregate course registrations to the individuals who produce them (Ostendorf, 1975). Also, since these surveys cover single years, it is impossible to estimate cumulative years of courses taken in terms of the percentage of individuals with zero, one, two, and so on, courses or years of coursework. Survey data on high school students, such as those from the National Longitudinal Study of High School Class of 1972 and High School and Beyond, are potentially comparable data, but in both cases, the data were collected for three rather than four years of high school.

One approximate comparison, however, is presented in Table 19. Essentially all California high school students take at least one year of mathematics. By assuming that students take their first (or only) mathematics course in ninth

Table 19

Percent of Twelfth Graders Reporting Specified years of Mathematics Coursework Taken in the Last Three Years of High School, 1979-80 and 1981-82

	1979-80*		1981-82**
Years of mathematics	Nation	California	California
0	7.8	9.7	8.6
1	27.3	32.1	30.1
2	33.5	32.6	32.1
3 or more	31.4	25.6	29.2
Total	100.0	100.0	100.0
Median years	1.44	1.25	1.35

*These data are derived from the High School and Beyond survey conducted by the National Center for Education Statistics in 1980.

**These figures have been adjusted to reflect the fact that the High School and Beyond survey inquired only about the final three years of high school and that essentially all California students take at least one mathematics course. Thus, the values have been reduced by one year.

grade,* CAP derived twelfth grade data that are in line with those of High School and Beyond. It can be seen from Table 19 that California levels of mathematics coursework are similar to, but slightly less than, those across the nation.

One direct comparison of specific coursetaking is available from High School and Beyond. This involves the specific courses in college preparatory mathematics and science, which are precursors of the College Entrance Examination Board's achievement tests. Table 20 exhibits the percentage of seniors who have enrolled in these courses in California, New York, and the nation. The table indicates great similarity between California and the nation for mathematics but a small systematic deficit for California in science. Comparisons with New York, however, confirm the previous conclusion based on achievement test data: New York seniors are substantially better prepared in mathematics; fully twice as many students, proportionately, take trigonometry (53 percent) and calculus (16 percent). Science is similar: Twice as many students enroll in physics, and 40 percent more enroll in chemistry. This is truly a striking confirmation of the achievement differences.

Table 20

Percent of 1980 Seniors Reporting
Enrollment in Advanced Science and Mathematics Courses

Course	California	New York	Nation
Algebra I	81	86	79
Algebra II	50	59	49
Geometry	59	68	56
Trigonometry	25	53	26
Calculus	8	16	8
Physics	17	36	19
Chemistry	33	55	37

SOURCE: These data were prepared by Penny A. Sebring, School of Education, Northwestern University, 1983, from High School and Beyond data.

College-Bound Seniors

Of special interest is the coursework of college-bound students, who compose about one-fourth of the relevant age population in California as well as in the United States as a whole. A comparison of coursework of California college-bound seniors to that of college-bound seniors nationwide is shown in Table 21. California college freshmen of 1983 tended to have less coursework

*According to the 1982-83 data, only three-quarters of the seniors took mathematics in the ninth grade; thus, if this were true in 1979-80 and 1981-82, these data would indicate closer parity of California and national data.

than college freshmen nationwide for all core subject areas. On the whole, the latest year's comparison of coursework in English, mathematics, and foreign language looks more favorable in California than it has in previous years. In physical science, however, only 43 percent of California's college-bound seniors report taking two or more years of physical science as compared to 61 percent of college-bound seniors nationwide.

Table 21

Coursework Levels of College-Bound Seniors in California and the Nation, 1973-83

Years of study	Percent of seniors with course level, by year										
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
English 4 or more years											
California	72	69	68	67	69	73	78	81	88	90	91
Nation	90	90	89	88	89	90	91	91	92	93	93
Difference	-18	-21	-21	-21	-21	-17	-13	-10	- 4	- 3	- 2
Mathematics 4 or more years											
California	35	35	34	36	37	38	42	45	47	51	55
Nation	49	48	49	51	50	53	55	57	59	61	64
Difference	-14	-13	-15	-15	-13	-15	-13	-12	-12	-10	- 9
Foreign language 3 or more years											
California	40	37	34	33	32	32	33	34	37	38	38
Nation	44	43	41	39	37	38	37	37	37	39	39
Difference	- 4	- 6	- 7	- 6	- 5	- 6	- 4	- 4	- 4	- 1	- 1
Physical science 2 or more years											
California	31	36	39	40	37	37	39	40	40	41	43
Nation	47	48	49	50	54	57	58	58	58	60	61
Difference	-16	-12	-10	-10	-10	-20	-19	-18	-18	-19	-18

SOURCE: The College Entrance Examination Board's reports on college-bound seniors

Since coursework in mathematics and science is almost always prerequisite to achievement in these areas, the lighter course loads of students in California are significant. California college-bound seniors take significantly less coursework in mathematics and science (chemistry, physics, biology) than do college-bound seniors in the United States as a whole (Table 22). We note also that New York generally exceeds the national average, but here we must keep in mind that these data for New York represent 45 percent of an age group as compared to only about 25 percent for California and the nation. This means that--relative to the total numbers of students--almost twice as many New York as California seniors complete these levels of coursework.

Table 22

Mean Years of Coursework in Academic Subjects for College-Bound Seniors, California, New York, and the Nation, 1982 and 1983

Subject area	California		New York	Nation	
	1982	1983	1982	1982	1983
English	4.0	4.0	4.0	4.0	4.0
Mathematics	3.4	3.5	3.5	3.6	3.6
Science	2.7	2.7	3.3	3.2	3.3
Social studies	3.2	3.2	3.6	3.2	3.2
Foreign language	2.3	2.3	2.5	2.2	2.2

SOURCE: The College Entrance Examination Board's reports on college-bound seniors

Coursetaking in Mathematics and Science

Table 23* presents the percent of students in grades nine through twelve enrolled in mathematics courses over the past three school years. The trend is encouraging. Enrollment in general and remedial mathematics courses declined by 8 percent between 1980-81 and 1982-83, and college-preparatory mathematics course enrollments increased during the same period by 11 percent (Table 23). The enrollment increase in college-preparatory courses occurred only last year and mainly in algebra.

Enrollments in science courses also show a significant increase in the 1982-83 school year as compared to the two prior years (Table 23). Especially, general science courses have benefited from the recent focus on science: Course enrollment increased by 11 percent over a two-year period. College-preparatory science courses have experienced enrollment increases of 3 percent during the same period. Note that these increases occurred in chemistry and physics only.

*Each October for the last three years, each California teacher has completed a Professional Assignment Information Form as part of the statewide information collection system known as the California Basic Educational Data System (CBEDS). On this form the teachers indicated the number of students in each course they teach.

Table 23

Mathematics and Science Enrollment as Percents of Total Enrollment in California Schools, by Type of Course, 1980-81 through 1982-83

Course topic	1980-81	1981-82	1982-83	1980-81 through 1982-83 Difference	1980-81 through 1982-83 Percent change
Mathematics					
General/remedial	32.0	28.8	29.4	-2.6	- 8
College-preparatory	38.4	28.7	43.1	+4.7	+11
Beginning algebra	18.8	18.8	20.9		
Plane geometry	9.0	9.1	9.8		
Intermediate algebra	4.1	4.2	5.1		
Precalculus advanced topics	5.9	5.8	6.3		
Calculus	0.6	0.8	1.0		
Other courses	8.3	9.9	10.0	+1.3	+20
Total	78.7	77.4	82.5	+3.8	+ 5
Science					
General	17.0	17.2	18.8	+1.8	+11
College-preparatory	22.7	22.4	23.3	+0.6	+ 3
Biology	16.0	15.5	15.9		
Chemistry	4.7	4.8	5.2		
Physics	2.0	2.2	2.3		
Advanced courses	1.4	1.3	1.3		
Other courses	6.6	6.8	7.7	+1.1	+17
Total	46.3	46.4	49.8	+3.5	+ 8

SOURCE: California Basic Educational Data System (CBEDS)

Timing of Coursetaking

CAP's 1982-83 survey of mathematics and science coursetaking produced information about the completion of specific courses in each semester from grades eight through twelve.* Courses are categorized in both areas into two groups: college-preparatory and any other, or general. At different points in this report, we display summary figures for these subdivisions and for total coursetaking in each area. For science, college-preparatory courses consist of biology, chemistry, and physics. For mathematics, they are algebra (all levels), geometry, trigonometry, and advanced topics.

The timing of coursetaking is exhibited in Tables 24, 25, and 26. First, we see that the majority of 1982-83 seniors took science only in grade ten, and even at this grade only 59 percent were enrolled in science during the second semester. General science is primarily taken in grades eight and nine, and college-preparatory courses are rare in those grades. These science courses are

*These data were collected by asking each twelfth grader to respond about taking specific courses in each semester of grades eight through twelve. We believe that this results in more accurate data than merely recording summary years and coursework.

mostly taken in grades ten through twelve, with biology, chemistry, and physics taken primarily in grades ten, eleven, and twelve, respectively (Table 25). As can be seen below, the major falloff over grades is due to smaller proportions of students enrolling in the more mathematically stringent courses. However, the extremely small enrollment rates for grade twelve, especially in the second semester, indicate major reduction in academic coursetaking for these seniors in grade twelve. Because this reduction is paralleled for mathematics (Tables 24 and 26), it reveals a serious point of concern. Finally, for science, we note that only 4 percent of these seniors did not take any science in grades nine through twelve and that almost 70 percent took at least one semester of college-preparatory science.

The picture for mathematics is more diverse. Algebra is started by some students before ninth grade and is still taken by significant numbers of students in eleventh grade (Table 26). Plane geometry is taken mostly in grades ten and eleven. Intermediate algebra has its highest enrollment rates in grades ten and eleven, and trigonometry and advanced topics are primarily taken in grades eleven and twelve. General mathematics courses are common for students in each of grades eight, nine, ten, and eleven. Again, there is a severe dropoff in mathematics coursetaking in the senior year and especially in the final semester. During the last four years of high school, only 3 percent of students did not take any mathematics, and over 80 percent took at least one semester of college-preparatory work.

Table 24

Percent of Students Taking Mathematics and Science Courses in Grades 8-12, by Grade and Semester

		No coursework		Some coursework			
				Any coursework		College-preparatory	
Grade	Semester	Mathematics	Science	Mathematics	Science	Mathematics	Science
8	First	46	51	54	49	13	4
	Second	36	46	64	54	17	3
9	First	34	56	66	44	47	8
	Second	21	55	79	45	55	8
10	First	36	44	64	56	52	36
	Second	30	41	70	59	57	40
11	First	50	57	50	43	43	30
	Second	47	53	53	47	46	33
12	First	73	75	27	25	23	16
	Second	87	88	13	12	12	8
Total							
Grades 8-12		2	3	98	97	82	70
Grades 9-12		3	4	97	96	81	69

SOURCE: CAP data, 1982-83

Table 25

Percent of Students Taking Science Courses, by Grade and Semester and Total Years of Science, Grades 8-12

Grade	Semester	General/other					College-preparatory				Total
		Life	Physical	Earth	Other	Total	Biology	Chemistry	Physics	Total	
8	First	30	9	4	2	45	2	1	1	4	49
	Second	30	13	5	2	50	2	1	1	4	54
9	First	16	12	5	3	36	6	1	1	8	44
	Second	14	14	5	3	37	6	1	1	8	45
10	First	9	5	3	3	20	32	3	1	36	56
	Second	8	5	3	3	19	36	3	1	40	59
11	First	4	3	2	4	13	14	14	2	30	43
	Second	4	3	2	5	14	15	15	3	33	47
12	First	2	2	1	4	9	4	6	6	16	25
	Second	1	1	–	2	4	2	3	3	8	12

SOURCE: CAP data, 1982-83

Table 26

Percent of Students Taking Mathematics Courses, by Grade and Semester and Total Years of Mathematics, Grades 8-12

Grade	Semester	General	College-preparatory						Total
			Beginning algebra	Plane geometry	Inter. algebra	Trigonometry	Advanced topics	Total	
8	First	41	12	–	1	–	–	13	54
	Second	47	15	1	1	–	–	17	64
9	First	21	37	6	4	–	–	47	68
	Second	24	43	7	5	–	–	55	79
10	First	12	18	22	10	1	1	52	64
	Second	13	18	25	11	2	1	57	70
11	First	7	6	12	16	6	3	43	50
	Second	7	6	13	16	7	4	46	53
12	First	4	2	4	5	6	6	23	27
	Second	1	1	2	3	2	4	12	13

SOURCE: CAP data, 1982-83

College-Preparatory Versus General

In Tables 27 and 28, we display the pattern of coursetaking--college-preparatory vs. general mathematics and science for 1982-83 seniors. In science only 4 percent take no courses at all. Twenty-seven percent--the total for row 1 (31 percent) minus the percentage of those taking no courses (4 percent)--take only general science; 29 percent--the total for column 1 (33 percent) minus the percentage of those taking no courses (4 percent)--take only college-preparatory courses. Forty percent take both types of courses--all students (100 percent) minus the percentage of those who take only general science (27 percent) minus those who take only college-preparatory courses (29 percent) minus those who take no courses (4 percent). In total, only 18 percent of students accumulate two or more years of college-preparatory science. Only 40 percent meet the new 1986-87 requirement of two full years of any kind of science.

Table 27

Percent of Seniors Taking Varying Numbers of Semesters of College-Preparatory Versus Other Science, Grades 9-12

Semesters of college-preparatory coursework		Semesters of other science coursework: 0	1	2	3	4+	Total percent college-preparatory
				2-3 semesters (45%)			
0	Less than 2 semesters----->	4	6	14	3	4	31
1	(15%)	5	5	3	1	1	15
2		14	4	9	1	2	30
3		2	1	2	0	1	6
4+		8	1	6	1	2	18
						4 or more <---semesters (40%)	
Total percent other		33	17	34	6	10	100

Mathematics presents a more differentiated picture (Table 28). Three percent of all seniors graduate with no mathematics courses in grades nine through twelve. Fifty-seven percent take only college-preparatory courses, and 16 percent take only general mathematics. This leaves only 24 percent with general and college-preparatory coursework, a clearer tracking than for science. Fully 46 percent of seniors take two or more years of college-preparatory mathematics, and 61 percent meet the new two-year requirements of total mathematics coursetaking, which includes general and college-preparatory coursework (30 percent plus 31 percent).

Achievement and Coursetaking in Mathematics

If we recall that the CAP mathematics test covers content which is taught primarily in pre-high school mathematics courses, then we expect smaller relations between mathematics coursetaking and achievement than would be obtained with a test focussed directly on the content of high school-level courses. To alleviate this problem, we have selected three items from the instruments which focus specifically on high school-level college-preparatory content.

Table 28

Percent of Seniors Taking Varying Numbers of Semesters of College-Preparatory Versus General Mathematics, Grades 9-12

Semesters of college-preparatory coursework	Semesters of general mathematics coursework: 0	1	2	3	4	Total percent college-preparatory
0	3	4	5	2	5	19
1	3	3	2	1	1	10
2	8	3	4	1	1	17
3	6	1	1	–	–	8
4	12	1	3	–	–	16
5	4	–	1	–	–	5
6	13	–	1	–	–	14
7	5	–	–	–	–	5
8*	6	–	–	–	–	6
Total percent general	60	12	17	4	7	100

2-3 semesters (49%)

Less than 2 semesters (10%)

4 to 5 semesters (31%)

6 or more semesters (30%)

46

Item A is an algebra problem requiring the symbolic addition of reciprocal fractions. This content would ordinarily be covered in the second or third semester of algebra, depending on the text used.

A. $\frac{1}{x} + \frac{1}{y} =$

☐	$\frac{2}{x + y}$	☐	$\frac{1}{xy}$
☐	$\frac{2}{xy}$	☒	$\frac{x + y}{xy}$

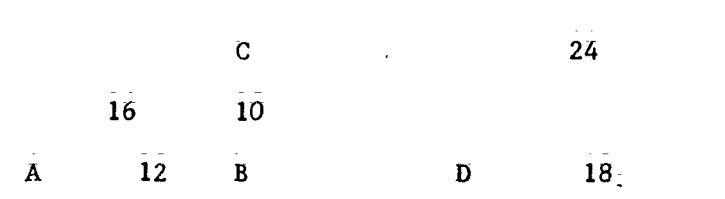
Item B is an algebra substitution item involving two quantities. This item content should be covered in the first year of algebra.

B. The number of feet that an object will fall in t seconds (neglecting air resistance) is given by the formula $s = 1/2\ gt^2$, where s = the number of feet, and g = 32 (the acceleration due to gravity). Assuming there is no air resistance, how far will a parachutist drop in a free fall of 10 seconds?

☒	1,600 feet	☐	3,400 feet
☐	2,440 feet	☐	None of these
☐	3,200 feet		

Finally, Item C is a geometry item comparing two similar triangles and requiring the calculation of the length of one side.

C.



In the figure above, ___ ABC is similar to ___ DEF. How many units are there in the length of side EF?

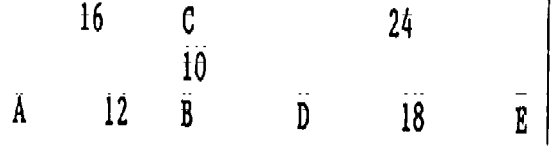
☐	12	☒	15	☐	16	☐	20	☐	None of these

This item should be covered in the first semester of a geometry course.

The content of each of these items should be mastered by the third semester (A), first year (B), and second year (C) of college-preparatory mathematics, respectively. As shown on Table 29, of individuals with three full years of college-preparatory work, only 43 percent solved Item A. Of those with one year, only 36 percent solved Item B, and of those with two years, only 31 percent solved Item C. We also see that after four full years of college-preparatory mathematics, only 67 percent of seniors can solve the problem requiring symbolic addition of reciprocals, only 88 percent can solve the simple first-year algebra substitution item, and only 65 percent can solve the geometry problem.

Table 29

Mathematics Achievement of Students with Varying Amounts of Mathematics Coursework

Achievement indicator	Number of semesters of college-preparatory courses									Total	Percent increase/ semester
	0	1	2	3	4	5	6	7	8		
Item											
A. $\frac{1}{x} + \frac{1}{y} =$	2.5	2.8	5.6	18.0	18.7	31.1	43.1	64.2	67.1	21.9	8.1
[ ] $\frac{2}{x + y}$ [ ] $\frac{1}{xy}$											
[ ] $\frac{2}{xy}$ [X] $\frac{x + y}{xy}$											
B. The number of feet that an object will fall in t seconds (neglecting air resistance) is given by the formula $s = 1/2\ gt^2$, where s = the number of feet, and g = 32 (the acceleration due to gravity). Assuming there is no air resistance, how far will a parachutist drop in a free fall of 10 seconds?	19.0	25.2	35.8	51.2	55.6	66.7	69.2	88.7	88.2	50.2	8.7
[X] 1,600 feet [ ] 3,400 feet [ ] 2,440 feet [ ] None of these [ ] 3,200 feet											
C.  In the figure above, ___ ABC is similar to ___ DEF. How many units are there in the length of side EF?	11.5	13.4	17.8	27.5	30.8	36.1	51.7	62.5	64.8	30.4	6.7
[ ] 12 [X] 15 [ ] 16 [ ] 20 [ ] None of these											
Total mathematics mean	50.3	57.9	63.3	69.5	71.9	75.2	80.0	84.1	84.7	67.7	4.3

The bottom line of Table 29 exhibits the mean performance on all of the CAP mathematics items for students with various amounts of college-preparatory mathematics. As can be seen, there is a steady increase in performance with increased coursetaking. This is partly due to coverage of more advanced topics which simultaneously reinforces earlier content, but it is also due to the fact that students who advance to the higher levels of mathematics coursetaking have already had greater mastery of the more elementary content.

Graduation Requirements

The new California course requirements for high school graduation, to take effect in the 1986-87 school year, reflect a new consensus on the quality of California education. The data thus far presented in this report surely undergird that consensus. As California has dropped from a position of leadership to below average, the national average has also fallen. Thus, the new educational reform in California immediately preceded a series of reports that recommend important changes in the national educational system:

A Nation at Risk (National Commission on Excellence in Education, 1983)
High School: A Report on Secondary Education in America (Boyer, 1983)
Educating Americans for the 21st Century (National Science Board, 1983)

Additionally, the California State Board of Education has recommended that school districts adopt a set of requirements more stringent than the legislated ones. Also, the Board of Regents in New York--which has more direct control over districts than the California board--has proposed revisions to graduation standards, both for the ordinary and the regents' diploma.

Although other states and other reports (e.g., Adler, 1982) have addressed these issues, in this section we will concentrate on two goals: (1) to compare the California efforts to other efforts; and (2) to assess how current California seniors measure up to the standards in the reform legislation and the State Board of Education's model.

In Table 30 we display some of the new graduation course requirements. All specify the last four years of high school as the time span for meeting the standards. The table first exhibits the new California Reform Act and the model graduation requirements (Raising Expectations, California State Board of Education, 1983). Next are the newly proposed graduation requirements of ordinary and regents' diplomas in New York. Then we record the requirements advanced in the A Nation at Risk report.

In the second half of the table, we contrast the state requirements/recommendations with those in Nation at Risk. We note that the requirements in the new legislation--while marking a large shift from no requirements at all--are the weakest of all those exhibited. The legislation mandates three years of English instead of four; two years of mathematics instead of three; two years of science instead of three; and no computer studies. Only in the area of social science (three years) does the legislation match the report's recommendations.

The State Board model compares more favorably. The only negative contrast is in science, where--in quantitative terms--the model matches the legislation. In content, however, as we will see below, it is more stringent. Finally, the California State Board's model does address foreign language instruction, with two years recommended. Also, the recommendations in the model match the A Nation at Risk report in specifying a semester of computer studies.

Table 30

Graduation Requirements in California and New York Compared to Those of A Nation at Risk

Subject area	California		New York[c]		Nation at Risk	Difference to A Nation at Risk			
						California		New York	
	Legislation	State Bd. model	Nonregents	Regents[b]		Legislation	State Bd. model	Nonregents	Regents
English	3	4	4	4	4	-1	0	0	0
Mathematics	2	3	2	3	3	-1	0	-1	0
Science	2	2	2	4	3	-1	-1	-1	+1
Social science	3	3	4	4	3	0	0	+1	+1
Foreign language	0	2	[a]	3	0[d]	0	+2	*	+3
Computer studies	0	1/2	0	0	1/2	-1/2	0	- 1/2	- 1/2

[a] New York requires foreign language proficiency, confirmed by an examination.

[b] The New York Regents' diploma requires passage of a Regents' examination, in addition to course requirements.

[c] These requirements are due for final approval in the spring of 1984.

[d] The A Nation at Risk report "strongly recommends" two years of foreign language for college-preparatory students.

The New York requirements--for a regular high school diploma--are slightly more stringent than California's: one more year of English and the same amounts of mathematics and science. However, New York requires an additional year of social science and foreign language proficiency--validated by a test. New York's Regents' diploma is--by far--the most stringent. It equals or surpasses the A Nation at Risk report in all areas but computer studies, requiring four full years of science and three of foreign language.

Recently, data have become available--for the nation as a whole and selected states--on the proportion of 1982 high school graduates who have met the various graduation course requirements specified in A Nation at Risk. These data (How Well Do High School Graduates of Today Meet the Curriculum Standards of the National Commission on Excellence? 1983) derive from analyses of the high school transcripts of 1982 seniors who are participating in the High School and Beyond longitudinal study (National Center for Education Statistics, 1981). The data are presented in Table 31. The percents of 1982 high school graduates meeting each requirement are exhibited for California, New York, and the nation as a whole. California is approximately comparable to the nation in most curricular areas except science, where only 17 percent of graduates meet the three-year requirement (compared to 52 percent nationwide). In contrast with New York, however, California falls short in every area, but most greatly in English, social studies, and science.

Table 31

Percent of 1982 High School Graduates Who Met Graduation Requirements Specified in A Nation at Risk

Requirement	Subject area	Coursework required	California	New York	Nation
Separately					
	English	4 years	48	72	59
	Social studies	3 years	67	92	65
	Mathematics	3 years	43	55	46
	Science	3 years	17	52	30
	Computer science	1/2 year	11	20	13
Simultaneously					
	All		1	9	3
	All but computer science		5	29	13

SOURCE: These figures are based on an analysis of transcripts of 1982 high school graduates. These transcripts were obtained as a part of the ongoing High School and Beyond study of 1980 and 1982 graduates conducted by the National Center for Education Statistics, U.S. Department of Education.

If we focus on the percentage of graduates who meet all the A Nation at Risk recommendations simultaneously, the results are even more striking: Only 3 percent of the 1982 graduates in the U.S. met them and only 1 percent of California graduates do so. New York fares better with 9 percent. If we disregard the computer science requirement, the results may be more meaningful because this part of the curriculum was not as fully developed in the period from 1978 to 1982, when these graduates were studying. With this requirement removed, the figures are:

California	5%
New York	29%
Nation	13%

This is surely unsatisfactory all around, but again New York has the highest level of academic coursetaking.

Because CAP's particular focus in the 1982-83 twelfth grade data collection was mathematics and science, we now turn to a systematic content and quantity comparison of the California requirements with those of all the major reports (Table 32). First we note that the State Board's recommendations specify that students take three full-year courses in mathematics, two of which must be algebra and geometry, thus extending minimal college-preparatory coursework to all students. We also note that the A Nation at Risk report has no course content specifications. The Carnegie Foundation-sponsored High School (Boyer, 1983) report also omits specification of content in the formal requirements. The National Science Board's 21st Century report is most detailed and stringent in this area. It specifies three years of both science and mathematics--

including algebra--for all students; for the college-bound it would require both physics and chemistry within four years of science, and two years of algebra within four years of mathematics. It further specifies for all students a semester of computer science to be included in the science coursework. The report is notable for explicitly recommending that plane geometry not consume a full year's work.

How well do current California students satisfy these mathematics and science requirements (Table 32)? Only 40 percent of 1982-83 California seniors satisfy the new requirements of two or more years of science (Table 27); 61 percent satisfy the parallel mathematics requirements (Table 28). If we apply the more stringent recommendations for graduation given by the California State Board, considerably fewer of all 1982-83 California high school seniors would be qualified to graduate.

Table 32

Percent of 1982-83 California High School Seniors Meeting Various Legislated and Proposed Mathematics and Science Graduation Requirements

Requirements	Science requirements	Mathematics requirements
California, Legislated and Proposed Legislated (1987 and after)	40	61
Proposed		
California State Board Model Requirements	40	30
National, Proposed		
Requirements for all students		
A Nation at Risk	15	33
Carnegie	40	61
National Science Board	21	32
Requirements for college-bound students		
National Science Board	5	1

Placing California students in the context of the three major national reports presents a more varied picture:

- A Nation at Risk. Only 15 percent of 1982-83 California high school seniors meet the science requirement, and 33 percent fulfill the mathematics requirement.

- High School (Carnegie). Forty percent of 1982-83 California high school seniors fulfill the science requirements, and 61 percent satisfy the mathematics requirements. Note that in these areas the report matches the new California legislation.

- Educating Americans for the 21st Century. A CAP comparison of mathematics and science coursetaking in California with the National Science Board's suggested requirements showed that 21 percent of 1982-83 California high school seniors meet the specified science requirement, and 32 percent fulfill the mathematics requirement.

It is important to observe that the California science requirements are substantially weaker than those recommended in two of the reports. The discrepancies are especially large when we compare science and mathematics coursework of 1982-83 California high school seniors to the requirements that are specified by the National Science Board: Only 5 percent of California seniors presently meet those science requirements and merely 1 percent meet the mathematics requirement. These proportions are far below those of California high school seniors who presently enter college. Although the State of California is mounting a great effort in increasing students' skills and knowledge in mathematics and science, the recent legislation might be only the first overdue step.

Ways to Increase Student Achievement

Once it has been decided what students are to learn, there are four ways to increase student achievement, the first three of which depend on increasing active learning time:

1. Increase the time allocated to instruction.
2. Increase the proportion of allocated instructional time actually devoted to instruction.
3. Increase the proportion of time devoted to instruction that students spend actively learning.
4. Reduce the time needed for learning.

Presented below are some suggestions that should be addressed in policy discussions related to improving student achievement.

Increasing the Amount of Time Available

The time allocated to instruction can be increased in three ways:

- Lengthening the school day and/or school year
- Reallocating instructional time
- Increasing homework assignments

Lengthening the School Day and/or School Year

Since California students are offered considerably less schooling than students nationwide, lengthening the school day and the school year seems an appropriate strategy for increasing student achievement. By passing the new Educational Reform Act, the Legislature has encouraged this strategy. As long as procedures are implemented to ensure that the additional time is used to increase the amounts of time devoted to learning activities, this method may be extremely effective. However, as we noted above, even full implementation of these instructional time targets would result in total instructional time in California still short of the national average. Perhaps additional measures, especially those that reduce the time needed for learning, should be considered.

Reallocating Instructional Time

Another way to increase allocated learning time is through reallocation. In elementary schools, where individual teachers usually plan their own activities in self-contained classrooms, reallocating instructional time implies either external control or consensus on priority learning areas. All available evidence points to wide variations in teacher priorities, even within a single elementary school. One possibility would be to increase the degree of departmentalization in elementary schools, including lowering the grade levels for

which it is the mode of instructional organization. In secondary schools this could occur through elimination of electives or by reinstituting or expanding required courses. These actions result in reallocations from low- to high-priority learning activities and subject areas.

Surely, the newly legislated high school graduation standards will accomplish a much needed reallocation to priority academic subject areas, especially in schools which do not increase total instructional time. Again, however, the question must be raised about whether this is sufficient. Even the new California requirements will not match New York's new standards in English and social science. And merely meeting the new minimums will leave a considerable gap between the coursetaking of California high school students and those in New York, especially in college-preparatory mathematics and science. Additional action may be called for, particularly for college-bound students.

Increasing Homework Assignments

Increasing homework assignments can be very effective in improving student achievement. One way to increase achievement for all students would be to extend the school day with a homework period. Another might incorporate parental "sign-off" on homework assignments.

Increasing the Proportion of Time Devoted to Instruction

All the time nominally allocated for instructional activities is not actually used for instruction. Some of this loss of time from subject matter instruction is a result of explicit policy--e.g., fire drills or schoolwide assemblies and transitions between one classroom activity and another. However, much lost time can be avoided.

Time accounting studies of elementary school classrooms have found variations of 50 to 90 percent in the portion of total allocated time actually devoted to instruction. Much of the loss results from poor management of student activities: excessive transition time between activities, poorly handled recesses and breaks, pullout activities that are disruptive or that increase transition time, and subgroup and seatwork activities that take too long to establish. Also, in many classrooms, schedules are not met or activities involving more than one teacher are poorly coordinated. All these problems result in losses of precious instructional time in elementary schools.

Secondary schools, because of the period structure and departmentalized organization, are less prone to losses of this type, but issues do arise about the length of period transitions and how related rules are enforced. More effort devoted to identification of such problems and formulation of appropriate school policies or in-service training efforts would be worthwhile. The following steps should be considered:

- Review pullout programs to determine the difference between allocated instructional time and time actually devoted to instruction.
- Increase teachers' classroom management skills. Teacher training institutions need to put more emphasis on developing such skills.

- Evaluate school schedules (e.g., length of period, recess, lunch) to determine how much time scheduled for instruction is lost.

- Other steps might focus on:

  -- Increasing attendance and reducing tardiness through clear and consistent school policies

  -- Reducing discipline problems by the use of firm codes and alternative programs for the chronically disruptive

  -- Lightening teachers' administrative burdens

Increasing the Proportion of Time Spent Actively Learning

The clearest message from the research on active learning time is that active learning is fostered by teacher-student contact and interchange. Unsupervised learning activities have uniformly lower levels of active learning time. Small-group instruction and, to an even greater extent, tutorial instruction increase students' active learning time. This increase is most pronounced among students who have low achievement or motivation levels, such as educationally disadvantaged students.

The problem with routinely implementing changes based on this finding is one of resources. In many classrooms, lower student-teacher ratios could be achieved by reducing the size of supervised instructional groups, thereby increasing student-teacher contact time. In self-contained classrooms, without additional resources, there is a trade-off: When some students are tutored or taught in small groups, others are necessarily unsupervised. Thus, the critical issue--with resources being constant—is the trade-off between (a) large-group instruction accompanied by little unsupervised work; and (b) small-group/tutored instruction accompanied by considerable amounts of unsupervised, student-managed activity. The best evidence available is that reducing unsupervised time, even at the cost of increasing the total amount of large-group instruction, is appropriate, especially with students who have low levels of learning motivation and self-discipline and who are poorly prepared for academic work. It is recommended that school personnel:

- Review the grouping strategies that are routinely used in elementary schools and that are encouraged by textbooks and workbooks. Minimizing subgrouping, and thereby unsupervised seatwork, should be primary goals.

- Evaluate the use of aides in classrooms; using qualified aides is an effective way to increase direct instruction for students.

Reducing the Amount of Time Needed to Learn

Instruction can be made more effective in many ways, and effective instruction in turn will reduce the time needed for learning. Two ways deserve attention:

- Increasing the clarity and communicability of task-related instructions provided by the teacher or in text materials

- Increasing the capabilities of teachers to diagnose students' prior learning, to sequence the instructional tasks, and to keep the students working at a satisfying but challenging pace

First, clear explanations and communication are the keys to decreasing the time students need to master or complete a task. This is especially true for students from low socioeconomic backgrounds. These students are especially affected by inappropriate and unclear explanations and verbal communications, whether they emanate from teachers, textbooks, or other instructional materials. The more capable students and those from higher socioeconomic backgrounds are more likely to be able, by themselves, to "fill in" or substitute for incomplete or insufficiently communicated instruction.

Second, teachers need to consider students' abilities and prior learning in arranging learning tasks for them and estimating the time needed for learning. The time needed for learning is unnecessarily increased if teachers incorrectly assume specific prior learning for a task or if they allocate time to tasks that students have already mastered.

Staff development efforts should address these issues. Also, textbooks and workbooks should be more carefully screened and pretested with particular types of students. Teachers should be taught to use diagnostic instruments more extensively for assessing students' prior learning. At best, improving teachers' abilities to communicate is difficult, because communication skills are learned over long periods early in one's life. Improved teacher recruitment and selection may be the only long-term solutions certain to bring about significant improvement in communication skills.

In addition to modifying instructional materials and strategies, time needed for learning can be reduced by enhancing student study skills. If students can learn effective ways to organize their study time, to draw upon library and reference resources, and to request help when it is actually needed, the total time needed to master school learning tasks is lessened. It is recommended that school personnel:

- Evaluate textbooks and workbooks for clarity of instruction.

- Make greater use of diagnosis to ensure improved pacing and increased challenge of students.

- Focus instruction on building effective study skills and efficient and appropriate use of learning resources.

Selected References

Adler, M. J. The Paideia Proposal. New York: Macmillan, 1982.

Anton, T. A. Length of School Day and School Year--A Comparison of California with Other States. Stockton, Calif.: Lincoln Unified School District, 1981.

Bloom, B. S. Human Characteristics and School Learning. New York: McGraw-Hill, 1976.

Boyer, E. L. High School: A Report on Secondary Education in America. New York: Harper and Row, 1983.

Carroll, J. B. "A Model for School Learning," Teachers College Record, 1963, 64, 723-733.

Compensatory Education Study. Final report to the Congress. Washington, D.C.: National Institute of Education, 1978.

Denham, C., and Lieberman, A. Time to Learn. Washington, D.C.: U.S. Department of Education, National Institute of Education, 1980.

DeVault, M. L.; Harnischfeger, A.; and Wiley, D. E. Schooling and Learning Opportunity. Chicago: ML-GROUP for Policy Studies in Education, CEMREL, Inc., 1977.

Digest of Educational Statistics. Washington, D.C.: U.S. Department of Education, 1980.

Educating Americans for the 21st Century. Washington, D.C.: National Science Board Commission on Precollege Education in Mathematics, Science and Technology, National Science Foundation, 1983.

Fisher, C. W., and Berliner, D. C. Perspectives on Instructional Time. New York: Longman, 1983.

Harnischfeger, A., and Wiley, D. E. "Conceptual Issues in Models of School Learning." Studies of Educative Processes, No. 10, Chicago: ML-GROUP, CEMREL, 1977. Also in Journal of Curriculum Studies, 1978, Vol. 10, No. 3.

Harnischfeger, A., and Wiley, D. E. "Teaching-Learning Processes in Elementary School: A Synoptic View," Curriculum Inquiry, 1976, 6, 5-43; and in Readings in Educational Research: Educational Organization and Administration. Edited by D. A. Erickson. American Educational Research Association. San Francisco: McCutchan, 1976, pp. 195-236.

Harnischfeger, A., and Wiley, D. E. "Origins of Active Learning Time." In Fisher, C. E., and Berliner, D. C. Perspectives on Instructional Time. New York: Longman, 1983.

High School and Beyond: A National Longitudinal Study for the 1980's. Washington, D.C.: National Center for Education Statistics, 1981.

Hinckley, R. H.; Beal, R. S.; and Breglio, V. J. "Student Economic and Educational Status and Receipt of Educational Services." Technical Report No. 3 from The Study of the Sustaining Effects of Compensatory Education on Basic Skills. Santa Monica, Calif.: System Development Corporation, 1978.

How Well Do High School Graduates of Today Meet the Curriculum Standards of the National Commission on Excellence? NCES Bulletin 83-223, Washington, D.C.: National Center for Education Statistics, 1983.

A Nation at Risk. New York: National Commission on Excellence in Education, 1983.

Ostendorf, L. Summary of Offerings and Enrollments in Public Secondary Schools, 1972-73. Washington, D.C.: U.S. Government Printing Office, 1975.

Proposed Action Plan to Improve Elementary and Secondary Education Results in New York. Albany, N.Y.: New York Board of Regents, 1983.

Tyler, R. W. Basic Principles of Curriculum and Instruction. Chicago: The University of Chicago Press, 1949.

Wiley, D. E., and Harnischfeger, A. "Explosion of a Myth: Quantity of Schooling and Exposure to Instruction, Major Educational Vehicles," Educational Researcher, 3, 1974, 7-12.

83-92 CR 514220 3-84 500